ISSN (Print) : 2277-7261
ISSN (on-line) : 2278-3857

PRATIBHA

INTERNATIONAL JOURNAL OF SCIENCE, SPIRITUALITY, BUSINESS & TECHNOLOGY (IJSSBT)

Vol. 6, No. 1, January - 2018

www.ijssbt.org

SHRAM SADHANA BOMBAY TRUST'S

COLLEGE OF ENGINEERING & TECHNOLOGY, BAMBHORI, JALGAON (INDIA)

PRATIBHA : INTERNATIONAL JOURNAL OF SCIENCE, SPIRITUALITY, BUSINESS & TECHNOLOGY (IJSSBT) Vol. 6, No. 1, January - 2018 ISSN (Print) : 2277-7261 • ISSN (on-line) : 2278-3857

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PRATIBHA: INTERNATIONAL JOURNAL OF SCIENCE, SPIRITUALITY, BUSINESS AND TECHNOLOGY (IJSSBT), Vol. 6, No. 1, January 2018
ISSN (Print) 2277-7261

Human Factors of Accident and Unexpected Road Hazards: A Review

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ABSTRACT :
The road accidents are the major causes of death all over the world along with India. Road traffic injuries are one of the leading causes of mortality and disability and are notably increasing in developing countries with increased population and density of vehicles. Many researchers in India and abroad have tried to quantify different Human factor, Environmental factor, Unexpected situations for the cause of accidents by conducting surveys in a particular city and developing different models on it showing the contribution of different factors in accidents. The present study aims at studying the different human factors and unexpected situation which can contribute to accident and can affect the severity of accident with the help of the available research data. It has been found that there number of methods of accidental data analysis are available, out of which Logistic Regression in widely used. It was found that there are numbers of independent variables with which severity of accident have either positive or negative relationship. Almost all of human factors have positive correlation to the road accidents except age of the driver.

Keywords: Road safety, Human factors, unexpected hazards,

I. INTRODUCTION

Road accidents are very common all over the world and annual global road crash statistics (Association for Safe International Road Travel, 2013) states that: Nearly 1.3 million people die in road crashes each year, on average 3,287 deaths a day [1]. In the year 2015, more than 140000 people are killed in India due to road accidents. More common age group of accidental deaths is 15 to 29[1]. Road crash deaths account 2.2% of all deaths over the world wide and rank 9th in the leading death cause [2].

There are number of causes of road accidents and is a subject of statistical analysis. The causes of accident are used to determine the accident preventive techniques. Number of typical causes of road accidents include collisions with other road users like two-wheelers, pedestrians, cars, or running into stationary obstructions parked vehicles, trees, utility posts, safety barriers, running over defects present on road surface like potholes, bumps. Above mentioned causes are common in most of the cases besides the above mentioned causes there may be the number of unexpected situations which can surprise the driver and lead to accident. The unexpected situations may include for instance unmarked obstacles, house animals, big stones lying on the roadway, oversized equipment loading and travelling on public roads and sudden change of the road surface quality. These unexpected obstacles can lead to serious accident if they are suddenly noticed at higher speeds.

Alireza Pakgohar et. al. studied the role of human factor in incidence and severity based on classification and Regression Trees and Logistic Regression. Many researchers have used Logistic regression and the negative binomial regression models and classification and regression tree (CART) to analyze traffic road accident. According to their study, the CART is much better method to analyze traffic accidents' data. The key variables and their impact in incidence and severity of road crashes were studied. The dependent and independent variables selected for study as shown in Table1.

The dependent variable Accident Severity had three levels included "Fatal", "Injury", and "No Injury". After executing algorithms, the accuracies of 81% and 78.57% were achieved for CART and LR respectively [3]. As dependent variable has three levels therefore multinomial regression analysis has used to classify the accidents according to their severity.

Table1: Key variables and their description [2]

Sr. No.	Variable	Type	Description
1	Age	Independent	Age of the driver
2	Gender	Independent	Gender of the driver
3	Safety Belt	Independent	The situation of fasten safety belt.
4	Driving License	Independent	Drivers Certificate

5	Accident Severity	Dependent	The severity of the crash

Accident was also classified using CART because it is more accurate as compared to the MLR. Human factors such as Driving License, Safety Belt, Age, and Gender were considered as attributes of human factor that impact crash severity in Iran's roads. It was concluded that 91% of accidents have resulted in no injury, 8% of resulted in injury and only 1% of all accidents have ended to fatal [2].

It has been concluded that "Driving License" and "Safety Belt" represent distinct relationship with the degree of injury in road crashes. It is also concluded that gender of drivers had no significant relationship with the degree of injury and age of the drivers have significant negative relationship with rate of deadly accidents.

II. HUMAN FACTORS:

Human factors are the common human errors which results into the accidental situation or accidents.

Common human risk factors:

A. Avoiding the use of Helmets while driving:

Helmet is kind of safety gear designed to protect head during accidental injuries. The density of two wheelers is tremendously increasing in the India. Already many of the researchers have found that the rate of accident is directly correlated to the no of vehicles. It is one of the factors, if not considered can lead to serious injury and even fatal loss [1].

B. Distracted driving:

Distracted driver is the one who not paying attention to the road while driving and is busy in some other activity like, chatting with the friend while driving, using cell phone, or searching for something here and there. Distracted drivers directly put the lives of other road users to risk. Research has shown that teens use phone more number of times while driving [13].

C. Parking at improper place:

The vehicles parked on the sides of road without any kind of warning or reflectors on narrow roads. This causes inconvenience to the easy plying of other vehicles and can also cause the fatal accidents.

D. Anger during driving:

There may be the number of reasons for the anger while driving, like communication gap between the road users, which makes driver difficult to convey and interpret the message accurately. They are some added factors like time to travel is less, and presence of more traffic. Most of the researchers found that aggressive driving is the outcome of anger. Meta-analysis was used to find out the effect of driving anger on different types of driving outcomes. Meta-analysis is one of the widely used technique to find out and explore the sources of disagreement between the results of previous studies. It was assumed that increasing age reduces the adverse driving outcome associated with driving anger. It was also assumed that there is less aggression in Asian countries with anger as compared to western countries. The driving outcomes were coded into five categories: (1) aggressive driving (AD); (2) risky driving (RD) (3) driving errors (DE); (4) near misses (NM), and (5) accidents (AC) [5].It was observed from the results that the driving was positively correlated to driving outcome.

It was found that the driving anger has highest correlation with aggressive driving followed by risky driving and then driving error. It was observed that the driving anger and driving related outcome have higher correlation than accident related outcome. The Meta-analysis also showed that, risky driving is more favourable outcome in young drivers when compared with elderly drivers as consequences of driving anger.

Results from the meta-analysis indicated that aggressive driving, risky driving, and driving errors, were all positively related to driving anger. In addition, a higher road accident risk was found to be related to driving anger and young drivers were found to be more susceptible to the adverse effects of driving anger [5].

E. Personality characteristics in young drivers

Many researchers have already noted that, young drivers do not formulate the homogeneous group. Because they have different characteristic therefore they are divided into different groups, with unique characteristic. They have risk taking nature in traffic areas. Women prefer less risky driving when compared to the men. Driver having high risk taking nature show less humanity and concern to other road users. They prefer furious driving and have overconfidence on their driving skill.

Aggressive drivers sub group respond very less to safety campaign. From the case study conducted on students of high school who have license to drive. The junior drivers were divided into three

sub-groups with characteristics: a) Risky driver, b) Worried drivers, and c) careful drivers [3]. It was observed that these sub-groups have showed less attention while driving, furious driving, and violated traffic rules.

F. Age of the driver and traffic condition:

Researches showed that old people cautious about drunk and drive and hence old drivers cause less accidents in this category [12]. It was observed that old age drivers were not been able to change lane easily, and during lane change there more possibility of accident. Also at complicated intersections they are not been able to judge the traffic and vehicle speed properly and can lead to accident. Because of lack of regular driving practice, older women create more hazards for road safety. Older drivers are more susceptible to the accident hence accidents caused by them are very serious [3].

III. SOME UNEXPECTED HAZARD SITUATION:

Unexpected hazard situations are due to presence of unmarked obstacles, dirt, improperly loaded vehicles travelling on road etc. The factors like these create the unexpected situation. To overcome the situation driver must enough experience of handling unexpected situation.

A. Soiled road surface:

Motorists can encounter areas soiled with various substances, such as mud, dirt, fallen goods or sand, spillage and sudden change of road surface. Whenever any driver faces such unexpected condition the driver's reaction is obvious in most of the cases, i.e. initiates hard braking or an intense effort to avoid the obstacle. Braking hard without usc of Anti-lock-braking system (ABS) can lead to unstable and uncontrolled situation of vehicle. Making right decisions when faced with unexpected and extraordinary safety hazard requires knowledge and skills which in most cases exceed the average driver's capabilities [4].

To find out the right decision that should be taken by the driver Marian Dudziak et al. performed an experiment on runways of unused military airfield. A 70m long test section was considered with wet asphalt contaminated with grain on it. The speed was varied from 80km/h to 12km/h during 17 tests. Results showed that there adverse effect of road surface contamination on the braking performance and there is drastic decrease in braking distance upto 60% as compared to wet reference surface without grain. It was observed in the test performed on car equipped with ABS and surface contaminated with grain, that even if the hard braking is applied it does not lead to stability loss of car. The observations made on the vehicle at a speed of 120km/h without braking showed that there is no loss of stability of vehicle. From the experiment it has been concluded that the drivers apply hard brake or can ignore the hazard related to contaminated road surface.

B. Split-mu braking:

Marian Dudziak et al. mentioned special test to check the behaviour of vehicles with and without ABS during hard braking on split-mu surfaces. The test were carried out such that two wheels on a side will travel on contaminated surface and remaining two on other side plane surface. The results revealed that ABS plays vital role in stability of vehicle on split-mu surface[4].

Fig. No.1: Vehicle stability on split-μ surface during braking on wet asphalt covered with grain: (a) without ABS, (b) with ABS [4]

The graphs represent the vehicle behaviour during the field tests. The front wheels locked up after 5m after putting on the brake. On the other hand, variation of speed and braking deceleration were much smaller in the test run with ABS on.

From experiments Marian Dudziak et al. concluded that it is possible to provide the driver with the guidelines and instructions of how to react to

sudden and unexpected hazards by knowing the actual behaviour of car.

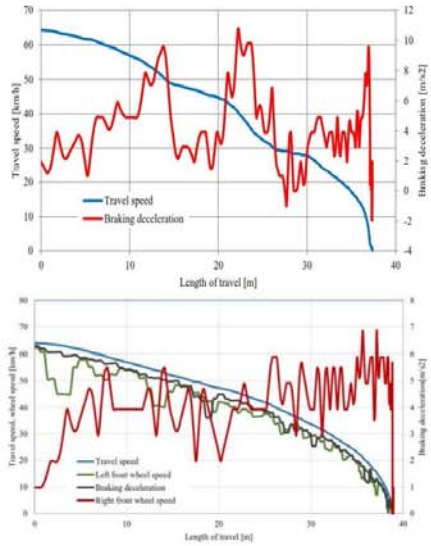

Fig. No.2: Change of motion parameters of a test car travelling on a split-mu surface with and without ABS. [4]

IV. CONCLUSION:

From the study of the available literature it can be concluded that the number of accidents is increasing day by day.

It has been found that human factors have different correlation with severity of the accident.

Age of the driver have negative correlation with the severity of the accident however the accidents caused by the elder drivers lead to more fatal losses and are susceptible to accidents.

Anger of the driver which may be the result of number of road situations can lead to different driving outcomes, aggressive driving, risky driving or driving error.

The higher accident risk is found to be related with driving error.

It can be concluded from the study of literature that during the unexpected road situations vehicle is more stable if it is equipped with ABS.

The fatalities that are arising due to unexpected situations can be reduced greatly by providing the guidelines to the driver to take decision in similar kind of situation.

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PRATIBHA: INTERNATIONAL JOURNAL OF SCIENCE, SPIRITUALITY, BUSINESS AND TECHNOLOGY (IJSSBT), Vol. 6, No. 1, January 2018
ISSN (Print) 2277-7261

Factors Leading to Brand Evangelism: An Explanatory Study of Consumers Buying 4-Wheeler at Bhubaneswar

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ABSTRACT :
India is one of the world's fastest growing automobile markets and is poised to become the third largest passenger's car market by 2020 (Philip, L. 2016, Economic Times). The recorded sales growth of 4 wheelers like passenger car & utility vehicle has also risen up to 7.87 % and 6.25% respectively during April-March 2016 (SIAM, 2015-16). But what makes a car maker like Japan's Maruti Suzuki and Korea's Hyundai enjoys more than 67% of market share while others like US car makers Ford India and General Motors combined market share is just 4-5% (Philip,L.2016,The Economic Times). Sales in the North & East region have evidenced only 5% of changes in the FY16 which is comparatively lower than the west & south region (Khan,A.N, 2016, The Economic Times). The Japanese car makers(Honda, Hyundai, Isuzu Motors, Nissan & Toyota) achieved an average of 48.01% of growth till July 2016 having a better stand from the Indian car makers (Hindustan Motors, M&M,M&S, Tata & Force motors) i.e. 6.74% (Autocar Pro News Desk, July 2016). In this study the researcher explored the key features about any particular brand which makes them a brand evangelist and helped to achieve brand efficacy too.

Keywords: Brand evangelist, Brand Efficacy, strategy, automotive sector, advertisement

INTRODUCTION

A brand evangelist is a diehard fan of any product, who doesn't feel bad to talk about the company product/service to public. They share the product information with other people frequently and helps in aggressively promoting any product/services (Patil,N. 2015). The goal of the brand evangelists are to share benefits to other customers as they spread recommendations to other customers based on their personal beliefs without expecting any benefits of goods or money voluntarily (Wikipedia ; Kemp, Childers, & Williams, 2012). Brand evangelists are sometime known as customer apostles (Jones and Sasser 1995), Brand zealots (Eighmey, Sar, and Anghelcev 2006; Rozanski, Baum, and Wolfsen 1999), champions (Bhattacharya and Sen 2003; Weiser 1995), inspirational consumers (Roberts 2004), advocates (Christopher, Payne, and Ballantyne 2002; Chung and Darke 2006; Rusticus 2006), and Volunteer sales people (McConnell and Huba 2003). Brand evangelism is an advanced form of Word-of-Mouth Marketing (Wikipedia, Doss, S. K. 2014). It is a mode of persuasion (Becerra and Badrinarayanan 2013) on behalf of the brand and sometime considered as preachers to consume a specified brand (Doss, S. K. 2014). It is not always the customers sometimes the employee of the company act as brand evangelists (Nadeem, 2007) Brand satisfaction, Brand salience, Customer-brand identification, Brand trust and opinion leadership are few characteristics of Brand Evangelism which can be developed by the brand to promote positive WOM to acquire new customer. (Doss, S. K. 2014). Positive word-of-mouth has been spread mostly by the enthusiastic consumers and the enthusiastic consumers also engage other customers (Pimentel and Reynolds 2004) and personality plays a vital role in finding how passionate is a person (Baumeister and Bratslavsky 1999). Passion is one of the element in consumer brand relationship (Fournier 1998) and passionate consumers evangelize, extraversion and openness personality traits are strongly interconnected to be passionate and it has proven that extravert (Talkative character) trait of consumers engage more customers (Matzler, K., Pichler, E. A., & Hemetsberger, A. 2007).Hence it is vital to understand brand personality along with brand evangelism and we know that personality is the systematic depiction of traits (McCrae & Costa, 1987). Brand personality is a cluster of human attributes associated with a brand to which a customer can easily related with and helps in developing brand equity (Investopedia). Brand personality is a dimension of brand identity alike the human personality which can be attributed to any brand (Kapferer, J.N. 1992 ; Kapferer, J.N. 1998 ; Aaker, D. 1995; Aaker, D. and Joachimsthaler, E. 2000 ; Biel, A. 1993 ; and Keller, K. L. 1993). Consumer selects a particular brand the same way we select any friends besides their skills & physical attributes (King, S. 1970). Brand personality is very crucial in understanding the brand choice (Plummer, 1984 ; Plummer 2000) Brand evangelism is associated with the personality

like extraversion, openness and neuroticism (Doss, S. K., & Carstens, D. S. 2014). Responsibility, Activity, Aggressiveness, simplicity & Emotionality are the new brand personality measures (Geuens, M., Weijters, B., & De Wulf, K. 2009)Azoulay, A., & Kapferer, J. N. 2003 tries to measure the construct of brand personality to get the brand personality , instead the brand personality constructs measures other facets like product performance & brand identity.

Table 1

Brand personality dimensions and traits				
COMPETENCE	**SINCERITY**	**EXCITEMENT**	**SOPHISTICATION**	**RUGGEDNESS**
Reliable	Down to earth	Daring	Upper class	Outdoorsy
Hardworking	Family oriented	Trendy	Glamorous	Masculine
Secure	Small- town	Exciting	Good- looking	Western
Intelligent	Honest	Spirited	Charming	Tough
Technical	Sincere	Cool	Feminine	Rugged
Corporate	Real	Young	Smooth	
Successful	Wholesome	Imaginative		
Leader	Original	Unique		
Confident	Cheerful	Up-to-date		
	Sentimental	Independent		
	Friendly	Contemporary		

The five dimensions at the head of the column comprise the traits listed below them, as identified by: Jennifer L. Aaker, "Dimensions of Brand Personality," Journal of Marketing Research, Vol. 34 (August 1997), pp. 347-356.

Brand identification, brand trust, brand relationship, brand involvement and brand commitment positively effects brand evangelism (Riorini, S. V., & Widayati, C. C. 2016). Brand can create a competitive advantage, if the consumer has emotional relationship with it (Brand evangelism) (Becerra & Badrinarayanan, 2013). When the consumer has emotional relationship with a brand / Brand evangelist, it will lead consumer intention to buy the product (Brand purchase intention) in the future (Batra, Ahuvia, & Bagozzi 2012) and brand relationship only created if the consumer trusts the brand (Lamb, Hair, McDaniel, Boshoff, & Terblanche, 2008). Both Brand trust & brand identification triggers emotional relationship with a brand leading to positive action towards the brand (Wu, Lu, Wu, & Fu 2012). Trust can be developed by the company itself and create consumer buyer behaviour , positive attitude and commitment towards the brand (Elliott & Yannaopoulou, 2007) leading to brand loyalty (Power & Whelan, 2008) for which the company need to be consistent in its product performance (Becerra & Korgaonkar, 2011)

A strong brand evangelist can lead consumer intention to buy the product he/she associated with (Batra, Ahuvia, & Bagozzi 2012). With regular use of consumer's likable product an emotional relationship with the brand may be developed leading to referencing the brand positively either by verbally or visually to other consumers (Matzler, Pichler, & Hemetsberger 2007) and it has been also noticed that they spread bad remarks about its competitor brand (Sundaram, Mitra, & Webster 1998). Structure capital, relational capital, cognitive capital and positive brand referral is strongly & positively related with brand love enhancing the positive feedback about the brand which leads to brand evangelism (Hsieh, S. & Lee, T.C 2016).

Research Question:

1. What attributes makes a customer a brand evangelist for any specific brand?
2. How brand could be able to produce desired result?
3. What is the accepted marketing tool for automotive sector?

OBJECTIVE

1. To find out the attributes of brand evangelist.
2. To Find Out solution for company to develop brand evangelist?
3. To find out the most accepted marketing tool.

RESEARCH METHODS & METHODOLOGY

Keeping the objective in mind the authors collected responses via survey (Questionnaire method) of the people of Bhubaneswar owning 4-wheeler from various govt. Offices, Institutions, Financial institutions, Hospitals, corporate through Non probability- convenience sampling technique. The sample size is 128. All the items were measured & validated through "Content Validity" methodology.

The Research approach is exploratory in nature which helps the researcher to formulate hypothesis based on the findings. The data collection has been done after a pilot test of 30 people owning 4-wheelers to access the content adequacy, including appropriateness of the questions, scales & instructions given. All the demographic constructs & research items in Part- 1 were measured on nominal scale where male were coded as 1 & Female 2 ; age group were coded as 1,2,3 & 4 for the group of 18-25, 26-35, 36-45 & 46 & above simultaneously; Professionals were coded 1 & business man were coded 2 in occupation segment; income level were again coded as 1,2,3 & 4 for the category of <5 Lakhs, 6-10 Lakhs, 11-15 Lakhs, and > 16 Lakhs simultaneously ; Educational data was grouped into 3 category as Traditional programme (comprises of PG,BA.B.Cpm, B.Sc) coded 1 , Professional programme (comprises of B.Tech, BE, M.Tech, MBA, MCA, LLB, MBBS, CFA, Ph.d. KBA-army) coded as 2 & Other Qualification (comprises of ITI & Diploma) coded as 3. Part- II research items were measured on Nominal scale (Yes = 1 & No=2), Interval scale and few items were open ended questionnaire to get the insights of various identified items. The Personal Value, Digital Media platform and Marketing tool constructs were measured via interval scale. Respondents were asked to fill the responses the degree to which they will buy 4-wheeler in 7 point Likert scale where 1 represents strongly agree and 7 represents strongly disagree.

DATA ANALYSIS & RESULT

Before starting up of actual data analysis, the final data has been prepared manually to check the missing value and observed few missing values where responses collected through open ended questionnaire methods (objective 1 & 2) however the researcher did not found any missing value in other category where the responses were collected with a help of Likert scale.

The data than categorised manually (objective 1 & 2) in different segments to find out different attributes customer affinity for a specific brand from the variables like Brand Evangelism, Ego centric relationship, company makes good relationship, Brand efficacy, Recommendation from existing customers & post sales service which was identified during the literature review and customer's view collected through open ended questions by stating "Kindly mention the reason" for each identified (6) variables.

Table-1 explains different views of respondents for brand evangelism category where respondent answered the same context but with different sentences, were merged into 1 item i.e. "MODEL" where the respondent's response Branding Model, Good Model, Engineering, I like this model, Amazing style & Style & Model. Respondent's response Comfortable car is interpreted as "COMFORT". Engine capacity & style is interpreted as "Engine & Style". Engine capacity is very high is interpreted as "ENGINE". Good Mileage is interpreted as "MILEAGE". Good company & i love this company as interpreted "BRAND IMAGE". Good Enging is interpreted as "ENGINEE". Good Quality has interpreted as "QUALITY". Good quality & Good value has interpreted as "QUALITY & VALUE". Good Quality & Largest Car has interpreted as "QUALITY & LARGEST CAR". Good quality & good price has interpreted as "QUALITY & PRICE". Good Value has interpreted as "VALUE". Cheap price & Low maintenance has interpreted as "PRICE & LOW MAINTAINCE". Wonderful, My favourite & I like has interpreted as "FAVOURITE". Demand, Love, Very Good & Larger car has interpreted as "DEMAND" in the variable customer ego centric relationship. Low cost & price were interpreted as "LOW COST" and No & No reason were interpreted as "NO" in the variable Recommendation. Term "RELATIONSHIP" is used by merging lot of different responses like customer relation, customer support, good relation, good relationship with manager, good relation with company, good relationship with customer, Good relationship with the dealer and good relationship with area manager and in never & no is interpreted as "NO" in the Relationship variable category.

Table 7 explaining the demographic profile of the respondent in this study. Out of 128 respondents 93.8 % are male (N=120) & 6.3% are female (N=8),)0 % of people belongs to the age group of 18-25 years (n=0), 51.6% of responses (n=66) belongs to the age group of 26-35 years, 37.5% responses (n=48) belongs to the age group of 36-45 where as 10.9% (n=14) are people whose age group is more than 46 years. Professional respondents were 62.5% (n= 80) and businessman were 37.5% (n =48).79.7% (n = 102) of respondent's annual income is less than 5 Lakh , 18.8% (n = 24) are earning 6- 10 Lakh per annum and1.6% (n = 2) are earning 11-15 Lakh per annum . 54.7% (n =70) of our sample belongs to the professional education category who have done courses like (B.Tech, BE, M.Tech, MBA, MCA, LLB, MBBS, CFA, Ph.d. KBA-army) are highest in our sample.

Model/Style and overall Quality of the car are the top 2 attributes of brand evangelism (Table – 2 & Figure - 1 explains). Model/ Style becomes the most preferred features for a customer to think about only one company it means through a good Model/Quality a brand can create ego centric relationship with a customer (Table- 3). Companies can create Brand efficacy (creation of positive attitude for the brand) through giving customer a delightful experience (Table – 4). The major setbacks of the brands are to create desired result

by maintaining a good relationship post sales and giving values to customer to get recommendation. (Table –5). Now a days the most accepted marketing tools are Advertisement on Social Media (Mean value -4.54), Advertisement on TV (Mean value =4.52) and Catalogue available with dealer (Mean value = 4.48) (Table – 6)

CONCLUSION

Brands need to maintain more relationship with the customer by providing value addition to the customers by creating unique delightful experience for the customer who visit any dealer network while buying a car and to service station post sales to create maximum customer satisfaction who can become a brand evangelist later on and will spread good words for the specified brand.

DISCUSSION & LIMITATION

The responses are collected to do an explanatory studies only which will help the researcher to formulate hypothesis, actual study on the topic may lead to different result with more responses to minimise error and to generalise the data for the larger population.

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Appendix
Table – 1

Variable	Respondent's Response & its interpretations
Brand Evangelism	BRANDING MODEL, GOOD MODEL,engineering, I like this model,Amazing style, Style & Model = Model
	COMFORTABLE CAR = Comfort
	ENGINE CAPACITY AN STYLE = Engine & Style
	ENGINE CAPACITY IS VERY HIGH = Enginee
	GOOD MILEAGE = Mileage
	GOOD COMPANY, I love this company= Brand image
	GOOD ENGING = EnGINEERING
	GOOD QUALITY = QUALITY
	GOOD QUALITY & GOOD VALUE = QUALITY & VALUE
	GOOD QUALITY AND LARGEST CAR = QUALITY & LARGEST CAR
	GOOD QUALITY&GOOD PRICE = QUALITY & PRICE
	GOOD VELUE= VLAUE
	PRICE IS CHIED & NO MANTENCE = PRICE & LOW MAINTAINCE
	Wonderful, My favourtite, I like = Favourite
Ego centric Relationship	demand , love, Very good & largest car = demand
Recommendation	low cost, price= low cost
	No, No reason = No
Relationship	customer relation, customer support, good relation, good relationship with manager, good relation with company, good relationship with customer, Good relationship with the dealer and good relationship with area manager =

	Relationship
	Never & No = No
NB	The details were mentioned as it was collected from the respondents.

Table – 2 (Brand evangelism attributes)

Attribute	Count
Style	51
Quality	13
Favorite	10
Engine	8
Mileage	5
Low cost	3
No	3
smooth drive	3
Brand image	2
engine & style	2
quality & largest car	2
quality & value	2
style & quality	2
Value	2
Brand image & Model	1
Car & quality	1
Comfort	1

engine & safety	1
Largest Car	1
Price & Low maintenance	1
quality & price	1
style & driving	1
style & engine	1
style & value	1

Table – 3 (Customer Ego centric relationship)

Attribute	**count**
No	60
style	20
quality	8
value	7
demand	5
Milleage	5
smooth driving	5
enginee	4
Low cost	3
brand image	1
largest car & Style	1
Power steering	1
quality & comfort	1
Relationship with manager	1
safety	1
self accomplishment	1
style & comfortable	1
style & milleage	1
	126

Table – 4 (Brand Efficacy)

Attribute	COUNT
No	34
Customer delighted	26
Style	12
Mileage	9
Performance	9
Engine	7
Low cost	7
Smooth driving	6
Value	6
Quality	3
Stle & quality	2
Cost and quality	1
Engine & mileage	1
Low cost & facility	1
Multifunction	1
Quality & style	1
Size	1

13

Table – 5 (What company should do ?)

Post sales service		Recommendation		Relationship	
Attribute	**Count**	**Attribute**	**Count**	**Attribute**	**Count**
No	70	No	23	Customer relationship	81
GOOD COSTEMBER CARE	29	GOOD VALUE	20	No	36
GOOD SERVICES	13	GOOD QUALITY	13	Engine	5
GOOD COMPANY	3	CUSTOMER SATISFACTION	10	Low cost	2
GOOD QUALITY	3	Customer care	9	Mileage	1
low cost	3	LOW COST	8	Design	1
CUSTOMER SATISFICTION	2	GIVE GOOD VALUE	7	Smooth running	1
GIVE GOOD VALUE	1	STYLE	7		

GOOD MILEAGE	1	PERFORMANCE	5		
PERPORMANCE	1	GOOD CUSTOMER SUPPORT	4		
QUALITY	1	brand image	3		
		Comfortable	3		
		cost & quality	2		
		NICE CAR	2		
		GOOD QUALITY & GOOD MILEAGE	1		
		GOOD QUALITY&LOW COST	1		
		GOOD SUPPORT OF DEALER	1		
		IT IS LARGEST &STYLIST CAR	1		
		LARGEST CAR	1		
		Millage	1		
		Safety	1		
		smooth driving	1		
		STYLE & QUALITY	1		
		STYLE, CUSTOMERSATISFACTION	1		
		STYLIST & GOOD MILEAGE	1		

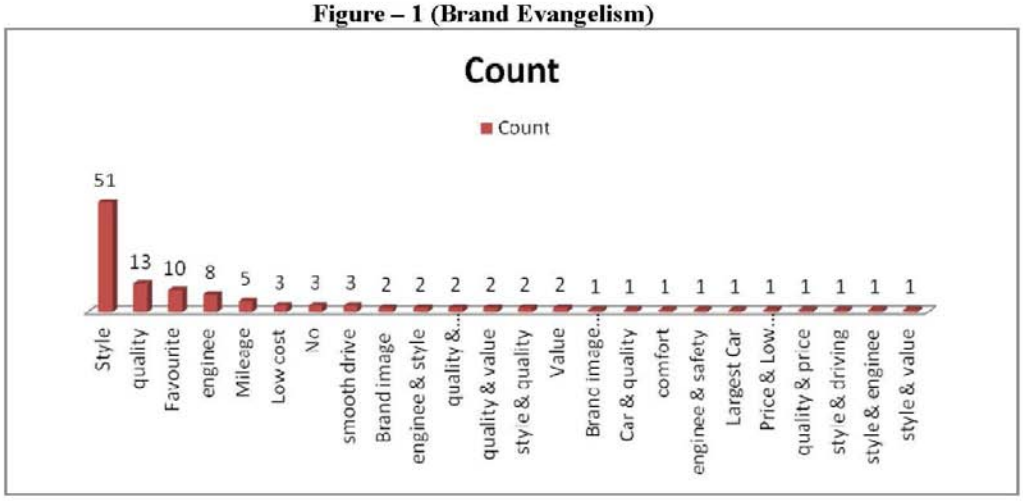
Table – 6 (Marketing Tool)

Statistics					
	N		Mean	Std. Deviation	Sum
	Valid	Missing			
CATALOGUE_OL	128	0	4.31	1.910	552
CATALOGUE_DEALER	128	0	4.48	1.836	573
CUST_DATA	128	0	4.40	1.846	563
TV_ADVT	128	0	4.52	2.004	579
SM_ADVT	128	0	4.54	2.023	581
NEWSPAPER_ADVT	128	0	4.36	2.061	558

Table – 7 (Demographic Data)

Sample characteristics	**Frequency (N = 128)**	**Percentage %**
Gender		
Male	120	93.8
Female	8	6.3
Age		
18-25	0	0
26-35	66	51.6
36-45	48	37.5
46 & above	14	10.9
Occupation		
Professional	80	62.5
Businessman	48	37.5
Income		
< 5 Lakh	102	79.7
6-10 lakhs	24	18.8
11-15 lakhs	2	1.6
Academic background		
Traditional Programme (PG,BA.B.Cpm, B.Sc)	55	43
Professional Programme (B.Tech, BE, M.Tech, MBA, MCA, LLB, MBBS, CFA, Ph.d. KBA-army)	70	54.7
Other Programme (ITI & Diploma)	3	2.3

Figure – 1 (Brand Evangelism)



PRATIBHA: INTERNATIONAL JOURNAL OF SCIENCE, SPIRITUALITY, BUSINESS AND TECHNOLOGY (IJSSBT), Vol. 6, No. 1, January 2018
ISSN (Print) 2277-7261

Patients Identification with Atrial Fibrillation (AF) & Normal Sinus Rhythm (NSR) using Linear-Nonlinear Parameters

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ABSTRACT :

A wide range of heart diseases like palpitations,arrhythmia,bradicardia,tachycardia etc. The common cardiac arrhythmias is atrial fibrillation (AF).This can be efficiently diagnosed by resultant Electrocardiography (ECG). QRS complex is most prominent waveform within ECG, which reflects ventricular contraction of Heart. From ECG , RR intervals, R peaks are detected which is used to get HRV (Heart rate variability) signal. This HRV can be calculated using Time domain ,frequency domain (Linear)and Poincare plot (Non linear)analysis.This paper focus on identification of patient with AF.

Keywords: Heart rate variability, ECG, QRS complex, RR interval, R peak

I. Introduction

Heart rate Varibility (HRV) analysis method can be used for differentiate between atrial fibrillation (AF) and Normal Synus Rhythm (NSR).The Detection of ECG RR interval and QRS complex is essential for a sustainable health monitoring, since a wide range of heart diseases like palpitations, arrhythmia, bradicardia, tachycardia, this can be efficiently diagnosed utilizing the resultant RR interval. One of the most common cardiac arrhythmias is atrial fibrillation. The number of patients with AF will increase in the future [1]. AF is not life aggressive but the most dreaded problem is embolism, and strokes in particular. The rate of ischemic stroke among patients with AF is two to seven times higher than for people who don't suffer from AF [2]. One out of six ischemic strokes is caused by AF [1]. Unfortunately, AF remains under diagnosed, as it is often asymptomatic: up to 30% of all patients with AF are unaware of their diagnosis [3]. Thus, there are high risk patients, unaware of the disease. AF is typically diagnosed by ECG. It is characterized by the substitution of reliable P waves by express fibrillatory waves, associated with an irregular and often too rapid ventricular response when atrioventricular conduction is integral.

II. QRS Detection Methodology

Two stages of QRS detectors: a filtering stage and a decision stage. The filtering stage is used to emphasize the QRS complex and to reduce noise and the influence of the other waves in the ECG signal (P and T waves). Typically first a bandpass filter is applied to the signal to reduce noise and to suppress P and T waves and then put through a non-linear stage to enhance the QRS complex. Then the QRS enhanced signal is thresholded and some decision logic is used for the final stage of detection. Wavelet transformation has proven to be a very efficient tool in the analysis of ECG signals. Its ability to automatically remove noise and to cancel out undesired fenomena such as baseline drift are a benefit over other techniques. When an arrhythmia appears, such a monitor can be programmed to immediately store an interval of the abnormal ECG for subsequent conduction to a central station where a physician can interpret it. Such a device requires a very accurate QRS recognition capability. False detection results in

unnecessary transmission of data to the central station or requires an excessively large memory to store any ECG segments that are unnecessarily captured. Thus, an accurate QRS detector is an important part of many ECG instruments.

QRS detection is difficult that depends on physiological variability of the QRS complexes, various types of noise that can be present in the ECG signal. Noise sources like muscle noise, artifacts due to electrode motion, power-line involvement, baseline wander, and T waves with high-frequency characteristics similar to QRS complexes. ECG signal.

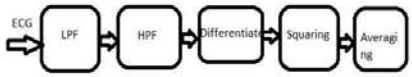


Figure.1 Block diagram of QRS detector algorithm

In this approach, digital filters reduce the influence of these noise sources, and thereby improve the signal-to-noise (S/N) ratio of the many QRS detectors proposed in the literature, few give serious enough concentration to noise reduction.

In software QRS detectors typically include one or more of three different types of processing steps: linear digital filtering, nonlinear transformation, and decision rule algorithms [2]. Linear processes include a band pass filter(BPF), a derivative, and a moving window integrator. The nonlinear transformation that is used is signal amplitude squaring. Applying thresholds provide part of the decision rule algorithm.

Fig.2.A shows the signals at various steps in digital signal processing of Atrial fibrillation. A real-time QRS detection algorithm was developed by Pan and Tompkins [2].First, in order to ease noise, the signal passes through a digital band pass filter composed of cascaded high-pass and low-pass filters. Fig. 2.A.(b) shows the output of this filter. The next process after filtering is differentiation [Fig. 2.A.(c)], followed by squaring [Fig.2.A. (d)], and then moving window integration [Fig. 2.A.(e)]. Information about the slope of the QRS is obtained in the derivative stage. The distance between adjacent QRS complexes is termed as the R to R (RR) or normal to normal (NN) intervals.

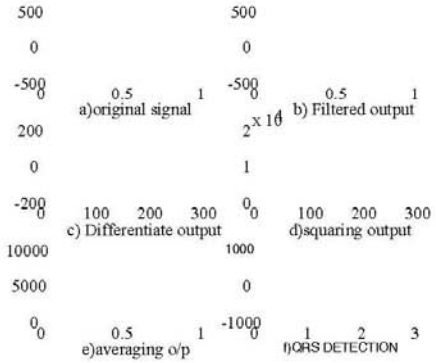


Figure 2.A Output of QRS Detection Algorithm for AF
a) Original signal b) Filter output c) derivative output d) squaring output e) averaging f) QRS detection

The squaring process intensifies the slope of the frequency response curve of the derivative and helps restrict false positives caused by T waves with higher than usual spectral energies. The moving window integrator produces a signal that includes information about both the slope and width of the QRS complex. Fig. 2.A.(f) shows the final output stream of pulses marking the locations of the QRS complexes after application of the adaptive thresholds. The purpose of this system to obtain the range of values of the time and frequency domain parameters in parallel with non linear parameters for identification of different arrhythmias. Fig.3 shows the system block diagram.

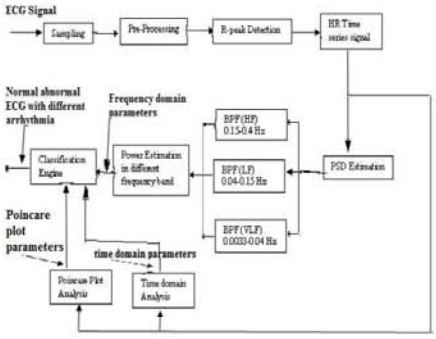


Figure.3 System Block Diagram.

Signal processing and filters

Signal processing can be defined as the manipulation of a signal for the purpose of extracting information from the signal, extracting information about the relationship of two (or more) signals, or producing an alternative representation of the signal. Most commonly the manipulation process is specified by a set of mathematical equations, although qualitative or "fuzzy" rules are equally valid. Pre-processing ECG signals helps to remove the contaminants from the ECG signal [9].

The noise cancellation method is band pass filtering. This filter is the combination of a low pass and high pass filter. A low pass filter was implemented with t he first side-lobe zero amplitude response placed at 50 Hz. This filter with a cutoff frequency at about 18 Hz can easily remove noise and other less important high-frequency components of the ECG signal. The cutoff frequency of the high pass filter is at about 1 Hz.

III. Heart Rate Variability

Heart rate variability (HRV) refers to the beat-to-beat alterations in heart rate. Under inactive conditions, the ECG of healthy individuals exhibits periodic variation in R-R intervals. The HRV measurements are captured noninvasively from the ECG signal. The results from this HRV data are capable of portraying physiological condition of the patient and are an important indicator of cardiac disease. Variability in heart rate is clinically linked to congestive heart failure, lethal arrhythmias, hypertension, tachycardia, coronary artery disease, organ transplant, neuropathy, and diabetes.There are two methods in linear analysis time domain and frequency domain analysis

Time Domain Analysis:

Time domain analysis is easiest measure of HRV. Initially, HRV was measured manually from the mean R-R interval in time domain and its standard deviation measured on short-term 5 minute ECG segment. With these methods either the heart rate or the RR intervals or each QRS complex between successive normal complexes are determined. Simple time–domain variables include the mean RR interval, the mean heart rate, the difference between maximum and minimum heart rate, etc. Table I shows in detail the various time domain HRV parameters [3].This are the recordings for a longer period of 24 hours allow complex statistical time-domain analysis. These statistical parameters may be derived from direct measurements of the RR intervals or from the differences between RR intervals. The simplest variable to calculate is square root of variance i.e. the standard deviation of the NN interval (SDNN). Since variance is mathematically equal to total power under the curve, SDNN covers complete variability in the ECG recording.

$$NN50 = \sum_{i=1}^{N} \{|RR_{i+1} - RR_i| > 50ms\}[count;-] \quad \text{.....[1]}$$

$$pNN\ 50 = \frac{NN\ 50}{N} . 100\ [\%;-] \quad \text{.....[2]}$$

$$SDNN = \sqrt{\frac{1}{N}\sum_{i=1}^{N}\left(RR_i - \overline{RR}\right)}[ms;-,ms,ms] \quad [3]$$

$$\overline{RR} = \frac{RR_1 + RR2.....R_N}{N} = \frac{1}{N}\sum_{i=1}^{N} RR_i\ [ms;-,ms] \quad \text{.....[4]}$$

$$SDANN = \sqrt{\frac{1}{N}\sum_{i=1}^{N}\left(\overline{RR_i} - \overline{\overline{RR_i}}\right)^2}\ [ms;-,ms,ms] \quad \text{.....[5]}$$

$$RMSSD = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N-1}(RR_{i+1} - RR_i)^2}\ [ms;-,ms,ms] \quad \text{.....[6]}$$

Table I. Time Domain HRV Parameters

Variables	Unit	Description
		Statistical measures
SDNN	ms	Standard deviation of all NN intervals
SDANN	ms	Standard deviation of averages of NN intervals in all 5 min. segments of the entire reading.
RMSSD	ms	The square root of mean of the sum of the square of differences between adjacent NN intervals
NN50 count		Number of pairs of adjacent NN intervals differing by more than 50ms

Frequency Domain Analysis:

In distinction to the time domain measures of HRV mentioned above, recent developments in microprocessor technology has enabled the calculation of frequency measures on the same ECG data. Frequency measures involve the spectral analysis of HRV. The RR interval time series is an irregularly time-sampled signal. This is not an issue in time domain, but in the frequency-domain it has to
be taken into account. If the spectrum estimate is calculated from this irregularly time-sampled signal, additional harmonic components appear in the spectrum. Therefore, the RR interval signal is usually interpolated before the spectra analysis to recover an evenly sampled signal from the irregularly sampled event series. The HRV spectrum contains the high frequency (0.18 to 0.4 Hz) component, which is due to respiration and the low frequency (0.04 to 0.15 Hz) component that appears due to both the vagus and
cardiac sympathetic nerves [3]. Ratio of the low-to-high frequency spectra is used as an index of parasympathetic sympathetic balance. Frequency domain HRV variables are detailed in Table II [3]. In the frequency-domain analysis power spectral density (PSD) of the RR series is calculated. Methods for calculating the PSD may be divided into Fast Fourier transform (FFT) based and autoregressive (AR) model based methods. The PSD is analyzed by calculating powers and peak frequencies for different frequency bands. For the FFT based spectrum analysis powers are calculated by integrating the entire spectrum. The spectrum in AR model methods can be divided into components and the band powers are obtained as powers of these components [3].

Poincare Plot :

Many nonlinear phenomena are certainly involved in the genesis of HRV. It has been speculated that the analysis of HRV based on the methods of nonlinear dynamics might extract valuable information for physiological interpretation of HRV and for the assessment of the risk of sudden death [4]. The investigation of Poincaré plots of *RR* intervals is an emerging method of nonlinear dynamics applied in HRV analysis.

		in the entire recording
pNN50	%	NN50 count divided by the total number of all NN intervals

From all RR intervals a Poincare Plot is created. Two consecutive RR intervals represent one point in the plot. The first RR interval (RR_N) represents the x-coordinate, the second interval (RR_{N+1}) the y-coordinate. The Poincare Plot generated for all RR intervals of a patient with sinus rhythm is shown in Figure 4.

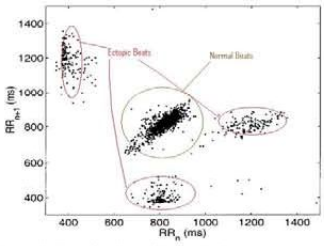


Figure 4 Visualization of ectopic beats.

Table II. Frequency Domain HRV Parameters

Variables	Unit	Description	Frequency Range
Total Power	ms^2	Variance of all NN intervals	Approx.≤0.4 Hz
VLF	ms^2	Power in the low frequency range	0.003-0.04Hz
LF	ms^2	Power in the low frequency range	0.04-0.15Hz
HF	ms^2	Power in high frequency range	0.15-0.4Hz

Specifications of software *:*

- Software used: Matlab 7.8, cygwin and wfdb toolkit: wfdb-10.4.21
- Operating system: Windows 7

Cygwin is free software that provides a Unix-like environment and software tool set to users of any modern version of MS-Windows for x86 CPUs (NT/2000/XP/Vista/7) and (using an older version of Cygwin) some obsolete versions (95/98/ ME) as well. Cygwin and WFDB toolkit is installed. The data from the physionet Archives are download and wfdb command 'wfdb2mat –r filename' is used to convert the data into matlab format.

IV. RESULTS

The ECG signals are used from the MIT-BIH AF Database and the MIT-BIH NSR Database, which are derived from the archive of PhysioBank [6].

Analysis of Normal Sinus Rhythm: MIT-BIH NSR Database includes 18 long-term ECG recordings of subjects referred to the Arrhythmia Laboratory at Boston's Beth Israel Hospital.The results of the algorithm are summarized in Tables III .

Table III Time-Frequency Domain Measure Of Normal Sinus Rhythm

Signal	Time domain measures					Frequency domain measures				
	SDNN	*SDANN*	*RMSSD*	*PNN50*	*HR*	*TF*	*LF*	*HF*	*VLF*	*LF/HF*
17453	129.350	58.7208	4.5427	11.6700	82.87	1.31E+07	3.34E+04	5.35E+04	3.17E+04	0.62
16273	108.29	66.8916	7.254	9.903	79.633	1.31E+07	8.23E+03	5.26E+03	2.56E+04	1.56
16786	68.792	61.4817	4.9623	13.5589	73.4144	1.30E+ 07	1.16E+ 04	6.27E+03	1.28E+04	1.84
18184	102.3229	74.1323	4.5579	6.866	86.8041	1.31E+07	1.88E+04	1.41E+04	3.52E+04	1.33
19093	93.5589	73.2916	9.4759	9.6547	69.0503	1.28E+07	1.22E+04	2.60E+03	2.74E+04	4.68

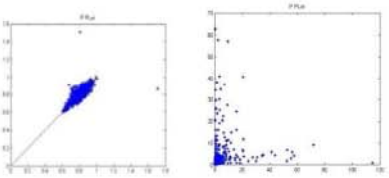
Analysis of Atrial Fibrillation: MIT-BIH AF Database includes 25 long-term ECG recordings of human subjects with AF. The individual recordings are each 10 hours in duration, and contain two ECG signals each sampled at 250 samples per second. The typical recording BW of approximately 0.1 Hz to 40 Hz. The rhythm annotation files (with the suffix .atr) were prepared manually.In fact, they may contract 57 times faster than normal-up to 300-400 bets per minute. Not all these signals go to ventricles, so although their rate is irregular, it is not too fast and the ventricles can still pump out blood. That makes it the most common "serious" heart rhythm abnormality. The results of the algorithm are summarized in Table IV .

Table IV Time-Frequency Domain Measure Of Atrial Fibrillation

Signal	Time domain measures					Frequency domain measures				
	SDNN	*SDANN*	*RMSSD*	*PNN50*	*HR*	*TF*	*LF*	*HF*	*VLF*	*LF/HF*

08455	755.8688	35.4495	1.6275	1.0526	77.4012	4.3901E+06	2.7529E+005	6.2450E+005	9.3905E+004	0.4408
06995	172.5533	55.4949	6.2289	4.0900	222.6845	3.517E+006	3.8146E+005	9.0537E+005	2.1103E+004	0.4213
04043	632.4581	152.3067	2.5981	17.4367	109.2900	4.3876E+06	2.6914E+005	6.2531E+005	9.3838E+004	0.4304
06426	338.1285	165.1368	22.6916	78.2313	83.0707	1.32E+07	5.81E+04	1.18E+05	2.14E+04	0.4927
08378	310.701	249.3951	39.9613	25.7373	70.546	6.27E+07	1.31E+07	2.47E+07	9.99E+06	0.3285

The Poincare plot results are shown in Fig.5 a) for NSR and fig.5 b) for AF.



a b

Figure 5.a)Typical Poincare plot for NSR
b)Typical Poincare plot for AF

IV. Conclusion

From this paper it is concluded that the time domain parameters (SDNN, SDANN, RMSSD, NN50 and pNN50) which are arbitrarily varies in analyzed signals, these parameters are not proper for atrial fibrillation detection. So frequency domain analysis plays a vital role in analysis and identification of different arrhythmias. Parameter LF/HF ratio can be used as atrial fibrillation indicator. Ratio varies from 0.28± 0.25 for atrial fibrillation and 2.63±0.93 for normal sinus rhythm. The discrimination between NSR and AF patient using LF/HF is not satisfactory. The resulting accuracy calculated for ECG recordings from MIT-BIH NSR is 88.5% and from MIT-BIH AF is 86.94%.

To identify patient with AF Poincare plot can be used as a significant tool and improve the performance. This system allows patients suffering from AF to be identified in an easier and more suitable way.

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PRATIBHA: INTERNATIONAL JOURNAL OF SCIENCE, SPIRITUALITY, BUSINESS AND TECHNOLOGY (IJSSBT), Vol. 6, No. 1, January 2018
ISSN (Print) 2277-7261

Optimization of Cooperative OFDM based AF-DF Relaying Transmission

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Abstract :

The wireless communication technology has been developed rapidly due to the demand of the wireless networks. Cooperative communication (CC) has become as a promising research to improve the efficiency of the wireless networks, utilizes the spatial diversity gain in the system of multi user wireless communication. The three major issues considered in orthogonal frequency division multiplexing (OFDM) cooperative transmission are relay selection (RS), power allocation (PA) and sub-carrier pairing (SP). These optimization issues depend on the system capacity maximization and minimization of bit error rate (BER) and symbol error rate (SER). To maximize the throughput of the system, our work is carried out with two phases. In the first phase, cat swarm optimization (CSO) and genetic algorithm (GA) is combined to select the optimal relay from multiple relays and optimal power allocation. In the second phase, munkres algorithm is performed for pairing the sub-carriers in which same sub-carrier is applied for both first and second hop. These two phases are done at the nodes of source, relay and destination under fixed rate of sub-carrier and total constraints of power. The simulation results show the performance of the optimization algorithms of the proposed system.

Keywords:- cooperative transmission, relay selection, sub-carrier pairing, power allocation.

1. INTRODUCTION

Wireless communication is the critical element in the technology of information and communication, foundation to the other industries. It is the sector which grows dynamically in the world [1]. In the wireless communication network, signal fading may arise during transmission of signal from source to destination from multipath propagation which is particularly in terms of interference. A space diversity known as CC is used to overcome the interference which uses multiple user's distributed antennas in order to transmit their own information [2].

CC is a method which enables single antenna in the environment of multi users and achieve transmission by sharing the antenna [3]. In CC, the major research challenges are relay selection (RS), power allocation (PA) and sub-carrier pairing (SP). Relay selection based on the channel state information (CSI) availability at the source and relay increases the efficiency and the performance of the symbol error rate (SER) [4]. Power allocation is required because power is not allocated equally in the nodes for all subcarriers. PA through an energy harvesting relay in CC achieves tradeoff between the complexity and the performance of the system with minimized BER [5]. SP improves the error rate performance and the capacity of the system [6].

In CC, the process of relay can be carried out based on commonly used modes of operation known as amplify-and-forward (AF) and decode-and-forward (DF) [7]. In AF, the relay retransmit the amplified signal to the destination and in DF, the signal that is received are decoded and then the decoded signal is retransmitted to the destination. Incremental hybrid decode-amplify-forward (IHDAF) is a relaying protocol which selects the mode depend on the quality of the channel [8]. The other relaying protocols that are used in CC are estimate-and-forward (EF) [9], compress-and-forward (CF) [10] and cooperative coded [11].

To maximize the throughput in [12-14], authors consider the OFDM network to make the communication bi-directionally, by using multiple relays. To maximize the capacity of the system and to reduce the complexity, the two hop relay system with DF mode was used and based on partial CSI, power was allocated to the nodes [15-17]. Resource can be scheduled and allocated using OFDM based multi access channel which increases the sum rate as well as optimizes the pairing and assignment of sub-carrier, source node pairing and PA [18-20].

The optimization problem that are considered in cooperative OFDM are optimal selection of relay from multiple relays, optimal PA and SP. These issues can be stated as an optimization problems and that can be evaluated by means of system capacity, SER, and BER and finally the power can be distributed to all the sub-carriers equally. In this work, RS,PA and SP can be done at the nodes of source, relay and destination to achieve the performance with improved system capacity and with reduced BER and SER.

Significant contribution of the proposed work:-

1. To improve the rate of transmission, resources can be managed effectively in the CC for every transmitter.
2. An optimization technique to increase the system throughput with the optimization problem RS, PA and SP.

The paper is categorized as follows:- section II gives the related work based on the management of resources. The system model is represented in section III. The proposed optimization approach is stated in section IV. Section V states the experimental results and finally the paper concludes in section VI.

2. Related works

The survey delineates the management of resources in terms of RS, PA and SP. The survey focused mainly on joint resource management (JRM), optimal selection of relay, optimal allocation of power and joint power allocation and sub-carrier pairing.

Singh *et al.* [21] introduced an algorithm to increase the efficiency of the energy (EE) in the network of relay interference. The EE problem is constructed as the spectrum efficiency (SE) ratio over the consumption of the power subject to the constraints of PA and SP. An algorithm known as an iterative EE maximization (EEM) was presented to determine the optimal relay, optimal allocation of power and pairing of sub-carrier jointly. The algorithm of resource allocation can be analyzed based on both interference and noise dominated rule. The spectrum and energy efficiency was increased and gives better performance but the there was an expense in EE while maximizing the user's number to achieve the SE.

Singh *et al.* [22] focused on utility based algorithm to increase the EE with joint PA and sub-carrier in the network of multi user relay. The objective was to allocate the power evenly to each sub-carrier. To convert the formulated problem into complex, a concave lower bound and convex transformations are used. The optimal solution has been found by using the decomposition dually. From the optimal solution, the optimal prize can be found for allocating the resources. Thus the complexity was reduced and the utility function of the network was increased.

Qin *et al.* [23] dealt with joint PA and AP for OFDM based AF system. The optimization was SER in terms of the adaptive white Gaussian generalized noise. The performance of SER was optimized at a particular rate of data. The SP in OFDM increases the capacity of the system and reduces the error rate. The noise under AWGGN was obtained easily and the power can be allocated to the sub-carriers.

Chen *et al.* [24] dealt with two modes for relay network as DF and CF. Cooperative communication was improved based on these combined two modes. The advantages of these modes can be aggregated by a scheme of joint PA and strategy selection (PASS). This scheme achieves higher rate when compared with the normal hybrid DF or CF scheme. The rate gain was achieved by adjusting the relay power and selecting the better CF or DF strategy. Allocation of power was established depend on the rate concave which was achieved by PASS in static channel of relay.

Shen*et al.* [25] authors investigated the optimization of joint resource for OFDM transmission of relay and for information and transfer of power, the relay used the time switching (TS). The authors aim was to increase the total rate under the constraints of SP, transmission power of the source, transmission power of the relay and the TS. Based on the feasible condition, the problem can be solved optimally. The searching algorithm was presented to solve the resource allocation problem optimally. The resource allocation problem was converted into an equivalent problem and concave functions are used to reduce the complexity.

3. System model

Consider a multi user OFDM based cooperative system with the nodes of source, relay and destination. The relay node is located between the nodes of source and destination. The overall transceiver model is represented in Fig. 1. These nodes are operated in the mode of half-duplex which can be furnished with single transmit antenna or receive antenna. The paths that are used for transmission are from source to relay, relay to destination and directly from source node to the destination. The relaying protocol that are consider for our work are AF and DF with CSI at the nodes. Assume the sparse fading and frequency selective fading are subjected to each sub-carrier in the existence of AWGGN noise. The bit stream of input is fed at the source node in to the QAM modulator.

The M-QAM modulation can be denoted as,

$$Q_1, Q_2, \Lambda, Q_{s/2-1} \quad (1)$$

Where s represents the number of sub-carriers and M denotes the QAM modulation factor.
Consider that the AWGGN corrupts the signal and SER can be denoted as,

$$S\left(\sqrt{\lambda \eta_n[k]}\right) = SER = \sum_{i=1}^{N}\sum_{j=1}^{N} \varphi_{i,j}\, a\, G_\alpha\left(\sqrt{b\varphi_{i,j}}\right) \quad (2)$$

Where $\varphi_{i,j}$ represents the sub-carrier pairing variable, a and b denotes the constants for the scheme of modulation and G_α denotes the generalized function of Gaussian. The variable i in the first slot time of the subcarrier and j in the second slot time of the subcarrier are paired and can be represented as $\varphi_{i,j}$.

The altered bits of the data stream are computed by the BER over the channel of communication. The bit error can be measured as,

$$B\left(\sqrt{\lambda \eta_n[k]}\right) = BER = \frac{N_e}{N_b} \quad (3)$$

Where N_e is the total error number and N_b is the total amount of bits that has been sent.

The ergodic capacity is a channel capacity, which is a non-linear function for increasing the capacity of the channel under the fixed rate of sub-carrier and total constraints of power. It can be represented as,

$$C\left(\sqrt{\lambda\eta_n[k]}\right) = C = B/N \sum_{k=1}^{N} \log_2\left(1+\eta_n[k]\right) (4)$$

Where $\eta_n[k]$ denotes the sub-carrier rate and B denotes the bandwidth.

In DF, demodulation is performed. That is, the signal can be retrieved by using the DF protocol. After that, the OFDM modulation is performed, DC bias is added and the result is forward towards the destination node. While forwards the signal, the AF relay amplifies the signal and send it to the destination.

4. Proposed optimization for relay selection, Power allocation and sub-carrier pairing in AF and DF relaying

The optimization issues includes finding an optimal solution for the possible SP, RS and PA. To find an optimal solution, the proposed scheme procedure can be divided in to two phases. At phase I, obtain the optimal relay from multiple relays while loading equal power among the sub-carriers at both source and relay nodes by using CSO-GA optimization algorithm. At phase II, optimal power loading coefficients are obtained jointly under total power constraints and fixed sub-carrier rate for the source and relay sub-carriers by using munkres algorithm.

Assume that the input signal is corrupted by the Laplacian noise and AWGN. In order to find an optimal relay, at first, for each relay SER, BER and capacity are calculated over all sub-carriers. The relay which provides the least total of SER, BER and highest capacity are chosen as an optimal relay. That is, SER and BER minimization and capacity maximization are the optimization problem for the optimal RS and PA.

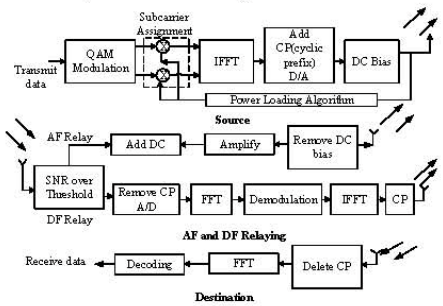


Fig. 1: Schematic block diagram of the transceiver model

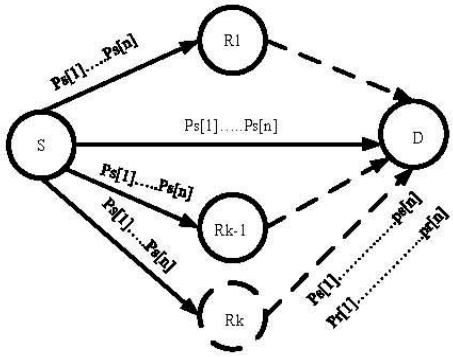


Fig. 2: Optimal relay selection

In the above Fig.2, S, D and R denotes the source, destination and relay nodes. The source node send the data packet along with OFDM block to all the relay and destination node. The dotted circle represent the optimally selected relay which send both the source and relay packet to the destination with OFDM block.

The block diagram illustrates the source, relay and destination nodes. The source and the relay power coefficients can be represented as,

$$S_{pc} = \left[S_{pc}[1], S_{pc}[2], \Lambda\ , S_{pc}[N]\right]^T \quad (5)$$

$$R_{pc} = \left[R_{pc}[1], R_{pc}[2], \Lambda\ , R_{pc}[N]\right]^T \quad (6)$$

Under the assumption of fixed subcarrier rate, M_k =M which results in the constant values $\delta_k = \delta$ for all subcarriers.

$$\delta_k = \frac{(M_k - 1)}{\sum_{k=1}^{N} \log_2^{M_k}} (7)$$

Mk represents the constellation size for the kth subcarrier.

(1) SER optimization problem

Phase I: Selection of Relay

The optimization constraint for RS can be stated as

$$\min_{\{n\}} \delta \sum_{k=1}^{N} S\left(\sqrt{\lambda\eta_n[k]}\right),\ \forall n = 1, 2, \Lambda\ , k \qquad (8)$$

Phase II: Optimal Allocation of Power

$$\min_{\{S_{pc}, R_{pc}\}} \delta \sum_{k1}^{N} S\left(\sqrt{\lambda\eta_n[k]}\right),\ \forall n = 1, 2, \Lambda\ , k \quad (9)$$

Subject to $\frac{1}{N}\sum_{k1}^{N} S_{pc}[k]+R_{pc}[k]$

$S_{pc}[k]>0, \forall k=1,2,\Lambda\ N$

$R_{pc}[k]\geq 0, \forall k=1,2,\Lambda\ N$

(2) BER optimization problem

Phase I: Selection of Relay

The optimization constraint for RS can be stated as

$$\min_{\{n\}} \delta \sum_{k=1}^{N} B\left(\sqrt{\lambda\eta_n[k]}\right),\ \forall n=1,2,\Lambda\ ,k \qquad (10)$$

Phase II: Optimal Allocation of Power

$$\min_{\{S_{pc},R_{pc}\}} \delta \sum_{k1}^{N} B\left(\sqrt{\lambda\eta_n[k]}\right),\ \forall n=1,2,\Lambda\ ,k \ (11)$$

Subject to $\frac{1}{N}\sum_{k1}^{N} S_{pc}[k]+R_{pc}[k]$

$S_{pc}[k]>0, \forall k=1,2,\Lambda\ N$

$R_{pc}[k]\geq 0, \forall k=1,2,\Lambda\ N$

(3) Capacity based optimal relay selection and power allocation

Phase I: Selection of Relay

The optimization constraint for RS can be stated as

$$\max_{\{n\}} \delta \sum_{k=1}^{N} C\left(\sqrt{\lambda\eta_n[k]}\right),\ \forall n=1,2,\Lambda\ ,k \ (12)$$

Phase II: Optimal Allocation of Power

$$\max_{\{S_{pc},R_{pc}\}} \delta \sum_{k1}^{N} C\left(\sqrt{\lambda\eta_n[k]}\right),\ \forall n=1,2,\Lambda\ ,k \ (13)$$

Subject to $\frac{1}{N}\sum_{k1}^{N} S_{pc}[k]+R_{pc}[k]$

$S_{pc}[k]>0, \forall k=1,2,\Lambda\ N$

$R_{pc}[k]\geq 0, \forall k=1,2,\Lambda\ N$

In the transmission phase, the input stream is fed in to the serial-to-parallel converter which can be modulated by QAM modulation scheme. Then the OFDM modulator applies the Inverse Fast Fourier Transform (IFFT) in which each sub-carrier's power is modified based on the optimization power

loading algorithm. The IFFT parallel output stream is changed into serial stream to make OFDM. Each OFDM data packet consist of cyclic prefix OFDM (CP-OFDM) which is used for detection, synchronization and Doppler scale estimation. Then DC bias is added to shift the negative values into positive values.

In the phase of relaying, the signals can be transmitted by the paths from source to destination, source to relay and relay to destination. At the relay node, OFDM is converted in to parallel via FFT after removing the CP. In DF relaying demodulation is performed by QAM demodulator and recovers the signal. Then, OFDM modulation is performed, add DC bias and forwards the packet to the destination. In AF relaying, at first it eliminates the DC bias and amplifies the signal. Then, the DC bias is added by the relay to perform the electrical to optical conversion and at destination, the received symbol is converted into parallel via FFT.

4.1. CSO-GA optimization algorithm

Both RS and power coefficient selection are considered as an optimization problem in the CSO-GA optimization algorithm. The CSO-GA optimization algorithm can be adopted due to its lower complexity and cost.

Algorithm : CSGA optimization

egin
Input: The parameters Spc and Rpc (power coefficient of source and relay) of the algorithm.
Initialize the population based on CSO.
Evaluate the fitness function for the source and relay power coefficients.
Power coefficient with optimal solution.
Optimal selection of both the power coefficient with the weight values 0.4 and 0.6 can be represented as,
$M = w_1 M_1 + w_2 M_2$
Start seeking mode and tracing mode operations.
Power coefficients can be ranked and positioned based on the seeking and tracing mode operations.
New source and relay strings are generated in GA based on the operators
i) Selection
ii) Cross-over
iii) Mutation
Output: Optimal source and relay power coefficients
End

In the CSGA optimization algorithm, the relay and power coefficient can be selected optimally. At first, based on the seeking and tracing operations, the power coefficient can be ranked and positioned and new strings are generated using the operators of genetic algorithm and the best power coefficient in the past population is added by replacing the string randomly in the present population and finally the optimal solution gives the optimal RS and power coefficients.

The optimal solution of this algorithm is the optimal selection of relay and power coefficients that can be used for allocating the optimal power among all sub-carriers.

4.2. Munkres algorithm

Munkres algorithm is used to choose the suitable pairs of sub-carrier for relaying to maximize the utility of total network.In munkres algorithm, the problem can be denoted in the square matrix form and each worker accomplishes one task.

Consider that the spectrum used by the users and the relay is divided by ZS subcarriers. The relay chooses a proper subcarrier m after the message of the subcarrier k is decoded correctly to transmit the re-encoded signal, where k,m∈ {1,...,ZS}. The (k.m) is denoted as a subcarrier pair.

After selecting the relay, in each pair of subcarrier (k,m), the communication mode depend on the data rate can be specified. Then N × N matrix with its row and column illustrates the subcarriers in the first time slots and second time slots. The cooperative data rate is used in the matrix for each subcarrier pair. Then, munkres algorithm is applied to this matrix for the assignment of subcarrier.

Given the N × N matrix matrix ($S_{k,m}$) of real numbers, find a permutation P ($P_{k,m}$; k,m∈ {1,...,ZS}) of the integers 1, 2, . . . , ZS that minimizes $\sum_{k,m} S_{k,m} P_{k,m}$.

Permutation gives the smallest sum is the solution to the assignment problem for this matrix. It is called as cost minimizing assignment.

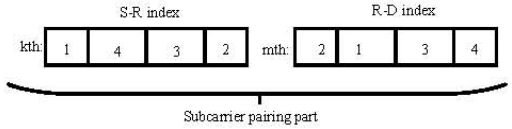


Fig. 3: Subcarrier pairing

Given S-R and R-D index, an $n \times n$ matrix containing the cost of assigning each "kth" (S-R index) to a "mth" (R-D index) is represented in Fig. 3. The following steps describes the subcarrier pairing using munkres algorithm.

Step 1: To perform the row operation, in each row, the smallest element is taken and deducted from all the element in that row. This will cause that the matrix is with minimum one zero in all the rows. Now, one task is allotted to each agent.

Step 2: If the matrix cannot be able to allot the task, then the first step is repeated for all columns. That is in each column minimum element is deducted from all the elements in that column and then checks if there is possible for an assignment.

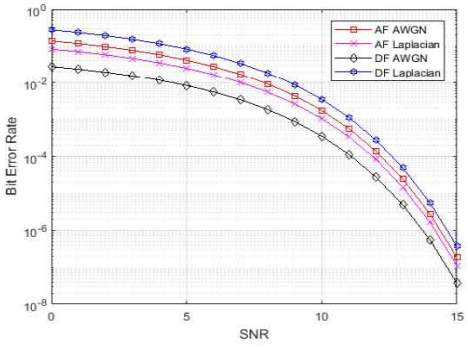
Step 3: The zeros that are in the matrix must be concealed by labelled as few rows or columns.

Step 4: The smallest value is find from the remaining elements and deduct that from every unconcealed element and append it to every element that are covered by two lines.

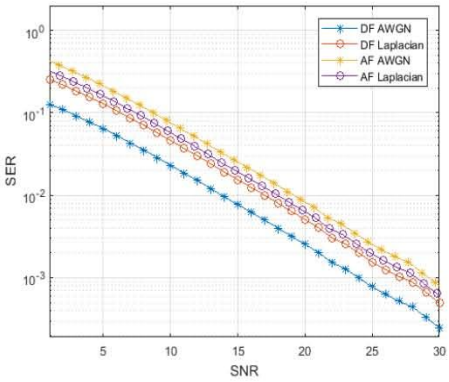
The procedure is repeated until the least cost is distinguished. The cost is calculated based on BER, SER and system capacity. The least cost represents the suitable subcarrier pair.

5. Simulation results

To evaluate the optimization algorithm of the proposed system, some simulations are carried out and the experimental results are handled on MATLAB under various schemes. The OFDM based AF and DF network has been considered, in which the sub-carrier channels are assumed as independent. Laplacian and AWGN are considered among the sub-carriers. At relay and destination, the noise powers are considered for each sub-carrier. 16 QAM modulation scheme is used for signaling. The performance are estimated in terms of BER, SER and capacity compared with the signal-to-noise (SNR) ratio.



(a)



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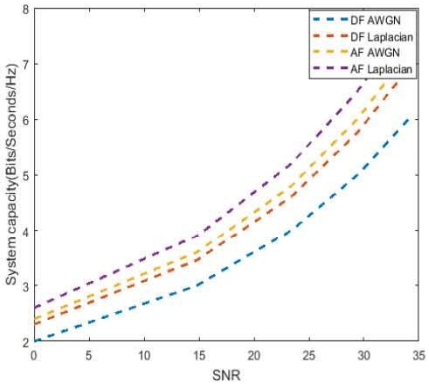
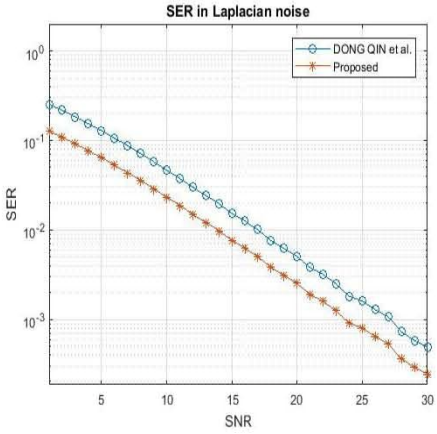


(c)

Fig. 4: Performance evaluation of (a) BER, (b) SER and (c) system capacity versus SNR

Figure 4shows the performance of BER, SER and system capacity for the proposed optimization algorithm that is compared in terms of SNR for both AF and DF relay in the existence of AWGN and laplacian noise. As seen, the proposed schemes provides a marginal performance.The performance of CSGO algorithm is further included as the benchmark and it is evaluated for AF and DF relaying in terms of laplacian and AWGN noise. BER, SER and system capacity indicates the channel's performance. The performance will be high, if BER decreases and the system capacity increases.



(a)

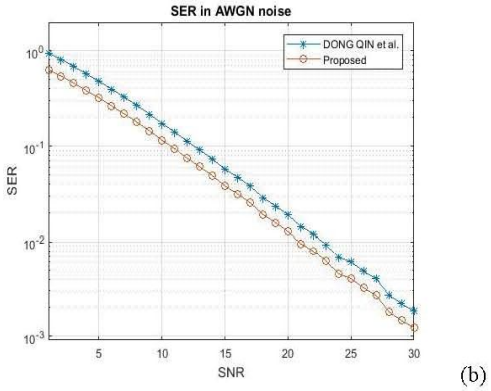


Fig. 5: Comparison of the performance of SER for the proposed scheme with the existing method

Figure 5 shows the performance of the proposed scheme with the Dong et al. [23]. The performance of SER is shown when the received signals are corrupted by the laplacian noise and AWGN. The graphical representation shows that the SER is minimized for the proposed system as compared with the traditional system. The algorithm used in our work optimally selects the relay and power coefficients and performs the sub-carrier pairing in the presence of noise.

6. Conclusion

This paper formulates the RS, PA and SP for a cooperative OFDM system with AF and DF relaying protocol. The proposed optimization algorithms CSGO (cat swarm and genetic optimization) and Munkres algorithm efficiently solves the optimization problem. The relay and the power coefficient can be selected optimally and power is equally allocated to all the sub-carriers. That is, the PA, maximizes the effectiveness of energy by allotting power to all the sub-carriers with fixed SP. Thus the simulation results proves that the proposed optimization function achieves higher performance with minimized SER and BER and with maximized system capacity than the other approaches.

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PRATIBHA: INTERNATIONAL JOURNAL OF SCIENCE, SPIRITUALITY, BUSINESS AND TECHNOLOGY (IJSSBT), Vol. 6, No. 1, January 2018
ISSN (Print) 2277-7261

Effects of Machining Parameters on Cutting tool (steel EN8) in Wire cut EDM

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ABSTRACT :

Wire Cut electrical discharge machining process is a highly complex, time varying & stochastic process. This is used in the fields of dies, moulds; precision manufacturing and contour cutting etc. The output of the process is affected by large number of input variables. Hence a suitable selection of input variables for the wire cut electrical discharge machining (WEDM) process depends heavily on the operator's technology & experience. WEDM is extensively used in machining of conductive materials when precision is of prime importance. Rough cutting operation in wire EDM is very challenging one because improvement of more than one performance measures surface roughness (Ra) is of prime importance. Wire EDM process involves a large number of variables that affect its performance. In this paper, an attempt is made to study the effect of various process parameters such as pulse on time, pulse off time and current for high carbon high chromium cold work tool steel (EN8)with the help of molybdenum wire. The experiment has been completed with the help of Design of experiment and Taguchi method is applied to create an orthogonal array of input variables using the ANOVA. The regression analysis is used to optimize the process parameter of Surface roughness.

Keywords: WEDM, Pulse on, pulse off, current, surface roughness, ANOVA Taguchi DOE, Regression Analysis.

I. INTRODUCTION

Wire Electrical discharge machining (WEDM) is a nontraditional, thermoelectric process which erodes material from the work piece by a series of discrete sparks between a work and tool electrode immersed in a liquid dielectric medium. Machining removes certain parts of the work pieces to change them to final parts. Machining has been classified in two types are Traditional Machining and Non-traditional Machining. Traditional Machining, also known conventional machining requires the presence of a tool that is harder than the work piece to be machined. This paper investigates the interactions between common process parameters of WEDM and final quality of the generated surface, through analysis of variance (ANOVA) and regression models based on experimental results. In particular, the paper is focused on the effects of pulse on time, pulse off time, current on the surface finish during the WEDM of an EN8 material.

V.Chengal Reddy [2015] works to study the effect of various process parameters such as pulse on time, pulse off time, wire tension, current, upper flush and lower flush for Aluminium HE30. The experimentation has been completed with the help of Taguchi grey relational analysis. Taguchi grey relational analysis is used to optimize the process parameters on multiple performance characteristics such as Material removal rate, surface finish. The experimental result analysis showed that the combination of pulse on time, pulse off time, wire tension, lower flush, wire tension and upper flush is essential to achieve maximization of material removal rate and minimization of surface roughness and kerf width.

Kashid D.V [2014] presented their work, the parametric optimization method using Taguchi method is proposed for WEDM of steel grade EN 9 component. He used three process parameters for this investigation; Pulse on-time, Pulse off-time and wire feed. Signal to Noise ratios of the Material removal rate for all experiments are calculated. From by using Taguchi's L9 orthogonal array, he has concluded that material removal rate was highly influenced by pulse-on time and pulse-off time. The higher discharge energy, the more powerful explosion and the deeper crater created on the machined area. Pulse on-time (TON) with a contribution of 51.7103% has greatest effect on the machining output characteristics. Parameter pulse-off time (TOFF) is the next most significant influence42.153% on the material removal rate. Hence if requirement of material removal rate is high, then pulse on-time and pulse-off time must high, which affects on surface roughness.

S V Subrahmanyam [2013] in their work an attempt is made to study the optimization of Wire Electrical Discharge Machining process parameters for the machining of H13 HOT DIE STEEL, based on the Grey–Taguchi Method. taguchi's L27(21x38) Orthogonal Array was used to conduct experiments, which correspond to randomly chosen different combinations of process parameter setting, with eight process parameters: TON, TOFF, IP, SV WF, WT,SF, WP each to be varied in three different levels. Data related to the each response viz. material removal rate (MRR), surface roughness (Ra) have been measured for each experimental run; With Grey Relational Analysis Optimal levels of process parameters were identified. The relatively significant parameters were determined by Analysis of Variance. The

variation of output responses with process parameters were mathematically modeled by using non-linear regression analysis. The models were checked for their adequacy. It is observed that the Material Removal Rate increased, Surface Roughness reduced, which are positive indicators of efficiency in the machining process. Thus, it can be concluded that the Grey-Taguchi Method, is most ideal and suitable for the parametric optimization of the Wire-Cut EDM process, when using the multiple performance characteristics such as MRR (Material Removal Rate), Surface Roughness for machining the H13 or for the matter for any other material. Mathematical relations between the machining parameters and performance characteristics established.

Jangra Kamal et al [2012] are study the inter-relationship among various input parameters such as Pulse on Time, Pulse off Time, Peak current, Wire speed and Wire tension with output measures namely Cutting Speed, Surface Roughness and Dimensional lag in wire electrical discharge machining of D3 tool steel as a work piece material and using Taguchi and Grey Relational Analysis techniques. It has proved using GRA, optimal setting of process parameters for multiple performance characteristics was set with A5B2C1D1E2 corresponding predict values were confirmed experimentally that the cutting speed was observed 3.80mm/min and surface finish was poor and it can be improved by assigning high importance in grey relational grade.

B.K.Nanda et al [2011] have conducted the experiment on "Parametric Optimization of CNC Wire Cut Electrical Discharge Machining using grey relational Analysis". In This Experiment has been performed under different cutting conditions with the grey relational Analysis and analysis of variance (ANOVA). Grey relational grade using the optimal process parameter combinations and found that a good agreement between the predicted and actual grey relational grade. The increase of grey relational grade from initial factor setting to the optimal process parameter setting is of 0.1275. It has concluded that optimization of the complicated multiple performance characteristics using gray relation method and obtain the material removal rate, surface roughness are improved together.

Vikram Singh [2014] presented their work is to investigate the effects of various WEDM process parameters such as pulse on time, pulse off time, servo voltage and wire feed rate on the Material Removal Rate (MRR), Surface Roughness (SR) and cutting rate. Secondly, to obtain the optimal settings of machining parameters at which the Material Removal Rate (MRR) and cutting rate are maximum and the Surface Roughness (SR) is minimum in a range. The experiments were carried out as per design of experiment approach using L27 (34) orthogonal array. In the present investigation, AISI D2 steel specimen is machined by using brass wire as electrode and the response surface methodology (RSM) is used for modeling a second-order response surface to estimate the optimum machining condition to produce the best possible response within the experimental constraints. Results showed that, The optimum parameters of combination setting is Pulse on time 112.99 µs, Pulse off time 45µs, Servo Voltage 20 volts, and Wire feed 4.85mm/min for maximizing MRR and Cutting, minimize the SR.

II. METHODOLOGY

A. Properties of EN8 material

EN8 is medium carbon steel usually supplied untreated and US grade of EN8 material is AISI: 1040. EN8 has good tensile strength and is often used in applications such as: shafts, gears, stressed pins, studs, bolts, keys etc. EN8 is a very popular grade and is readily machinable in any condition. It can be further surface-hardened to produce components with enhanced wear resistance, typically in the range 50-55 HRC through induction processes.

B. Chemical Composition

The following table shows the chemical composition of AISI 1040 carbon steel.

Element	Content (%)
Iron, Fe	98.6-99
Manganese, Mn	0.60-0.90
Carbon, C	0.370-0.440
Sulphur, S	≤ 0.050
Phosphorous, P	≤ 0.040

Table No.1. Chemical Properties [14]

C. Physical Properties

The physical properties of AISI 1040 carbon steel are tabulated below.

Properties	Metric	Imperial
Density	7.845 g/cc	0.2834 lb/in³
Melting Point	1521°C	2770°C

Table No.2 . Physical Properties [14]

D. Mechanical Properties

The mechanical properties of AISI 1040 carbon steel are outlined in the following table.

Mechanical Properties	Metric	Imperial
Tensile strength	620 MPa	89900 psi
Yield strength	415 MPa	60200 psi
Bulk modulus	140 GPa	20300 ksi
Shear modulus	80 GPa	11600 ksi
Elastic modulus	190-210 GPa	27557-30458 ksi
Poisson's ratio	0.27-0.30	0.27-0.30
Elongation at break (in 50 mm)	25%	25%
Reduction of area	50%	50%
Hardness, Brinell	201	201
Hardness, Rockwell B	93	93
Hardness, Rockwell C	13	13
Hardness, Vickers	211	211
Izod impact	45 J	33.2 ft-lb

Table No.3. Mechanical Properties [14]

E. Thermal Properties

The thermal properties of AISI 1040 carbon steel are given in the following table.

Properties	Metric	Imperial
Thermal expansion co-efficient	11.3 µm/m°C	6.28 µin/in°F
Thermal conductivity (@ 100°C/212°F)	50.7 W/mK	352 BTU in/hr.ft².°F
Thermal conductivity (@ 0°C)	51.9 W/mK	360 BTU in/hr.ft².°F

Table No.4. Thermal Properties [14]

III. EXPERIMENTAL ANALYSIS METHOD

Methods adopted for analysis of trials are Taguchi Method and Regression Analysis Design of Experiments (DOE) is a powerful technique used for exploring new processes, gaining increased knowledge of the existing processes and optimizing these processes for achieving world class performance. Design of Experiments refers to the process of planning, designing and analyzing the experiment so that valid and objective conclusions can be drawn effectively and efficiently. In order to draw statistically sound conclusions from the experiment, it is necessary to integrate simple and powerful statistical methods into the experimental design methodology. The success of any industrially designed experiment depends on sound planning, appropriate choice of design, and statistical analysis of data and teamwork skills. The Taguchi approach is a DOE method that has been widely used in industrial robust design procedures. Though this approach can identify the main effects of separate design factors, it is limited in that interactions among those factors cannot be considered effectively.

The DOE procedure consists of the following four steps

a) Planning: definition of the problem and the objective, and development of an experimental plan.
b) Screening: reduction of the number of variables by identifying the key variables that affect product quality.
c) Optimization: determination of the optimal values for various experimental factors.
d) Verification: performing a follow-up experiment at the predicted best processing conditions to confirm the optimization, results.

A. Design Of Experiments by Taguchi Method

Taguchi techniques were developed by Taguchi and Konishi, these techniques have been utilized widely in engineering analysis to optimize the performance characteristics within the combination of design parameters. Taguchi technique is also power tool for the design of high quality systems. It introduces an integrated approach that is simple and efficient to find the best range of designs for quality, performance, and computational cost.

In product or process design of Taguchi method, there are three steps:

1. System design: selection of a system for a given objective function
2. Parameter design: selection of the optimum levels of parameters
3. Tolerance design: determination of tolerance around each parameter level.

In this study, parameter design is coupled to achieve the optimum levels of process parameters leading to minimum surface roughness during the cutting of material.

In this study, Taguchi parameter design was used for identifying the significant processing parameters and optimizing the minimum surface roughness. Two important

tools used in parameter design are orthogonal arrays and signal-to-noise (S/N) ratios. Figure 1 demonstrates the steps of Taguchi parameter design

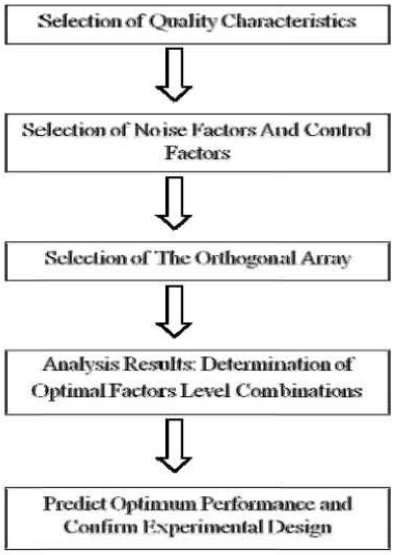


Fig. No.1 Steps of Taguchi Parameter Design

B. Selection of the quality characteristic

There are three types of quality characteristics in the Taguchi methodology such as the-smaller-the-better, the-larger the -better, and the-nominal-the-best. Signal to Noise analysis is designed to measure quality characteristic. It is given by

$S/N = -10 \log_{10} (MSD)$

Where MSD= Mean Squared Division

For the **smaller the better** characteristic,

$MSD= (Y_1^2 + Y_2^2 + Y_3^2 + \ldots\ldots\ldots) / n$

Larger the better characteristic,

$MSD= (1/Y_1^2 + 1/Y_2^2 + 1/Y_3^2 + \ldots\ldots\ldots) / n$

Nominal the best characteristic,

$MSD = [(Y_1 - m)^2 + (Y_2 - m)^2 + (Y_3 - m)^2 + \cdots\cdots)]/n$

Where Y_1, Y_2, Y_3 are the responses and n is the number of tests in a trial and m is the target value of the result.

C. Selection of Parameters and Their Levels

Roughness is often a good predictor of the performance of a mechanical component, since irregularities in the surface may form nucleation sites for cracks or corrosion. Roughness is measure of texture of a surface. It is qualified by the vertical deviations of a real surface from its ideal form. If these deviations are large, the surface is rough; if small, the surface is smooth. Roughness is typically considered to be the high frequency, short wavelength component of a measured surface.

The parameter mostly used for general surface roughness is Ra. It measures average roughness by comparing all the peaks and valleys to the mean line, and then averaging them all over the entire cut-off length. The surface roughness can be measured using a surface roughness tester machine, which is shown in Fig.2.

Fig. No.2 Equipment for Surface Roughness Measurement

The top 3 from the list of 9 qualified factors were selected for the study. To keep the size of the experiment small and study as many factors as possible, all factors were studied at two extreme ranges of values (2 levels). These factors and their levels are shown next.

Surface roughness is govern by various control factors such as

1) Current
2) Pulse on Time
3) Pulse off Time
4) Pulse width
5) Pulse interval
6) Speed
7) Applied Voltage
8) Wire speed
9) Wire Tension

The top 3 from the list of 9 qualified factors were selected for the study. To keep the size of the experiment small and study as many factors as possible, all factors were studied at 3 levels. These factors and their levels are shown next.

Notation	Factor Description	Level 1	Level 2	Level 3
A	Current (Amp.)	2	3	5
B	Pulse On Time (µs)	2	32	65
C	Pulse Off Time (µs)	5	8	15

Table No.5 Control Factors and Levels for EN-8 material

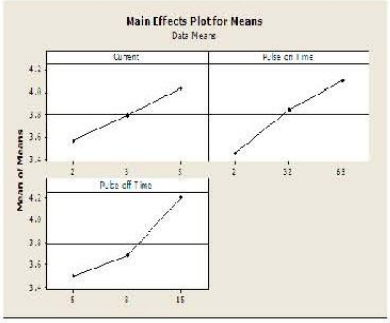
D. Selection of Orthogonal Array

Because there are only 3 3-level factors and no interaction is selected an L-9 array is used to design the experiment as shown below.

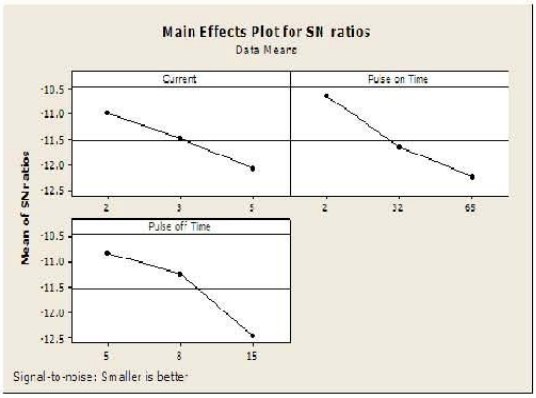
Table No.6. Layout for Experimental Design according to L9 Array

Exp. No.	A Current (Amp.)	B Pulse on Time (µs)	C Pulse off Time (µs)	Average	S/N Ratio
1	2	2	5	3.00	-9.5424
2	2	32	8	3.70	-11.3640
3	2	65	15	4.00	-12.412
4	3	2	8	3.05	-9.6860
5	3	32	15	4.32	-12.7097
6	3	65	5	4.00	-12.0412
7	5	2	15	4.30	-12.6694
8	5	32	5	3.50	-10.8814
9	5	65	8	4.30	-12.6694

for EN-8 material



Graph No. 1: Main Effect Plot for Average RA for EN-8 Material



Graph No. 2. Main Effect Plot for S/N Ratio for EN-8 material

Level	Current	Pulse on Time	Pulse off Time
1	-10.98	-10.63	-10.82
2	-11.46	-11.65	-11.24
3	-12.07	-12.25	-12.47
Delta	1.09	1.65	1.66
Rank	3	2	1

Table No.7 Response table for Signal to Noise Ratio of EN-8 material

Source	DOF	Seq. SS	Adj. SS	Adj. MS	F	P
Current	2	1.790	1.790	0.895	0.86	0.537
Pulse on Time	2	4.015	4.015	2.008	1.93	0.341
Pulse off time	2	4.425	4.425	2.212	2.13	0.319
Residual Error	2	2.077	2.077	1.038		
Total	8	12.307				

Table No.8 Analysis of Variance for Signal to Noise Ratio of EN-8 material

S = 1.0190 6 R-Sq = 83

R-Sq (adj) = 32.49 %

After machining of EN-8 material on EDM, it can be noted that Pulse off Time has the largest effect on the surface roughness. The current has the smallest effect on the surface roughness. To attain better surface finish, surface roughness has to be minimized. From above main effect plot, it can observed that for the three levels of peak currents the surface roughness is declining linearly and at current level 5 amp the Surface roughness value is the lowest (-12.07). Similarly Surface roughness also diminishes with increased levels of both, pulse on time and pulse off time. At pulse on time (65 µs) the SR value observed was the least i.e. -12.25 also for Pulse off time (15 µs) the smallest SR value (-12.47) was monitored. Thus the optimum condition for surface roughness observed were, A3, B3, and C3 i.e. Current (5 amp.), Pulse-on (65 µs) and Pulse off time (15 µs). Interaction plot fig 4.3 and fig. 4.4 which is the combination of all three parameters interacting with each other at different levels gives the idea that current, pulse on time and pulse off time had their considerable effects on EN-8 material surface roughness while machining with EDM.

E.Prediction Model

Regression analysis is used to find the mathematical model to predict surface roughness for the present work. In the model, Surface Roughness is assumed as function of Current, Pulse on time and Pulse off time. The relationship between surface roughness and other input variables is modelled as fallows.

The regression equation is

SNRA = - 7.93 - 0.354 Current - 0.0256 Pulse on Time - 0.167 Pulse off Time

SNRA = S/N Ratio of Avg. Surface Roughness

A = Current (Amp.)

B = Pulse on Time (µs)

C = Pulse off Time (µs)

The optimal level obtained by S/N ratio analysis is A_3, B_3, and C3

Sr. No.	Factors	Level Description
1	Current (Amp.)	5
2	Pulse on Time (µs)	65
3	Pulse off Time (µs)	15

Substituting these values in above regression equation

(SNRA)opt = - 7.93 - 0.354 Current - 0.0256 Pulse on Time - 0.167 Pulse off Time

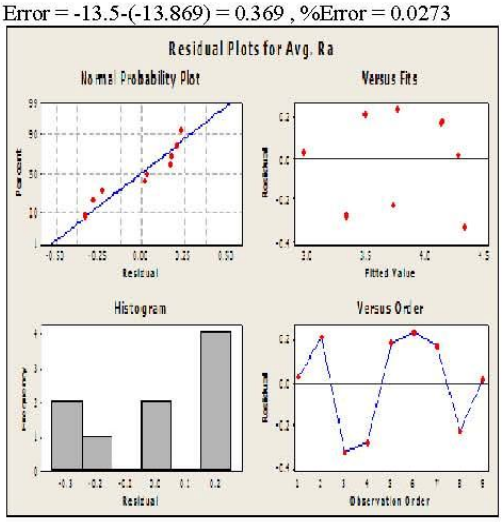
(SNRA)opt = - 7.93 – 0.354 * 5 – 0.0256 * 65 – 0.167 * 15

(SNRA)opt = -13.869 (Predicted by Regression Equation)

S/N Ratio of average Ra values obtained by validation experiment SNRA (actual) = -13.5

Error = (SNRA)actual – (SNRA)predicted

Error = -13.5-(-13.869) = 0.369 , %Error = 0.0273



Graph No. 3 Prediction and Residual Plots for SNRA for EN-8 Material

IV.CONCLUSION

The Taguchi method was applied to find an optimal setting of the Wire cut EDM process. The result from the Taguchi method chooses an optimal solution from combinations of factors if it gives minimized normalized combined S/N ratio of targeted outputs. The L-9 OA was used to accommodate three control factors and each with 3 levels for experimental plan selected process parameters are Current, Pulse on Time, Pulse off Time for both the materials i.e. EN8. The results are summarized as follows:

- Among the three process parameters for cutting of EN-8 material pulse off time has significant effect on Quality Characteristic.
- For EN-8 material maximization of Pulse off Time gives maximum surface finish of component.
- The Optimal level of process parameter for EN-8 material were found to be A3, B3, and C3 i.e. Current (5 amp.), Pulse-on (65 µs) and Pulse off time (15 µs).
- The predictions made by Taguchi parameter design technique are in good agreement with confirmation results.
- The result of present investigation are valid within specified range of process parameters
- The developed model gives the predicted values against the actual SNRA values. The residuals tend to be close to diagonal line indicating that the developed model is adequate, confirmation tests are conducted by using new conditions at optimal levels as obtained by using MINITAB Software.
- Also the prediction made by Regression Analysis is in good agreement with confirmation results.

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PRATIBHA: INTERNATIONAL JOURNAL OF SCIENCE, SPIRITUALITY, BUSINESS AND TECHNOLOGY (IJSSBT), Vol. 6, No. 1, January 2018
ISSN (Print) 2277-7261

A Review on Effect of Superconducting Fault Current Limiter on Power System

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ABSTRACT :
Now a days due to increase in electricity demand for the purpose of industrialization, agriculture, domestic and educational etc there exists more chances of fault occurrence. The Faults occurs due to insulation damaging, breaking of conductor, short circuit, lightning etc. Also the power generation capacity of electrical power systems has led to increase in the fault current level which can exceed the maximum designed short circuit rating of switchgear. Many conventional protective devices installed for protection of excessive fault current in electric power systems, especially at the power stations are circuit breakers, tripped by over-current protection relay. Till now we used various mechanical devices for protection purpose of a transmission line against fault like a relay, circuit breakers etc. But it is impossible to reduce the magnitude of fault current totally. So in addition to circuit breaker another electrical device is connected in series in a network called as superconducting fault current limiter i.e SFCL. The elimination of the fault current completely is not possible, but we can minimize the fault current in large amount by using SFCL.This superconducting fault current limiter (SFCL) is an electrical equipment which capability to limit the fault current level without affecting the performance of power system network. The application of the fault current limiter (FCL) would not only decrease the stress on network devices, but also can offer a connection to improve the reliability of the power system. This paper reviews the application of superconducting fault current limiter in power system and also shows the effect of superconducting fault current limiter on power system under fault condition.[1]

Keywords –fault, transmission line, power system network, protection, SFCL

I. INTRODUCTION

The best and usable method to reduce the fault current by reducing the investment of circuit breaker (CB) of high capacity and also of high cost, is the use of superconducting fault current limiter (SFCL). There exists various kinds of superconducting fault current limiters for limiting excessive fault current.

Basically there are three types of SFCL

- Resistive superconducting fault current limiter
- Inductive superconducting fault current limiter and
- Bridge superconducting fault current limiter

Some Bridge type limiter concepts have been developed too, but will not be include here.

Here we describes all the types of superconducting fault current limiter with it's resistive operating characteristics also. At the last we compare both the resistive and inductive superconducting fault current limiter. Given Fig.1 shows an arrangement of resistive superconducting fault current limiter (SFCL). When current exceeds it's certain limit then superconductor losses it's superconductivity and becomes normal conducting with infinite resistance. This resistive superconducting fault current limiter has capability to absorb most of energy of fault current and then keep it within a limit.[1]

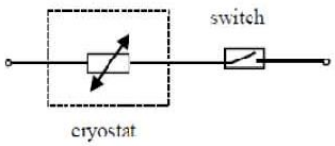

Fig 1. Arrangement of resistive SFCL

In the case of resistive type, the limiter is connected directly into the short-circuit current path and the normal load currents as well as short-circuit currents flow through the superconductor. Should the current exceed a certain limit the superconductor loses its superconducting ability very fast and becomes normal conducting ('quenches'). The corresponding increase in resistance effectively limits the fault current.Once the superconductor has gone normal conducting it heats up very fast due to Joule dissipation. To avoid overheating a mechanical switch opens the circuit within a few half cycles after occurrence of the fault. The limiting elements then automatically cool back to their

normal operating temperature and the superconducting state is regained. Thus the circuit might be closed again for continued operation. For resistive type limiters the recovery time is of the order 1 - 2s.
Some model-type resistive limiters have been developed so far. Siemens demonstrated a liquid nitrogen cooled 100kVA-limiter made of thin films of high temperature superconducting material . An 1 MVA unit has been already built and is being tested at the moment.[1]
The inductive-type superconducting fault current limiters (LSFCLs) mainly consist of a primary copper coil, as secondary complete or partial super-conductor cylinder & open magnetic iron core. Complete performance of these devices significantly depends on the optimal selections of its materials and dimensions of construction, electrical, magnetic, thermal, and parameters. It is important to identify a comprehensive model describing the characteristics of LSFCL in a power system prior to its fabrication. When any fault occurs, the dynamic model will characterize the overall phenomena to compare the simulation results by varying LSFCL parameters to maximize the merits of a FCL while minimizing its drawbacks. The principle object of this paper is to achieve a full penetrative approach of design of LSFCLs by means of multi criteria decision-making techniques. In principle the inductive current limiter is a kind of the transformer in which the superconducting material screens magnetic field of the primary copper winding from the iron core during normal operation. Therefore it is often called a 'shielded iron core'-type limiter in the literature. Contrary to the resistive limiter the superconductor is only magnetically coupled into the current path.[2]

Figure 2 shows the simplified electrical view of an inductive superconducting fault current limiter. This SFCL is like as a transformer having two windings. The primary coil has several winding turns and is normal conducting. While the secondary coil has only one turn and it is superconducting winding.

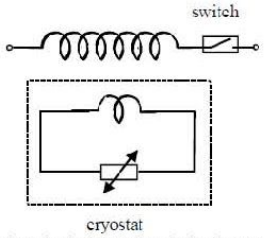

Fig 2. Electrical view of an inductive SFCL

When fault occurs in a system the current value reached to its peak value at the same time this maximum fault current induces in secondary winding, thus secondary winding loose it's conductivity and become resistive.

In this paper, the transient recovery voltage (TRV) analysis, based on electromagnetic transient program (EMTP), is used to investigate the behaviour of each three types SFCL installed in an electrical distribution grid. Simulation of TRV result developed In MATLAB/Simulink

This simulation result shows that TRV can be damped in the presence of resistive and bridge type SFCL during fault clearing period. The simulation has been carried out with a fault starting at t= 140ms. The circuit breaker has been opened after 1 cycle.Total simulation time was 200ms according to the circuit breaker opening time, and simulation step is 1μs. In this paper we studied the conventional solution for protection of power system, the whole introduction of SFCL with their characteristics. During fault in a system, a large amount of power flows through the grid which results in a failure of the electric supply. That's why protection of the system is an important. For that point of view SFCL i.e superconducting fault current limiter is implemented in transmission system. SFCL is an electrical equipment which has capability to minimize the fault current level, also reduce the stress of energy and mechanical energy loss on circuit breaker. This paper also include the applications of SFCL such as[3]

i) limit the fault current
ii) Secure the interconnector to the network
iii) reduces the voltage sag at distribution system.

The best and usable method to reduce the fault current by reducing the investment of circuit breaker (CB) of high capacity and also of high cost, is the use of superconducting fault current limiter (SFCL).
Here also explains the material details used for making SFCL. The use of superconducting fault current limiters (SFCL) in power system provides an effective technique to minimize the fault current. This SFCL is made of thin film of Yttrium Barium Copper Oxide (YBCO) which is of low cost. The metal organic deposition (MOD) method has been used for making SFCL. The (MOD) i.e metal organic deposition method can generate large Yttrium barium copper oxide (YBCO) thin film having with peak current density without technique of evaporation method.[3]

This paper also includes which electrical, thermal and mechanical properties posses by superconducting fault current limiter (SFCL).

- Zero impedance and power losses at normal operation
- Large impedance in fault conditions.
- Quick appearance of impedance when fault occurs.
- Fast recovery after fault removal.
- Reliable current limitation at determined fault current and good reliability.
- Negligible influence during normal operation
- Effective reduction of short circuit currents (well before the first current peak)

To select the optimal location of the SFCL, the sensitivity analysis of power changes and/or power losses in the system with respect to its resistive value occurred in series with a transmission line during a fault is introduced. Moreover, the optimal location determined by the proposed method is coordinated with the corresponding optimal resistive value of the SFCL to improve low-frequency oscillation damping performance of the system.In other words, the SFCL improves the transient stability of the power system by suppressing the level of the fault current sin a fast and effective manner. Moreover, even though it is the one of protective devices, it provides the system effective damping to improve its dynamic response, similarly to the other power controllers such as power system stabilizers or dynamic reactive compensator. It also has the additional advantages of causing no power loss in a steady-state condition without any system contingencies and providing an effective operation with auto recovery property within 0.5 s in case of a fault. In the past three decades, many studies on the application of high-temperature SFCLs to electric power systems have been carried out and various types of SFCLs havebeen designed until now. Moreover, the SFCL with good performance is currently being made in industry. To connect the existing SFCL to an electric power grid, the following important factors must be considered:[4]

- Optimal place to install the SFCL.
- Optimal resistive value of the SFCL occurred in series with a transmission line during a short circuit fault.
- Potential protection-coordination problem with the other existing protective devices such as re-closers and circuitbreakers.

From the results that the SFCL with the proper Rsfcl at the optimal location can improve the system dampingperformance most effectively when a severe fault occurs nearthat location. Moreover, it can reduce the level of short circuit currents in the overall system effectively even if the fault occursfar away from the optimal location. The remaining open questionis the protection-coordination problem with the existingprotective devices such as re-closers and circuit breakers. This issue is being investigated with the several case studies.[4]

Applications of SFCL in power system

1) Limit the fault current
2) Secure interconnector to the network
3) Reduces the voltage sag at distribution system

In electrical network, there are various faults, such as lightning, short circuits, grounding etc., which occurs large fault current. If these large currents are not properly controlled for power system security, there happens unexpected condition like fire, equipment and facility damage, and even blackout. Therefore, Circuit Breakers are installed and have the duty to cut off fault current, however, it takes minimum breaking time to cut, and sometimes fail to break. Fault Current Limiter (FCL) is applied to limit very high current in high speed when faults occur. Different with normal reactor, normal impedance is very low and have designed impedance under faulted situation. Fault limiting speed is high enough that it can limit fault current within 1/4 cycle. Also, this function has to be recovered fast and automatically, too.[5] Various FCLs are developed and some of them are applied in power system. Most typical FCL is to change over circuit from low impedance circuit to high impedance circuit. Circuit breakers and/or power electronics devices are used to control FCL circuits. Fuse or snubber circuits are used to protect high recovery voltage. These FCLs are attractive as it implements normal conductor, however, there are weak points such as slow current limiting speed and big size in distribution and transmission level as well. Superconducting fault current limiter (SFCL) has been known to provide the most promising solution of limiting the fault current in the power grid. It makes use of the characteristic of superconductor whose resistance is zero within critical temperature (Tc) and critical current (Ic). If fault current exceeds Ic, superconductor lose superconductivity and the resistance increase dramatically (called quench) and limit circuit current.In practice the SFCL might be used in distribution systems first. However, the function of the SFCL is only to limit the fault current at a chosen value until the conventional circuit breaker could eliminate the fault. An SFCL in series with a downstream circuit breaker could provide a fast and reliable means of reducing and interrupting increasingly higher short circuit currents. Transient recovery voltage and transient overvoltage are both remarkably damped and improved by the presence of the SFCL after the circuit breaker is opened to clear the fault. This will thereby extend the breaker's life span and increase the chances of quickly achieving successful fault current interruption. The SFCL can be regarded as a very useful apparatus, shielding the distribution system from voltage decreases .The SFCL design probably requires that the limited fault current be between three and five times the steady-state currentrating.[5]

If the bus-bars are coupled via a SFCL the short circuit power can be doubled. A further improvement can be obtained, if low impedance transformers in series with SFCLs are used. The most economical short-circuit-voltage of the transformers would be 10 %. By application of SFCLs

in the transformer feeders the admissible short-circuit capability of the substation can be obtained. In this way the short-circuit power of the station is increased to nearly three times in total. By this means also voltage-disturbing customers and high loadings can be connected directly to the MV station and the connection to the higher voltage level can be avoided. Compared to the investment costs for a connection to higher voltages level, e.g. the 110 kV grid, the installation of SFCLs in the way suggested will be an economical solution, reasonable costs for the SFCL presumed.[5]The power distribution system will be operated to a type of loop. In this case, voltage drops (sags) are severe because of the increased fault current when a fault occurs. If SFCL is installed in the loop, power distribution system, the fault current decreases based on the location and resistance value of the SFCL, and voltage sags are improved. Analysed according to fault. The results found that the voltage sags at loop distribution system is more severe than radial distribution system by the increased fault current. Moreover, the results of simulation represent the SFCL with bigger resistance is needed to improve the voltage sags in loop system. When SFCL is applied to a radial power distribution system. In case parallel connection of radial systems via the SFCL which can make voltage dips less severe .Results in this paper shows that the improvement of voltage sags caused by fault current decreased by installing fault current limiter.[5]

II. EFFECT OF SUPERCONDUCTING FAULT CURRENT LIMITER (SFCL) ON POWER SYSTEM

The effect of SFCL in a HVDC power system is described as.For this HVDC system the simulation studies were performed using Matlab/Simulink. From simulation results, we found that the maximum stress on HVDC CB could be decreased by applying SFCL and maximum fault current interruption time could be reduced. To study the effect of SFCL under fault condition the simple HVDC transmission line model consider. The specifications of the HVDC line are given as, the rated voltage is±100 kV, nominal current of 1 kA, nominal power flow is 100MW and the transmission line length of 50 km. When single line to ground fault is occurred on a HVDC transmission line at receiving end initially circuit breaker trip. The circuit breaker will tries to interrupt the fault current, at a same time transient recovery voltage appear across the contacts of circuit breaker. Due to this circuit breaker may fails to interrupt the fault current.For such a purpose SFCL means superconducting fault current limiter is connected in series with circuit breaker. When fault current attains it's peak value, SFCL loose it's superconductivity and it's resistance becomes very large. Thisinfinite resistance lowers the magnitude of fault current and keep it within limit. Thus the remaining system remains healthy.[6]

The resistive system has capacity to consume the fault current energy and thus improves the stability of power system as well as reliability also. By considering the fault current interruption in HVDC system with and without SFCL. The prospective value of fault current 14.9 KA.This value reduced to some amount then the value using MCB is 13.7 KA.Means there is only few reduction in fault current magnitude. By using SFCL there is great amount reduction in fault current i.e fault current reduces from 13.7 KA to 9 KA. There exists approximately 83% reduction in amplitude of fault current.[6]

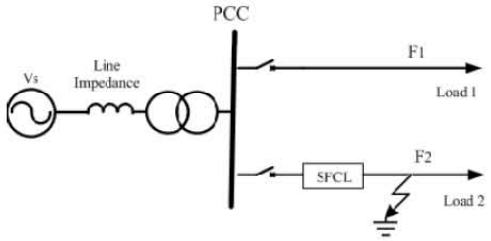

Fig. 3. Schematic diagram of study system

Most of the distribution systems have radial form. As a result in any branch of a radial system, power only flows in one direction. The distribution voltage levels are in the range of 10kV to 30kV. It can be expected that there will be interactions between the FCL and power system, if FCL is placed in the grid. A typical distribution system is represented in Fig. 5. The source impedance includes the transformer impedance and the upstream short-circuit impedance. Parallel feeders are connected to the Point of Common Coupling (PCC). The bus is supplied by a substation transformer from a 110 kV network. The upstream source system is modeled as an infinite bus and the source impedance is consists of an equivalent resistance and inductance connected to the local distribution

substation. The load is modeled as a lumped series R-L-C branch with a power factor of 0.886. A 3-phase short circuit fault is simulated at the load side, on feeder 2 (F2), as shown in Fig. 4. After one cycles, the circuit breaker opened to clear the fault. The circuit breaker is modeled as an ideal time-controlled switch with a parallel capacitance. This capacitance is the total capacitance of the source side circuit, which includes the stray capacitance of circuit breaker to the ground. The simulation has been carried out with a fault starting at t=140ms. The circuit breaker has been opened after 1 cycle.[2] The total simulation time was 200ms according to the circuit breaker opening time, and the simulation step is 1μs. When the circuit breaker attempts to interrupt the limited fault current, an over voltage is developed across contacts. This voltage is called Transient Recovery Voltage (TRV) of the circuit breaker. Circuit breakers may fail to interrupt fault currents when power systems have transient recovery voltage levels, which exceed the rating of circuit breakers. The Rate of Raise of Recovery Voltage (RRRV) is an important parameter in the power system operation. Electro-Magnetic Transients

Program (ATP-EMTP) was performed to determine the instantaneous values of the transient recovery voltage V_{CB} appearing after current zero and the current flowing I_{CB} through the contacts of the circuit breaker before current zero.[7] It is obvious that without SFCL the peak value of the fault current is maximum,which can damage the system devices. The TRV(transient recovery voltage) in the absence of the SFCL reaches a peak value approximate 24KV during 0.004s. The peak value of fault current is limited upto 800 A. SFCL achieves this function by losing its superconductivity and generating impedance in the circuit. SFCL does not only suppress the amplitudes of fault currents but also enhance the transient stability of power system .Up to now, there were some research activities discussing the fault current issues of smart grid. Hence, in order to solve the problem of increasing fault current in power systems having multiple micro grids by using SFCL technology is the main concern of this paper. The utilization of SFCL in power system provide them most effective way to limit the fault current and results inconsiderable saving from not having to utilize high capacity circuit breakers. With Superconducting fault current limiters (SFCLs) utilize superconducting materials to limit the current directly or to supply a DC bias current that affects the level of magnetization of a saturable iron core. Being many SFCL design concepts are being evaluated for commercial expectations, improvements in superconducting materials over the last 20 years have driven the technology [7]. Whenever ground faults occur, the ground fault current trips a ground over current relay on four wires, multigrounded neutral distribution systems. Due to this it can disconnect the energy storage from the grid. To reduce the fault current a SFCL is used in the appropriated location in the distribution system.[7] Superconducting fault current limiter is an innovative protection device which is used to reduce the magnitude of fault current in high voltage system. This paper explains the need of fault current limiter in present and future, because of increase in distributed generation. The fault current limiter proposed in the paper has the merit to meet the problem of voltage sags in distribution utilities with a solution that does not require control system and power electronic & also power capacity can be increased with out change in existing switchgear The simulation performed proves effectiveness as well as the possibility of building the 'FCL' with commercially available components. A superconducting fault current limiter (SFCL) is expected to be an ultimate automatic protection system against short circuit faults. A superconducting cable and superconducting transformer also expected to contribute to the system efficiency and stability.[8]

III Analysis of Energy Dissipation

Energy dissipation is the primary design parameter used to determine the breaking capability of CB. In this study, dissipated energies on SFCL and HVDC CBs were calculated. From (1), the measured current, voltage and total interruption time determine the dissipated energy across the HVDC CB:

$$E_{\text{dissipated}} = \int_{\text{t.fault}}^{\text{t.interruption}} P dt = \int_{\text{t.fault}}^{\text{t.interruption}} V_{\text{cb}} I dt \quad \text{---------- (1)}$$

where the V_{cb} is the voltage across HVDC CB during a fault interruption.

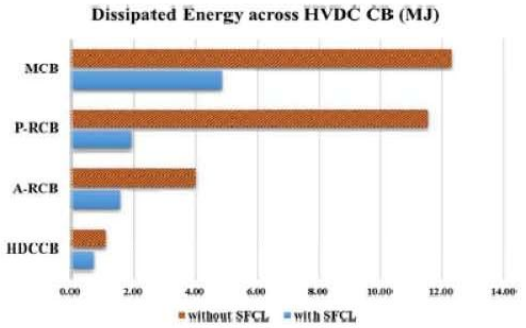

Fig 4. Comparison of dissipated energy across HVDC CB during fault

Fig. 5 shows the dissipated energy across the CB both with and without application of the SFCL. Without the SFCL, the highest energy dissipation was observed in the MCB due to interruption failure, and the lowest energy dissipation was observed in the HDCCB. By applying the SFCL, energy reduction was observed from all types of HVDC CB.[9]

III CONCLUSION

This paper shows the effect of SFCL (Superconducting Fault Current Limiter) on power system. With the application of Superconducting Fault Current Limiter (SFCL) there exists much reduction in magnitude of fault current, also the total mechanical energy stress on circuit breaker. This will extend the capacity as well as life of circuit breaker and power system stability improved too. Now SFCL are very attracted solution to limit the fault current. A resistive type SFCL (modelled in Matlab) has been installed at the key locations of the grid for all the four types of faults (3 phase, LG, LL and LLG). It has been observed that the SFCL should not be installed directly at the substation (Location1) and at the branch network (Location2) as this placement of SFCL results in the abnormal rise in fault current from the wind farm. Comparatively SFCL is much effective than conventional circuit breakers as it limits the fault current level approximate 83% of it's peak value. Paper shows the improvement of voltage sags caused by fault current decreased by installing fault current limiter.

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PRATIBHA: INTERNATIONAL JOURNAL OF SCIENCE, SPIRITUALITY, BUSINESS AND TECHNOLOGY (IJSSBT), Vol. 6, No. 1, January 2018
ISSN (Print) 2277-7261

Thermal Image Processing in Horticulture Sectors – A Review

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Abstract: Thermal imaging technology has a number of inherent benefits compared to traditional monitoring systems due to a non-contact, non-invasive and non-destructive process. In the beginning, thermal imaging was developed for military revolutions but well ahead extended widespread application in various sectors such as aerospace, veterinary, horticulture (agriculture), civil engineering and medicine. Thermal imaging technology being applied where temperature differences could be assist in evaluation, diagnosis or analysis of a process or product in all fields. Horticultural products include all products either raw or processed that arise from the horticultural industries and such products goes to market still respiring (fresh produce). The edible horticulture crops such as fruits and vegetables required inspection of quality changes at the postharvest period due to consumption by human being as a food. Potential use of thermal imaging technology in horticulture includes nursery and greenhouse inspection, plants disease recognition, pest exposure, fruit yield estimation, fruits ripeness evaluation, foreign body detection and fruits and vegetables bruise detection. This work reviews the fundamentals of thermal imaging processing and elaborates on the potential of thermal imaging in various in horticulture sectors.

Keywords: Thermal Imaging, Horticulture, Thermal Image Processing.

I. INTRODUCTION

Horticulture is the science and art of growing plants such as fruits, vegetables, flowers, nuts, culinary herbs and spices, beverage crops and medicinal as well as ornamental plants. It also includes plant conservation, landscape restoration, soil management, landscape and garden design, construction and maintenance and arboriculture.

India is prospective to record highest ever production of horticulture produce, including fruits and vegetables, in 2016-17. The total production is predictable at 295 million tonnes which is 3.2 % higher than the production in 2015-16. The estimate shows horticulture production in the country will outstrip the production of food-grains and in upcoming years as development and implementation of this new techniques use in horticulture sectors increase the production. The agriculture ministry also released second advance estimate of horticulture production, noting that the area under the horticulture crops has recorded an increase - from 245 lakh hectares in 2015-16 to 249 lakh hectares in 2016-17. As production is increases the export of this horticultural products are going to increase which deals with handling, transportation and quality maintenance up to the end user.

Horticulturists apply their knowledge, skills and technologies used to grow intensively produced plants for human food and non-food uses and for personal or social needs. Their work involves plant propagation and cultivation with the aim of improving plant growth, yields, quality, nutritional value and resistance to insects, diseases and environmental stresses.

The traditional methods of inspecting vegetation parameters are reliable; however, they are labour intensive, time consuming and limited for practical application in some regions. [1]

Several harms to tender saplings causes due to local climatic variations in the nursery arena and greenhouse. Early exposure of dampness and disease in nursery is very important to take early control measures. [2]

When plants goes through a stress period the normal growth process can be disrupted. Plants suffers different stress such as water stress, nitrogen stress, pest which affect chlorophyll production which causes loss and leaf colour change from green to brown which ultimately affect yield of fruits and vegetables. Estimation of crop yield gives the statistics about decrease in crop yield and evaluation of crop maturity is usually achieved by crop dissection and visual inspection which destructive method use for batch using sampling techniques. The present need is to reduce the number of toxic molecules permissible on the market under the 'Ecophyto 2018" strategy, which entails better control of disease outbreaks. [3]

Most of the horticulture products are consume as food by human being, hence continuous nourishment against disease and early detection of these products becomes supportive to implementation of corrective practice during preharvest and postharvest stages. The traditional methods show

inaccuracy and time consuming in in disease detection process.

Mechanical damages of fruits and vegetable due to handling, packing, transportation and insects' attacks in post harvesting results in economic losses for end users due to impaired appearance, increase microbial contamination and ripening acceleration. With the advancement in imaging technology using hyperspectral imaging have been reported for online detection of bruises on fruits and vegetables is feasible. [4]

Presently high demand of fruits in special season need additional stock of well quality and teste in markets and mostly fruit sellers uses calcium chloride and ethylene gas for fruit ripening which is dangerous to human health which affects legs and hands insensibility, damp and cold skin, weakness with low blood pressure and sometimes conduct miscarriage. So to evaluate fruit ripening process some techniques like thermal imaging is used. [5]

Different non-destructive techniques are being used for propagation, cultivation and seed quality assessment of this horticultural products such as machine vision, spectroscopy, hyperspectral imaging, soft X-ray imaging, thermal imaging and electronic nose techniques. These techniques are precise and consistent tools for composition prediction, quality rating, damage revealing, insect infestation detection and feasibility and also germ inability prediction of horticultural seeds. [6]

Thermal imaging process is a contactless, fast measurement methods for quality analysis of products. Due to dipping costs and upgraded operability, thermal imaging has advanced significant tool in engineering, medical research and other fields and this thermal image analysis has been used for physiological disturbances in harvested crops, the transpiration behaviour at the pre harvest stage of intact plant, stomatal conductance and behavioural study of individual cells. Thermal imaging is capable to detect temperature differences in leaves of standing cereal plants which caused by diseases and wind. [7]

This paper reviews the theories, technological advances and summarise potential applications of thermal image processing for quality evaluation of horticultural products during preharvest and post-harvest stages.

II. PRINCIPLE OF THERMAL IMAGING

Thermal imaging is conventionally perceived as an industrial tool. High equipment price and lack of training level necessary for applying effectively retains prevented its widespread use in this area. [8]

In the food industry, the thermal imaging (TI) seems to be an emerging, non-invasive diagnostic tool. The Infrared Radiation (IR) emitted by all objects which is invisible light band of electromagnetic spectrum with 0.75–100 μm wavelengths is basic principle of thermal imaging. Thermal imaging system develop a pseudo image of surface temperature dispersal by infrared radiation measurement emitted by body after recording temperature distribution. [9]

William Herschel in 1800 is invented infrared radiation generally known as electro-magnetism radiation. Stefan-Boltzmann law states that (Eq. 1), the total amount of radiation released by an object per unit area is directly correlated to the emissivity of the object and its temperature.

$$E = \varepsilon \sigma T^4 \qquad \text{.....(1)}$$

With E (w/m^2) the total amount of radiation emitted by an object per square meter at an absolute temperature of T (K), $\sigma = 5.67\times10^{-8}$ (w/m^2k^4), the Stefan-Boltzmann constant, and ε the emissivity of object ($\varepsilon = 1$ with an ideal black body and $\varepsilon < 1$ with other matter).

The temperature difference between defect tissue and sound tissue found to be small because of radiation emitted by fresh fruit and defected one is very little. Hence to highlight interest area in the image, some outside warmness is maintained before process is carried out. These methods used effectively for fruit surface infrared radiation measurement and analysis thermal properties. [10]

Thermal imaging principle is applied in horticulture sectors for monitoring and quality assessment. The radiation from any object directly proportional to emissivity and temperature of object and there is difference between radiation emitted by infected tissue and sound tissue which support the use the principle of thermal imaging in inspection of various horticultural products.

In Thermal imaging, a thermograph or thermal map of object surface is form using collection of number of point temperatures measured over area and processing. Thermal map with high spatial resolution is a dominant tool for visualising and analysing object with temperature differences. This system suitable for exploring quickly varying temperature

conditions because of image acquisition speed is high. [11]

Electromagnetic spectrum includes of radio waves, microwaves, infrared rays, visible light, ultraviolet rays, X-rays and gamma rays. All object above 0 K (−273.15° C) emit infrared rays and thermal imaging technique used for online applications. Thermal image captured by thermal cameras which has potential to measure highly accurate temperature and easy to handle. Temperature measurement of any selected region can be obtained quickly which is not possible with other temperature sensors and only measures spot temperatures. Temperature measurements repeatability is high and not require any illumination devices in thermal imaging like other methods. To get temperature resolution of 0.1°C old models of thermal camera has required cryogenically cooled sensors whereas now-a-days thermal cameras can operate at room temperature making these cameras user friendly and endorsing a rise in the use of thermal imaging in various fields. [12]

The author specified two techniques for obtaining thermal images as Passive and Active thermal image systems. Passive thermal image system extract features without external excitation of energy to object. Passive thermography has various applications such as medical judgement people surveillance at sight and effectively used for non-contact temperature evaluation of foods processing. Active thermography involves the thermal energy application to produce a thermal contrast between the object and background. Active thermography can be used to detect surface and sub-surface defects in food. [9]

The passive thermal imaging explains the temperature measurement of own radiation of the investigated body, while the active method is based on the sample excitation using energy into it, and thermal response measurement. Active approach is fully energetic process requiring different methods of image processing. [13]

All matter is emitting infrared radiation light as a result of blackbody radiation and is a function of its temperature, being able to accurately sense the IR radiation can allow us to create a thermal image using thermal camera. The difference in radiation emission by defected fruit and fresh fruits is very little and to inspection purpose; external excitation is necessary which is known as as Active thermography which helps to extract more features from thermal image during image processing methods.

2.1 Thermal Imaging System

Thermal imaging system is capable of catching moving targets in real time. The thermal imaging system mainly comprises thermal camera and image processing unit to extract features from thermal image.

The thermal imaging system consists of thermal camera equipped with infrared detectors, a signal processing unit and an image acquisition system, usually a computer. Role of infrared detector is to absorb the infrared energy of body and transform into electrical impulse which directed to the signal processing unit. This signal processing unit is used to interpret data into thermal image. Detectors plays key role in thermal imaging system because it converts the emitted energy into electrical signals which is proportional to the radiation amount falling on them. Thermal imaging devices classified as uncooled and cooled based on maintaining sensor temperature in thermal camera below 0°C or room temperature. In uncooled system, infrared detector elements enclosed in single unit which operating at room temperature having less image quality with resolution and inexpensive. In cooled devices, complete unit of detector has to be maintained below 0°C which has high resolution and measure temperature difference as low as 0.1°C but expensive. [12]

Fig. No. 1: Thermal camera FLIR SC620

In this application of thermal imaging system consists of Thermal camera FLIR SC620 (FLIR Systems, INC., US, Portland) system with a spectral response range from 7.5 µm to 13 µm and a temperature sensitivity of 0.04°C at 30° C. as shown in figure 1. [14]

FLIR SC620 system has features such as 640×480-pixel uncooled micro bolometer which can capture sharp pictures with high accuracy radiometric temperature readings. The range of temperature measurement of camera is in between - 40°C to 500° C and the accuracy is ± 2°C or ± 2% of readings. Camera was fixed on tripods 0.4 m away from the peach surfaces. FLIR Systems Inc. used for investigating the peach surface temperature and transform the thermal image into a suitable format for image processing. Image processing and numerical calculation were performed with Matlab 7.0

software which required computer for further processing of thermal image. [14]

The thermal camera selection for horticulture products is based on applications specific and environment. Features of thermal camera such as spectral range, camera resolution, temperature sensitivity and accuracy is governs the precise implementation of thermal imaging system for quality inspection of horticulture produces.

The figure 2 indicates general setup for Thermal imaging systems.

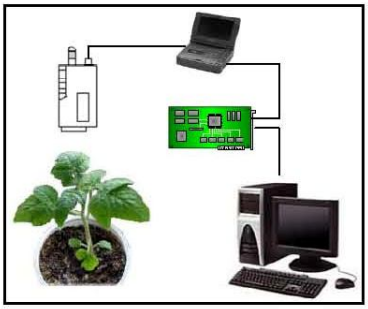

Fig. No. 2: Set up of Thermal Imaging System [15]

Typical thermal imaging system comprise the following components: Thermal camera, an optical system with focusing, collimating lens and filters, detector array – micro bolometers, signal processing unit and thermal image processing system – computers and image processing software. The updated technology of FPA sensor which has low cost and uncooled micro bolometers. [9]

III. THERMAL IMAGE PROCESSING

The image processing techniques plays key role in features extraction from thermal image. Thermal image processing can be done using computer software. This section reveals different stages applied in thermal image processing and its application done earlier.

Image processing techniques has been verified an effective machine vision system for agricultural and food domain. These imaging techniques suitable in defining the vegetation indices, irrigated land mapping, canopy measurement with greater accuracies and this accuracy varied reliant on the algorithm and image acquisition limitations. [16]

The contrast improvement of thermal images for highlighting interest area in the image carried out by thermal image processing. Compositional contrast between image pixels is display with greyscale or colour mapping with intensity scaling. The temperature of object measured by thermal camera is bundled with algorithm. Continuous increase in data load during active thermal imaging used for computerized image processing methods. Some of features like classification accuracy, precision, processing time, model complexity and easy of transfer can be used in thermal image processing. The comparative position of each performance characteristic will be decided on by specific application. The thermal image processing usually following typical steps: Image pre-processing, Image analysis, Image classification. [16]

Thermal image acquired by infrared camera in the afternoon was selected for analysis. Thermal image processing was done in IRBIS image processing software and image was separated from background for further processing. After image processing it is possible to detect maximum, minimum and average temperature in selected region in image processing software. [17]

The automatic image analysis offers flexibility for quality assessment of health and plant growth accurately. Mechanical devices incorporated with image analysis systems which is used for controlling machinery operations to replace human assessments. There are five important steps in image processing includes – Image recording, Pre-analyzing, segmentation, detection and classification. The image processing technique used for edges increment and making geometrical corrections before quality assessment of selected part of object. [18]

Thermal image processing provides automatic image analysis using thermal camera. Image processing techniques useful to detect the temperature range of horticulture products with segmentation and classification step.

The image fusion of thermal image recorded by thermal camera with visible image using digital camera of orange canopy scene is specified. In this study, the thermal camera is provided with software to compensate the acquired different properties of thermal images such as fruit emissivity, ambient temperature, relative humidity and reflected temperature. This software provide image in appropriate format for image processing. They had utilized image processing toolbox of Matlab software for thermal image processing and image fusion. [19]

The thermal imaging technology is also used for husk detection on single layer beds. Usually, thermal imaging method detect husk with 98.07 % accuracy. They had utilized image processing steps as sample preparation,

image acquisition and image analysis. Matlab 2012b software version is used for converting thermal image into final format required by end user for husk detection. [20]

The author specified methods of thermal imaging processing for passive and active thermography. The scientist keenly looking for processing sequence of thermal image. They specified step of Thermal image processing is Histogram and Image filtering, Thermal Image Signatures, Wavelet Transform, Image Classification. Recently different procedures from preprocessing with filtering, through histograms algorithm, up to advanced neural network applications and non-linear transform for image classification for thermal image processing had been elaborated. [13]

Thermal image processing is carried out for monitoring and validation of temperature of food which is usually an iterative process. The steps monitored in image processing are Image preprocessing – used to eliminate inessential information from thermal image and organize data for advance processing. Stages follows in pre–processing of thermal image consist of dead pixel correction, noise reduction, image filtering and deburring. The next step is image analysis and image classification based on specified characteristics. [4]

Thermal image processing reduces the cost and time of inspection process in horticulture sectors significantly by utilizing online processing technique with software. The software selection for image processing is solely depends on choice of user and region of interest. The basic steps to be followed in image processing are preprocessing, image analysis and classification.

Thermal imaging processing is applied for detection of contaminated fruits by toxic chemicals. The fruit sorting and quality analysis is done by image processing techniques. Processed followed for detection of toxic chemicals are as shown in following figure 3.

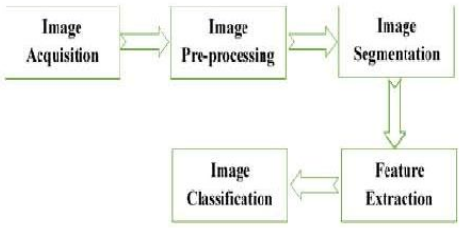

Fig. 3. Stages in Thermal Image processing [5]

Pre-processing, Classification and feature extraction are significant in image processing.

Stage 1: Pre-processing:

The transformation of thermal image into grey scale image with filtering and resizing of grey scale image followed in preprocessing to eliminate unwanted part of object in image.

The filtering process completed by using wiener and median filter. This filtering is used to reduce noise in grey scale image and good results displayed by median filtering algorithm during preprocessing. For improvement in features like boundaries or contrast, edge detection, noise depletion, pseudocolouring, magnification insertion is applied for enhancement in visual display of image analysis.

Stage 2: Image Segmentation:

Image segmentation is the essential phase in image processing which is used to separate region of interest (ROI) from image. These methods are categorized as Classification-based, Edge-based, Threshold-based and Region-based segmentation. The next stages in image processing such as analysis depends on image segmentation accuracy.

Stage 3: Feature Extraction:

Feature extraction are calculated from the images. Different thermal images show different extracted features have different value of mean, standard deviation, area and RGB. Normal and polluted images are classified on these features.

Stage 4: Classification:

Once feature extraction is over, classification of images completed by Artificial Neural Network (ANN). The feature extracted acts as input to ANN i.e. number of inputs nodes are identical to required number of features. User defining of ANN following hidden layer which authority to the nonlinear organizing of input attributes. [5]

IV. APPLICATIONS OF THERMAL IMAGE PROCESSING IN HORTICULTURE SECTOR

Thermal imaging play important role in quick identification of valuable individual genotypes diverse with variety of horticulture products. The previous work in development of thermal imaging advances its used for nurturing and quality assessment of horticulture products such as fruits and vegetables. Some of applications of thermal image processing are discussed as follows:

Thermal image processing is used to control temperature distribution in big Potato storage box. The thermal camera allowed to

control tuber surface temperature to attain the desire storage temperatures inside box. Thermal image data offers quick response on temperature changes, high resolution for temperature changes, also capability of measurement without any contact and provide online monitoring system. [21]

Automatic detection system for disease infected with powdery mildew fungus of Tomato plants using thermal image and stereo visible light images had been developed. The accuracy improvement in disease plants detection has been reported with extraction of novel features from images during image processing with depth information and thermal information using local and global statistics. It found that disease detection results are unstable and more sensitive to environmental conditions. [22]

The early bruises detection process in apple was considered using a system that combine hyperspectral camera and thermal camera. The captured image analysis is done by Principle Components Analysis (PCA) and Minimum Noise Fraction (MNF) and this method used to distinguish the infected and sound tissues of apple. Also depth along with position of damaged area of bruises of apple is provided by utilizing the fast Fourier analysis. [23]

During harvesting stage, for yield detection of fruit plants in orchard is laborious task and inaccuracy which leads to the development of new system for estimating number and diameter of apple using thermal imaging during growing season. This system captures the thermal images using thermal camera and image processing techniques with algorithm to measure the number of apples in orchard are used to overcome drawback colour imaging. [24]

The bruise defect in horticultural products often causes due to handling of fruits and bruises in tomato is difficult to visible. New system was developed with thermal imaging for detection of bruises in tomato with external heating using microwaves for 15 seconds gives support for bruise detection method. Bruises detection is observed by temperature differences between bruised tissue and sound tissues. By using the image processing, the colder temperature of bruised part and area enables to visible in images. [25]

The thermal cameras have slowly migrated into other fields wide-ranging as agriculture and horticulture areas especially for fruits and vegetables. The lowered prices of thermal camera helped in adoption of infrared viewing technology. Also advance optics interfaces with sophisticated software endure to increase the adaptability of IR cameras. These techniques used to identify defect, contusion during handling along with detection of fruit yield in canopy.

Apple monitoring system is developed for identifying decay fruits and its degree of decay under uncontrolled temperature conditions. The thermal images of apples were captured by thermal camera FLIR SC620 which indicates temperature difference between sound tissue and decay tissues after image processing using software Matlab7.0. This temperature difference used to find location of decay and its depth. [14]

Several methods had been used to detect health of plants leaves in nursery. The thermal camera is used to identify early detection of disease on leaves because more information can be extracted from thermal images. Thermal image of disease plant shows darker than healthy leaf due to drying of leaves and water is evaporated; hence shows lower temperatures in thermograph. [3]

Fruit yield detection in orange canopy improved by fusion of Thermal image captured using infrared camera and visual image captured using digital camera as compared to yield detection using any single methods. For accurate yield detection, this image fusion is processed in image processing software Matlab. [19]

Paddy harvested from farm contains impurities such as husk and this offers path to used thermal imaging techniques for husk detection in mixtures. The thermal image is captured by thermal camera FLIR E60, FLIR system and these thermal images were processed using Matlab 2012b software. External excitation using two lamps is provided to differentiate between husk and paddy which show darker shade for husk in mixtures. Results shows the mean pixel of seed thermal image higher as compared to husk. [20]

An online active thermal imaging system for early bruise detection was developed. This system comprises of heating and transport unit, bruise detection, apple rotation with orientation unit and control unit which analyse thermal properties of surface online in computer. The developed system shows 90% of defected apple recognised and 83 % of sound apple during test period. Proposed system has ability to distinguish of good apple with calyx. [10]

Many manual inspection processes used in horticulture divisions are time consuming and frequently influence accuracy due to human fatigue in spite of that application of thermal image processing in horticultural sectors provide numerous advantage along with quality assessment of perishable and mechanical

damaged products which are used as foodstuff in society. Implementation of these technique allowed to measure or observe in remote areas or hazardous for other methods. Rapid online usability is reason for fast growing demand of thermal imaging with image processing techniques in various horticulture field.

V. CONCLUSION

The review indicates thermal image processing techniques play vital role in malaise mapping and segregation of essential process and product in various industry and fast growing in horticulture sectors. The researchers are noticing the forthcoming of thermal imaging application in various practices in horticulture due to its various advantages. The image processing technique is the key factor for efficient working of this system used in particular application because it governs the end results of the inspection process; So we have studied the different steps used in thermal image processing especially for horticultural products such as fruits and vegetables.

Thermal image processing is currently used in some of applications and still in research stage. In some application, this system has possible to be online usability in the future. Thermal imaging systems are able to measure product properties associated with thermal processes which leads to the qualitatively new insights and thus make an influence on quality preservation of horticulture products.

Finally, this paper reviewed the basic concepts of thermal imaging and overall mechanism of the thermal image processing in quality inspection process along with common factors required for proper implementation of this system and some applications of thermal image processing for horticulture products such as fruits and vegetables.

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PRATIBHA: INTERNATIONAL JOURNAL OF SCIENCE, SPIRITUALITY, BUSINESS AND TECHNOLOGY (IJSSBT), Vol. 6, No. 1, January 2018
ISSN (Print) 2277-7261

Review on Comparative analysis of textured image classification using various techniques

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Abstract :

This paper presents the comparative analysis of texture image classification using three methods. Texture is a repeating pattern of local variation in image intensity. The texture provides information in the spatial arrangement of colors or intensities in an image, thus texture is a feature used to partition images into regions of interest and to classify those region. The content based image retrieval technique (CBIR) is very effective if classification of large scale general purpose image database into textured and non textured images is done. A technique to accurately classify the images into textured or non textured category is based on image features. In this paper we present three methods comparison purpose for classification of textured image. The third method is proposed method based on neural network method excepting that gives better accuracy for image classification.

Keywords- *Textured image, Support Vector Machines, Grey Level, Image segmentation, Wavelet transforms.*

I. Introduction

Texture classification is important in content based image retrieval (CBIR) system. The CBIR is technique for retrieving semantically relevant images from an image database based on automatically derived image features. Texture classification is concerned with identifying given textured region from given set of textured classes. The texture classification is basically classifying pixels in an image according to their texture cues .Three principles approaches used in image processing to describe the texture of region are Statistical ,Spectral, Support Vector Machines In this paper the following three methods were discussed

1. Classification of image using color and texture attributes.
2. Texture Image Classification Using Support Vector Machine
3. Texture Classification Based on Neural network and wavelet Transform

II. Classification of image using color and texture attributes.-In this method we propose an algorithm to improve the accuracy of this classification by employing wavelet transform for extraction of feature for monochrome as well as color images. We use an algorithm to classify a Photographic image as textured and non textured, using region segmentation and statistical testing. [1]

The algorithm uses well known LUV color space where L encodes frequency information (luminance). U and v encodes color information (chrominance).To obtain remaining three feature the Harr wavelet transform is applied to the L component of the image.[7] The k-means algorithm is used to cluster the feature vectors into several classes with every class corresponding to one region in the segmented image. The k-means algorithm is a well-known statistical classification algorithm The k-means algorithm is used to cluster the feature vectors into several classes with every class corresponding to one region in the segmented image. K-mean algorithm uses pixel wise segmentation instead of block wise segmentation.[3] After applying K-means clustering algorithm we obtain different classes. To classify images into the semantic classes textured or non-textured, a mathematical description of how evenly a region scatters in an image is the goodness of match between the distribution of the region and a uniform distribution. The goodness of fit is measured by the x2 statistics.
Textured and non-textured images are classified by thresholding the average x2 statistics for all the regions in the image.

$$X2 = 1/m \sum_{i=1}^{m} xi2 \qquad 2.1$$

Where Xi2 ---- statistics in region i (i= 1 …m)
X2 --- average statistics
Where Xi^2 =

$$\sum_{j=1}^{16} 16(p_{i,j} - \frac{1}{16})^2 \qquad 2.2$$

If $X^2 < 0.32$, the image is labeled as textured; otherwise, non-textured.
The histograms of X^2 for the two types of images are shown in Figure. It is shown that the two histograms separate significantly around the decision threshold 0.32. [3]

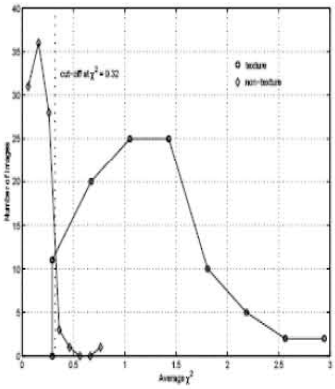

Fig.2.1 Textured Vs Non textured image
For general purpose images such as images in photo library, images on www (world wide web) etc automatic image classification for CBIR is difficult. In this method a wavelet transform based algorithm for computation of feature vector is proposed. We used a general-purpose image database containing 100 images of Dr. J. Z. Wang database. These images are pre-categorized into 10 groups: African people, beach, buildings, buses, dinosaurs, elephants, flowers, horses, mountains & glaciers, and food. All images have the size of 384x256 or 256x386. All images are stored in JPEG format.[1].

Simulation Result

Sr. no	Image no	X_1^2	X_2^2	X_3^2	X_4^2	X^2	Final Result
1	0	0.0448	0.0970	0.1111	0.2060	0.0765	Textured
2	4	0.1156	1.0572	0.7588	0.5204	0.4086	Non Textured
3	7	0.7242	0.4817	0.2200	0.3859	0.3020	Textured
4	17	0.8285	0.3974	1.2917	1.3316	0.6415	Non Textured
5	19	0.9563	0.3261	0.2291	0.5496	0.3435	Non Textured

Table 2.1 The Image and final result by using X^2

Fig 2.2 Sample images

The image database is downloaded from website http//www.DB.Standford.edu/Image. Further statistical method is used for the classification of images into textured or non textured classes so that the search domain for the CBIR is reduced. The algorithm is compared with the standard method and found to classify the images with good accuracy
From this method it is concluded that an algorithm for classification of images into textured/Non-textured images is implemented.
The limitation of this method is this algorithm classify only image and to improve the segmentation and classification accuracy, the

study of using the shape features into account during pixel clustering and similarity distance computation can be considered. Also it doesnot provide any information about Contrast, Correlation, Energy, and Homogeneity for texture classification .This can improve by support vector machine (SVM) technique that is discussed in second method.

III. Texture Image Classification Using Support Vector Machine- Texture is defined as a pattern that is repeated and is represented on the surface or structure of an object. To separate textures into a single texture type, first we need to preserve spatial information for each texture. For instance, the manual grey level thresholding which does not provide the spatial information for each texture that could generate in appropriate segmentation result. Grey Level Co-occurrence Probabilities (GLCP) statistics are used to preserve the spatial characteristics of a texture. The selection of certain texture is possible based on the statistical features. The best statistical features that are used for analysis are entropy, contrast, and correlation. However, further analysis in shows that correlation was not suitable for texture segmentation. GLCP statistics can also be used to discriminate between two different textures. Boundaries can be created from the shift on statistical feature while moving from one texture to another.[2]

Support Vector Machine (SVM) is a type of training method which is used to separate extracted features by creating a separating hyper plane . SVM have been proven to overcome the local minimum that happens in Neural Networks (NN) training algorithms. Thus, SVM provides a better performance in terms of accuracy for classification and regression. In imaging, SVM is modified to do several classification tasks, such as pattern recognition, in edge detection, in texture classification and video classification. SVM serves as complement for image segmentation methods.

A. METHODOLOGY

This method considers the problem of texture classification only for a gray-level case which is conventionally tackled in two stages of feature extraction and classification.

B. GLCP Feature Extraction:

GLCP is a discrete function that represents joint probability, Cij, of different sets of pixels having different grey levels, and is defined by

$$C_{ij} = \frac{F_{ij}}{\sum_{i,j=0}^{G-1} F_{ij}} \qquad 3.1$$

where Fij is the co-occurrence matrix constructed by the frequencies of two grey levels of two relational pixels. G represents the grey level quantization. The distance between two relational pixels is set to become 1 for micro-texture analysis. The common angle is either 0°, 45°, 90° or 135°. To reduce the computation time in GLCP feature extraction, we set a window size, M×N or a block of pixels as one feature value. [2]

C. SVM Classification

The purpose of SVM is to map feature vectors into a higher dimensional feature space, and then creating a separating hyper plane with maximum margin to group the GLCP features. Support vectors (SVs) contain highlighted pixels that help to create the margins or boundaries in an image. The higher dimensional space is defined by a kernel function. The kernel functions that we used in texture discrimination are shown in Table 3.1.

Kernels	Formula
Polynomial	$k(x, x') = (x, x')^d$
Gaussian Radial Basis Function (GRBF)	$k(x, x') = \exp(-\frlac{\|x - x'\|^2}{2\sigma^2})$ where $\sigma > 0$
Exponential Radial Basis Function (ERBF)	$k(x, x') = \exp(-\frac{\|x - x'\|}{2\sigma^2})$ where $\sigma > 0$
Sigmoid(Multi-Layer Perceptron (MLP)	$k(x, x') = \tanh(a(x, x') + r)$ where $a > 0$ and $r < 0$
Odd order B Splines	$k(x, x') = B_{2p+1}\|x - x'\|$ where $B_n := \otimes_{i=0}^{n} I_{[-1,1]}$

Table.3.1: Kernel functions for used in SVM training [2, 9]

D. Simulation Result:

In this SVM method the dataset is 15 types of texture images which are retrieved from bordatz database [13]. Each type of texture image consists of 9 equal size samples. Texture images are rice, oriented rattan, handmade paper, fur image, pressed cork, grass, straw etc. All images are stored in PNG format. The texture image database is downloaded from website:

http://perso.telecom-paristech.fr/~xia/invariant_texture/invariant_texture_brodatz/Brodatz_re.html

The sample image is shown

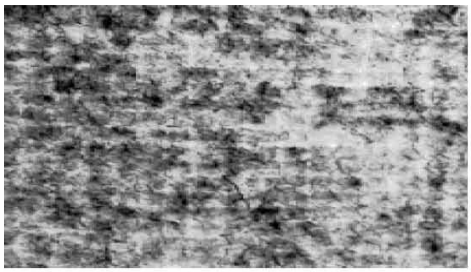

Fig.3.1 Sample image 1_1.png

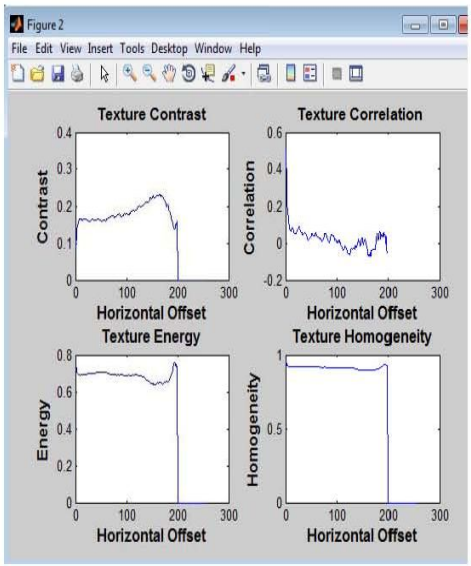

Figure 3.2: The graph of GLCP statistical features generated from figure3.1

In this method the texture related parameters like contrast, correlation,enerry and homogenety are calculated and depending on these parameter the image classification is done.

From above table it is shown that, for multiclass classification RBF(Radial basis function) provide maximum correct classification rate. Therefore more multiclass classification kernel choose to be Radial basis function, it is shown in table 3.2.

Table 3.2: Experimental results for accuracy that can be achieved in Developed System [2]

Sr No.	Kernel parameter	Classes	Accuracy %	training sample	Time (Sec)
1	Linear	2	100	10	79.45
2	RBF with c=128,g 0.125	5	90	25	161.19

Where c = set the parameter c for regularized support vector classification,

g = set gamma in kernel function.

From table 3.2, Experimental results shows accuracy for multiclass classification by selecting kernel RBF with **c =128,g = 0.125**.[2]

Figure 3.3 shows graph for Accuracy versus number of training samples per class. The average accuracy is achieved 80%.

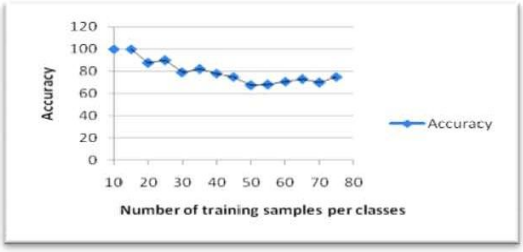

Figure3.3 Accuracy of texture classification of SVM system [2]

From this method it is concluded that an algorithm for texture image classification using support vector classification is proposed and implemented. This algorithm classifies texture images using GLCP and SVM as a feature extraction and classification. SVM can be considered as a modern classification approach which features a lot of benefits, such as kernel trick and soft-margin classifiers.

The drawback of this method is classification accuracy get reduced as training sample increases as well as execution time is also increased.

IV. Texture Classification Based on Neural network and wavelet Transform

In this method neural network and discrete wavelet transform is used for classifying textured images.[7]

The multi resolution analysis is applied to textured images to extract a set of intelligible features. These extracted features, in the form of DWT coefficient matrices, are used as inputs to four different multilayer perception (MLP) Neural Networks and classified. This is proposed method for texture classification. We expect that higher classification accuracy can be obtain as we increase training sample.[12]

The author Mazin Z. Othman et.al Proposed Classification of White Blood Cell for microscopic images using neural Network [14].

The author made conclusion using neural network as classifier that The proposed neural network classifier has better classification accuracy with less number of features relative to the number of classified WBC types. As a future work, the authors would like to focus on using these WBC and RBC images to increase the capability of diagnosing some popular regional blood diseases. [14]

Neural Network as a Classifier-The feed forward neural network, and a description of the back propagation learning algorithm is given, which is very help full for classification of texture. The basic building block of an artificial neural network is the neuron. The connection weights between neurons are adjusted. The neuron receives inputs opi from neuron ui while the network is exposed to input pattern p. Each input is multiplied by a connection weight wij, where wij is the connection between neurons ui and uj. The connection weights correspond to the strength of the influence of each of the preceding neurons. After the inputs have been multiplied by the connection weights for input pattern p, their values are summed, net pj. Included in the summation is a bias value □j to offset the basic level of the input to the activation function, f (net pj), which gives the output opj.[12] Figure 4.1 shows the structure of the basic neuron.

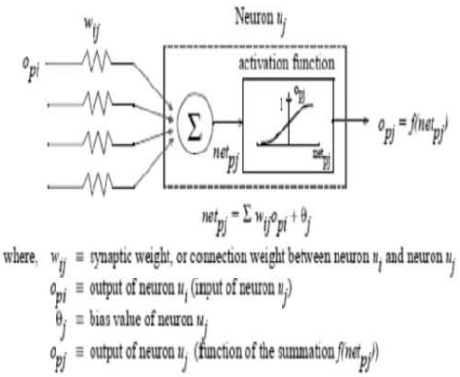

Fig 4.1 Basic Neuron

An artificial neural network is a system of processing elements (PE) interconnected by various synaptic strengths Recently, they have become popular classification devices for both one-dimensional and two-which use a gradient descent learning algorithm called back propagation (BP) and a topology called multilayer perceptron (MLP) have been the most dominant structure for classification purposes. Back propagation uses a squared error cost function which expresses the difference between the actual and desired responses of the network.

In this method the features are extracted using Discrete Wavelet Transform (DWT) is proposed. The spatial-frequency information which a DWT contains is ideal for classifying such images as textures. The four separable sub matrices at any given resolution level: low low(LL), LH, HL, and HH. [7]

The block diagram for proposed method is as shown in fig 4.2.[12]

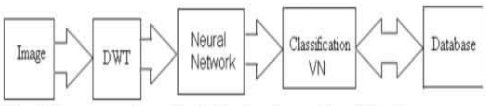

Fig.4.2 Proposed method for Texture Classification Based on Neural network and wavelet Transform

From this proposed method we are expecting better classification rate reducing execution time.

V. Conclusion

From above comparative analysis it is concluded that in first method, algorithm classify only image as texture or non texture .It does not provide any information about texture. So we use second method of SVM . In this method algorithm classifies texture images using GLCP and SVM as a feature extraction But drawback of this second method is as training sample increases the classification accuracy of texture image get redued so to over come this drawback we proposed the third method in which we will try to improve the classification accuracy by using neural network and discrete wavelet transform.

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PRATIBHA: INTERNATIONAL JOURNAL OF SCIENCE, SPIRITUALITY, BUSINESS AND TECHNOLOGY (IJSSBT), Vol. 6, No. 1, January 2018
ISSN (Print) 2277-7261

Design and development of Human Powered electric Generation machine

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ABSTRACT :
Human powered generators have been of interest at many places where no other alternative electricity generator has been available. While using pedal power is not a new concept in itself, it has not been successfully used on wider scale. Power generated by human can be converted from mechanical to electrical energy by using either a dynamo or an alternator. This principle can be extended to power mobiles, iPods', laptops home appliances etc. Power can also be generated from the human efforts or human energy. This human energy can be given to the driving wheel and with this driving wheel to alternator can produce the power and finally we can use this power for different applications like as early as stated. In this paper we proposed one new system for generating the power with the help of this system the person can maintain a good physic and along with it power can also be generated. This paper presents methods to generate electricity by pedaling. It also explains in detail the method using alternator to generate the power.

Keyword --- Human Power, Economic trend, Eco-Friendly.

1. HISTORY

India is the second most populous nation in the world. Like many other countries where agriculture is the main activity, biomass and other non-commercial fuels constitute around 40% of energy requirement in India. Around 85.49% of Indian villages are electrified; many will not be electrified for considerable time. The consumption of electricity in the country is increasing at the rate of 10% per year. The energy usage has been increasing through years, but there has been no sufficient increase in the production.

2. INTRODUCTION

Throughout history human energy has generally been applied through the use of the arms, hands, and back. With minor exceptions, it was only with the invention of the sliding-seat rowing shell, and particularly of the bicycle, that legs also began to be considered as a "normal" means of developing power from human muscles. A person can generate four times more power (1/4 horsepower (hp)) by pedaling than by hand-cranking. At the rate of 1/4hp, continuous pedaling can be done for only short periods, about 10 minutes. However, pedaling at half this power (1/8 hp) can be sustained for around 60 minutes. Pedal power enables a person to drive devices at the same rate as that achieved by hand-cranking, but with far less effort and fatigue. Pedal power also lets one drive devices at a faster rate thanbefore, or operate devices that require too much power for hand-cranking.

Over the centuries, the treadle has been the most common method of using the legs to produce power. Treadles are still common in the low power range, especially for sewing machines. Historically, two treadles were used for some tasks, but even then the maximum output would have been quite small, perhaps only 0-15 percent of what an individual using pedal operated cranks can produce under optimum conditions.

However, the combination of pedals and cranks, which today seems an obvious way to produce power, was not used for that purpose until quite recently. It was almost 50 years after Karl von Krais invented the steerable foot-propelled bicycle in 1817 that Pierre Michaud added pedals and cranks, and started the enormous wave of enthusiasm for bicycling that has lasted to the present.

The main use of pedal power today is still for bicycling, at least in the high-power range (75 watts and above of mechanical power). In the lower-power range there are a number of uses of pedal power--for agriculture, construction, water pumping, and electrical generation--that seem to be potentially advantageous, at least when electrical or internal-combustion engine power is unavailable or very expensive.

3. METHODOLOGY AND DESIGN:

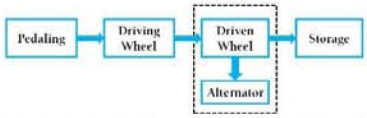

Fig 2.1: Block Diagram of Overall Design

This paper has various different design paths to complete our product while meeting the majority objectives. This means we will have to implement and compare our different designs to insure the best product based on our set of objectives. These paths have changed as we progressed through our project, and there were a few foreseen methods that we expand upon in the design section.

Fig 2.2: Actual view of bicycle and bike stand

The basic design for the bicycle powered generator is to have a bicycle on a fixed stand, and then when the bicycle is pedaled, the spinning motion of the rear ring is used to produce mechanical energy directly into a DC voltage. If an AC voltage is produced, a full bridge rectifier will be necessary to produce the DC voltage. This DC voltage can then be used immediately or stored via a battery array. If a constant DC voltage is required by the user a DC-DC converter may be necessary to change the varying DC voltages produced from the varying bike speed to a constant DC voltage for certain utilities or battery array. The first decision is selecting a bill of materials for each design path. This will help determine the ultimate product affordability. We must decide whether to use an alternator or dynamo to convert the bicycles mechanical energy to AC or DC, respectively. While an alternator is easier to find and purchase with many functioning units available in scrap yards, they also tend to be less efficient in the output of DC power compared to a dynamo. Another design factor that must be implemented and compared is the coupling of the bicycle wheel to either the alternator or dynamo rotor. One option is to use two contacting wheels to connect the two components. This option is a bit simpler to implement and take very little upkeep to maintain; however, the efficiency of the contact is relatively low due to slippage losses and frictional losses. A more efficient yet expensive design would be to have the wheel and the alternator/dynamo be connected via a rotary belt, similar to a car belt system. There are bound to be various other obstacles and design methods to be implemented as the project progresses, and will be observed and recorded as they occur.

3.1 Alternator Antis:-

Having bought our first alternator from Baheti Motors, Jalgaon, we tried to figure out how an alternator works. After a few discussions with experts and a web search, we determined that there are four connections that must be made to an alternator:

1. Ground (the case),

2. Positive (a post coming out of the top of the alternator),

3. The alternator's field, and

4. The alternator's regulator.

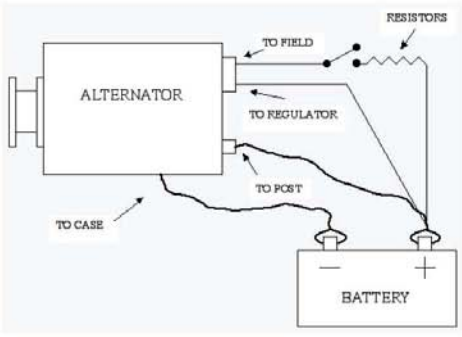

Fig 2.3: Battery Charging System Wiring with Alternator

During operation, charge flows from the alternator to the battery through the positive post. The field is connected to an indicator light or resistor and then to the battery's positive terminal. This supplies the initial charge that the rotor needs to produce electricity. It should only be connected during

operation (to avoid running the battery down) and, in a car, is connected through the ignition switch. Once the alternator is running and producing electricity, the current to field is internally supplied, and no current flows from the battery to the field. The regulator connection is made to the battery's positive post as well. The regulator connection does not draw current, but acts as a kind of internal circuit attempts to keep the voltage difference between the regulator connection and ground at 14.4V, the optimal charging voltage for a 12V battery. It does this by regulating the current owing to the internal field connection. At first we wondered why a third and separate connection to the battery's positive terminal was needed for the regulator. However, we realized that this allows voltage drawing components (such as diodes or other devices) to be placed in series with the battery without changing the 14.4V placed across the battery terminals. The real question was whether an alternator could successfully be run outside of a car at speeds lower than the typical car idle speed. We bought a new alternator from a Maruti Suzuki 800 (the ubiquitous Jalgaon taxi) for about Rs.4000. It is run of the car engine with a gear ratio of about 3:1.

The taxis apparently idle at a speed of 700 rpm, which means we needed 2100 rpm at the alternator to replicate slowest conditions. The alternator pulley has about a 2" diameter, giving us a 13:1 ratio between the bike wheel and pulley. With estimated bicycle speeds at 6090 rpm, we would get about 1000 rpm at the alternator well below its typical idle speed. We used the stationary bike in our \lab" to conduct tests on the alternator. Results were very much mixed, as there were a wide variety of variables we had to contend with in testing alternator performance. For one, we began by using the low quality wire that is readily available in Jalgaon to connect the battery to the alternator. Eventually we determined that the wire was interfering with current flow and our tests. We replaced it with cable from Prakash Cable, which is used to electrically wire houses. Secondly, the alternator regulates voltage only, not current. At a set voltage, the current is determined by the state of charge of the battery. We were using old used car battery. At a steady voltage, the current would vary by well over an amp, and it was difficult to determine how much power we could expect from the alternator at bicycle speeds. It took us a while, but eventually we convinced ourselves that the current variation was a product of the battery, and not the alternator being run at low speeds. If the alternator is generating 14.4V, increasing the rpm does not affect the output power. The real problem we encountered with running an alternator at low speeds was with the current flowing from the battery to the field connection. In a car, the field connection is wired from the positive terminal of the battery, then to the ignition switch, then to a small incandescent warning light, and then finally to the alternator.

The ignition switch is easy to duplicate with a small mechanical switch. The incandescent warning light, however, is a bit more complicated. In addition to serving as a warning to the driver (current owing to the field from the battery signifies that the alternator is not charging), this light also limits the amount of current that can flow to the field connection. In an alternator, electricity is produced by a combination of current owing through the field and the rotation of the rotor's coil. Initially, more current or more rpms means more electricity. Initially, this electricity is entirely unregulated. The incandescent light fixes the current at 0.15A through the field. With this amount of current, a fairly high rpm is needed before enough electricity is generated to turn the alternator on. It will not function in any way before a threshold speed. This threshold speed will be lowered if more current initially flows through the field. In this case, a lower rpm will produce the same amount of electricity and turn the alternator on at a lower speed.

At first, we just shorted the field connection directly to the battery's positive terminal. There are two reasons this should not, in practice, be done. The first is that this results in a very large current flow. We measured 3A owing through the field connection with the car battery connected. Although the current flows only for a brief period of time, it can be too great for a lesser quality alternator to handle, and can blow the field coil apart. Over the course of our experiments, we purchased 3 alternators: 2 good quality and one of poor quality. The lesser quality alternator was damaged beyond our ability to repair it after shorting the field coil to the car battery. The second problem with connecting the field directly to the battery is that it produces a very large electromotive force (emf), which acts counter to the motion of the rotor. It is very difficult to initially turn the alternator with such a large current owing through the field. In the lab, this meant that we had to pedal the stationary bike very hard initially to overcome the emf. This was further complicated by having to increase the belt tension to prevent slippage. Once the alternator started, however, we were able to resume normal pedaling with normal belt tension. At the ghatta, this was even more problematic. While we could put charge into a very dead motorcycle battery (which could not source

much current at all), we could not charge a car battery. There was not enough force to get over the initial induction hump," as we called it, and the stone ground to a halt against the load of the alternator. (During this test, we again learned the importance of welding the bike rim directly to the piece connecting it to the shaft. We had drilled and threaded a hole into the metal. This was _ne for a while, but eventually the strain was too much, and the threads failed.) The trick to charging a full car battery was to find the right combination of resistors to replace the light. Too low a resistance, and the bicycle would never be able to get over the induction hump of the electromotive force. Too high a resistance, and the alternator would never turn itself on at bicycle operation speeds. The resistors also had to be rated for the amount of current owing through them, which in reality meant using several resistors in parallel to share the current flow. Key Lessons Learned from this Test:

- Never use substandard wires when trying to do electrical work.
- The amount of power a battery draws during recharging is determined not only by the voltage placed across its terminals, but also the \state of charge" of the battery.
- Alternators can be operated at speeds lower than a car's idle speed (although efficiency probably decreases).
- The amount of current owing to the alternator's field coil determines when the alternator will turn itself \on" and begin producing current.
- The amount of current owing to the alternator's field coil will equally determine how difficult it is to overcome the coil's electromotive force and begin turning the rotor.

4. TESTS & TRIBOLOGICAL & ERGONOMICAL ASPECTS IN DESIGN

4.1 Importance of Ergonomics in Bicycle Design

When designing bicycle generator, many factors are considered: speed and maximum efficiency; space; ease of maintenance; cost. Creativity is the key for any design process. A design process, which is usually complex, is best simplified by inculcating creative design ideas. Thus it is of extreme importance that the ergonomic design is highly interdependent on the design factors. Ergonomics are implemented in every form of engineering design. It is of paramount importance that ergonomic factors are taken into consideration while designing a product. Human factors play a crucial role in the productivity of any activity. For example, for a person working on an assembly line in a automobile company needs to have all the available components for assembly at the right distance and the tools should be located at the correct places to avoid tangling of hands, moving from place to another. If these ergonomic considerations are made the worker would be enabled to make the assembly faster and therefore improving the overall efficiency of the company.

This field of ergonomic design has spread to all areas including computer desktop's, cell phone software, pens, banking, housing and farming sectors.

Ergonomic design means irrespective of the type of product and its function, evaluating it in terms of maximizing the interaction between product and user to make it more appropriate for use. The principles of ergonomic design are considered in five levels [16] are determined below.

- In the first level an equipment/ machinery must be safe while in contact with human beings.
- In the second level an equipment/ machinery must not produce harmful effects in human beings over longer periods.
- In the third level an equipment/ machinery must be physically comfortable that is, it should not require excessive efforts, both physical and mental or visual.
- In the fourth level an equipment/ machinery should provide mental satisfaction i.e. give a feeling of pleasure to the human being using the same. This must also include the cost price of the equipment against the function of the same.
- The fifth level is the determining the degree of modernity of an equipment/ machinery ergonomic considerations must constitute an essential factor of the social protability of the equipment/machinery. Even at the stage of establishing the design assumptions of an equipment/ machinery it is necessary to introduce both ergonomic requirements and limitations.

4.2 Ergonomic Solutions

4.2.1 Lateral Movement of The Seat

In the vast diversity of the human race there are people of different heights and it is not possible that

a single non customizable design would satisfy all the ergonomic requirements of everyone. Hence to solve the problem of high trunk inclination and improper hand posture a laterally movable seat has been proposed.

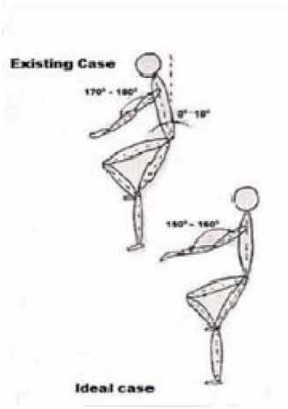

Fig 3.1: Optimum position of the hands while riding

It was identified that that the most comfortable elbow position of the rider is between 1500 and 1650. So in order to maintain this angle for the rider the need of the laterally adjustable seat is shown in Fig. 4. The seat has three modes of adjustment from which the rider can choose according to his/ her height [14].

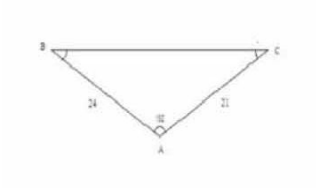

Fig 3.2: Hand position in First mode

Height of the Rider	Optimum Seat Height
1.60 m-1.68 m	0.43 m
1.68 m-1.75 m	0.48 m
1.75m-1.85 m	0.54 m

Fig 3.3: Optimum Seat to Handle Distance in various modes

4.2.2 Design of Foot Pedal

The design of the pedal is important as it is the part which the driver has to put the force in order to drive the bicycle. When the force is applied on the pedal there is an equal and opposite force which is acts on the foot. In the standard bicycle the pedal is designed in such a way that the total force is exerted at the toe of the foot. If the bicycle is pedaled for a long time then the stress concentration on the toe would cause pain to the rider.

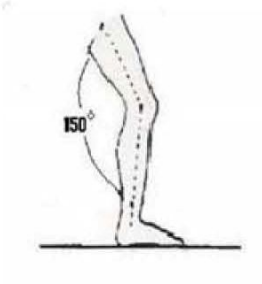

Fig 3.4: Angel between Legs

In order to solve this problem the pedal has to be designed in such a way that the force is evenly distributed on the foot. The proposed design of the pedal is like a foot rest so that it more convenient for the rider to ride the bicycle. The foot rest is also designed using acupuncture data to ensure good blood circulation.

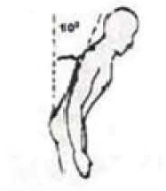

Fig 3.5: Trunk Posture

The most desired angle between the calf and thigh of the rider for comfortable sitting position is 1500. It was observed that the angle between the thigh and the calf is 1500 of more number of positions than the regular pedal of the normal bicycles [6].

5. TESTS & PLANNING

5.1 Planning

The test plans for the power generating bike include laboratory testing and field testing. We had two sizes of Maruti Suzuki 800 alternators available for the project: the 20 amp model and the 40 amp model. The nominal current outputs for the two types can be seen in Figure 4.3. We used the 20 amp alternator in laboratory testing and the 40 amp model was attached to the bike stand. The available DC motor was also testing in the laboratory to determine its output characteristics based on RPM.

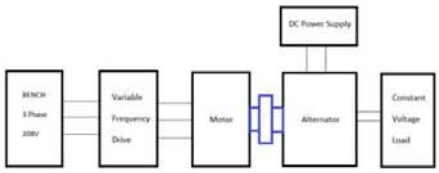

Fig 3.1: Alternator Bench Setup

In order to be able to record accurate data for the alternator we decided to use an induction motor as a prime-mover in the laboratory. The motor was run by a Variable Frequency Drive (VFD), which allows for precise control over the RPM of the alternator in order to understand the outputting characteristics of the motor based on the RPM. This also has the added benefit in we could measure the input power and hence calculate the efficiency of our alternator. The basic bench set up to record data for the 40 amp Maruti Suzuki 800 alternator is shown in Fig 3.1. The DC motor was testing in the same manner as the alternator for laboratory testing. The testing in the field, with the bicycle setup, was less accurate but just as important of information. The field setup was running the 40 amp alternator attached to the bicycle stand and wired to the components accordingly to the wiring section. A simple bicycle RPM meter can be connected to the back wheel of the bicycle. If you multiply the RPM measured by 10, we receive the approximate RPM of the alternator shaft. This multiplication is the result of the 10:1 diameter ratio between the bike wheel and alternator head. The bike diameter measured 24 inches while the alternator head measured less than 2.5 inches, which gives us the said 10:1 ratio. The issue with running a field test for the alternator current output is the difficulty of the peddler to hold a constant pedaling rate with the varying EMF strength and other external conditions.

5.2 Testing

The results of the alternator in the laboratory were very similar to the expected data for the 40 amp Maruti Suzuki 800 alternator. There were two factors to determining the output of the alternator: the RPM and the field resistance. The field resistance effect on the output current proved quite linear at high RPMs, while at RPMs lower than 1200 a resistance about 10 ohms kills nearly all of the current output and a resistance under 4 supplies an excess amount of current to the field. A resistance between 5-8 ohms proved to be the optimal field resistance when in the human pedaling RPM rate, between 0-1500 RPM, which is much lower than a car's standard RPM rate.

	RPM	**1792**	**1609**	**1488**	**1102**	**1013**	**804**
Motor Reading	Input Current	1.9	1.5	1.5	1.7	1.8	2
	Input Voltage	207	189	175	135	126	104
	Input Power	393.3	283.5	262.5	229.5	226.8	208
Alternator Reading	Output Current	9.1	2.3	1.1	0.66	0.02	0.01
	Battery Voltage	12.8	12.8	12.8	12.8	12.8	12.8
	Output Power	116.48	29.44	14.08	8.448	0.256	0.128
	Efficiency	29.61	10.38	5.36	0.8360	0.1128	0.061

Fig 3.2: Output current based on RPM for Maruti TVS 800 Alternator

The RPM of the alternator proved to be the more important of the two determining factors. The field current, regardless of the current, generates no output power if the RPM rate is too low. We tested the alternator through various RPM values with a 4 ohm field resistor attached. The data received and the calculated values of efficiency are shown on Fig 3.2.

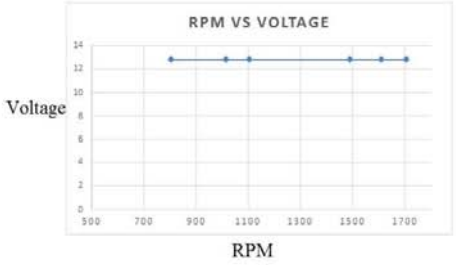

Fig 3.3: Voltage Output based on RPM of Maruti Suzuki 800 alternator

The voltage Vs the RPM proves to be completely unchanging as expected, due to the regulation of the alternator's controller. The regulation wire was connected to the battery's positive terminal which regulated the output voltage to 12.8 V, shown in Fig 3.3.

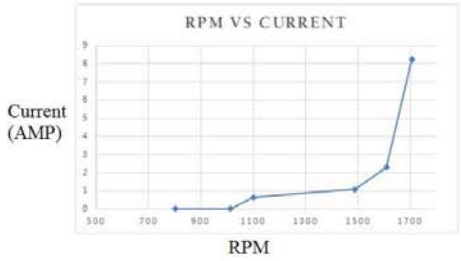

Fig 3.4: RPM vs. Output Current

The current output vs. the RPM of the alternator is very similar to the expected data of shown in Figure 4.3. The output current is minimum until around 1200 RPM. Once that RPM rate is surpassed, the output current increases greatly. The resulting graph can be seen in Figure 3.4.

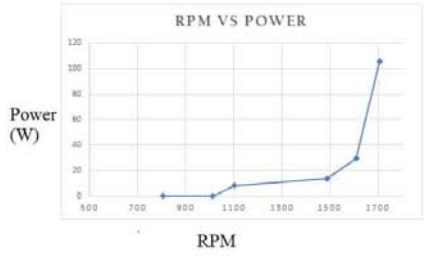

Fig 3.5: Output Power vs RPM

As stated before, an alternator is more efficient at higher a higher RPM. The idea to rewrap the rotor or stator of the alternator with thinner wire could shift the curve to the left, allowing for more power output at the lower RPM expected from our power generation design. The output power is just the multiplication of the output current and the regulated voltage. This can be seen in Fig 3.5.

Fig 3.6: Efficiency of alternator vs RPM

The efficiency was calculated by dividing the output power by the input power recorded from the VFD. The input power recorded may be incorrect as the labs power meters recorded a different input power value than the VFD, so it is unsure which value was more accurate. The efficiency results are shown in Fig 3.6.

From extensive testing with the system design, we received similar results from the laboratory data. For the field testing, a 40 amp Maruti Suzuki 800 alternator was used. The curve from Figure 4.3 shows the alternator produces higher currents at lower RPMs which seemed to be the case for testing.

A 7 ohm field resistor was used in field testing in order to allow for easier pedaling by the users. When pedaling at an easy pace of about 1000 RPM at the alternator shaft, we were receiving 14 volts regulated out and 1 to 1.5 amps.

This gives a power output from 14-21 watts when pedaling at an easy pace. A user was able to produce an RPM of 1500 at the alternator shaft, with 15 voltage at around 3.4 amps. This gave a respectable 51 watts of power output; however, the pace would be hard to sustain for any lengthy amount of time.

As shown early in the DC motor section in Figure 4.6, the output voltage vs RPM of the DC motor proved to be linear. The current was low, never passing 1.5 amps. This power output of the DC motor would not have been enough to charge the stator field of the alternator as previously desired. A

larger DC motor could have possibly supported the alternator field current at lower RPMs; however, the cost of such a motor would not have been financially viable.

6. CONCLUSION:

Through research and testing, this project aimed to design and implement a first phase of sustainable energy resources. The project goal was to supply a battery array with a 12 volt DC output. This goal had to be met within the constraints of a low production cost and high safety. The project had to offer a durable product with relatively good efficiency. We believe we accomplished this goal. The project results were conclusive with the alternator as an energy provider. Alternators are great tool when running at a high RPM, but less efficient when running at a lower RPM, like that provided by users pedaling the bike. There are many other options to explore to find the most efficient way of producing DC power from a bicycle, but we believe modifying an alternator is the most cost effective way to reach that goal. Unfortunately, the scope of time for our project did not allow for rewiring an alternator to test for the power output improvements at lower RPMs; however, we hope that students in the next phase of this project will be able to offer their time to try this improvement, as well as other ideas. The bike stand and coupling between bike and motor have room for improvement as well like to reduce torque and tension to the stand and reduce slippage between the belt couplings. Further stress tests over a longer period of time would also be beneficial in order to determine the actual average lifetime of our product, and if the cost of production is worth the provided power within that lifetime.

Our greatest difficulty came with wiring the alternator correctly to run on our bike system. The field resistor has to be set to a very specific resistance to find the perfect strength of the EMF in the alternator to provide a high power output and low pedaling resistance. More testing can be done in the motors laboratory to find this range of resistances based on the generated RPM rate of the users.

The cost of the bike stand was relatively low compared to many other sustainable energy sources. The cost is just about Rs. 15000, when including a new battery; however, when the battery cost is excluded, the system is closer to Rs. 12000 to produce. This cost would only decrease, if parts and equipment were bought in higher quantities for mass production. We believe our design is a great start in developing a low cost, low upkeep device that will allow power production whenever the user desires. Without access to power anything we can provide to the less fortunate people of the world will help. Our system along with solar, wind, and hydroelectric systems will help provide power for DC House users to run simple appliances like lights, medical equipment, and fans that so many of us take for granted on a daily basis.

ACKNOWLEDGEMENT:

Authors are thankful to the SSBT`s, College of Engineering and Technology, Bambhori, Jalgaon for providing library facility. Authors also would like to thank the staff and colleagues for useful discussions.

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PRATIBHA: INTERNATIONAL JOURNAL OF SCIENCE, SPIRITUALITY, BUSINESS AND TECHNOLOGY (IJSSBT), Vol. 6, No. 1, January 2018
ISSN (Print) 2277-7261

Power Quality Improvement Technique for Voltage Source Inverter

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ABSTRACT :
Utility distribution networks, sensitive industrial loads and critical commercial operations suffer from various types of outages and service interruptions which can cost significant financial losses. An active power filter *(APF)* implemented with a four-leg voltage-source inverter. A three-phase four-wire system connected a nonlinear load, dc/ac four leg voltage source converter to act as a four leg active power filter using of instantaneous power theory is presented. The use of a four-leg voltage-source inverter allows the compensation of current harmonic components, as well as unbalanced current generated by single-phase nonlinear loads. The instantaneous power theory is applied to design the APF controller, which shows reliable performances.

***Keywords*—Active Power Filter, Four-Leg Voltage-Source Converter, *Instantaneous Power Theory and* Power Quality**

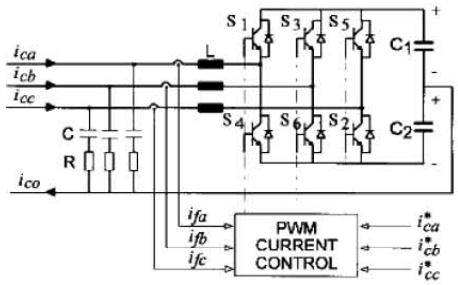
I. INTRODUCTION

Renewable generation affects power quality due to its nonlinearity, since solar generation plants and wind power generators must be connected to the grid through high-power static PWM (Pulse width modulation) converters [1]. The non-uniform nature of power generation directly affects voltage regulation and creates voltage distortion in power systems. The new scenario in power distribution systems will require more sophisticated compensation techniques.

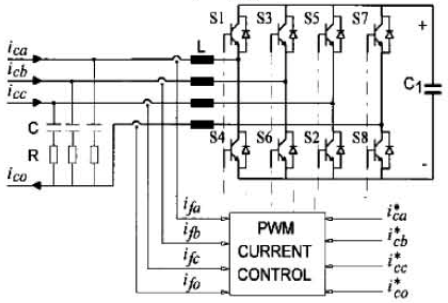
There are two approaches have been developed to control the active filter. Both control strategies consider harmonics and zero sequence components in the voltage and current simultaneously. The first one provides constant power and the second one sinusoidal current to the source, even under unbalanced voltage conditions [2]. Although active power filters implemented with three-phase four-leg voltage-source inverters (4L-VSI) have already been presented in the technical literature [3]-[6].The primary contribution of this paper is an instantaneous power balance theory control designed and implemented specifically for improvement of power quality of VSI. The APF system helps the utility supply a unity power factor and pure sinusoidal currents to the local nonlinear loads by generating the oscillating and imaginary components.

II. THREE PHSE FOUR WIRE SYSTEM PWM CONVERTER

In this section, two configurations of voltage source inverters (VSI), which can be used in three-phase four-wire systems, will be presented. The fundamental difference between the three leg and four leg converter are in Fig. 1(a) and (b) which shows the difference in number of power semiconductor devices. A conventional three-leg converter is used in Fig. 1(a) and the ac neutral wire is connected directly to the midpoint of the dc bus, while in Fig. 1(b) the ac neutral is provided through a fourth leg. Since the configurations have PWM current control, they behave as controlled current source.



(a) Three-leg converter ("split-capacitor" inverter topology)



(b) Four-leg converter ("four switch-leg" inverter topology). Fig.1. Three-phase four-wire PWM converters

The ac currents generated by the VSI have some high-order harmonics at the switching frequency, which can be easily filtered using a small passive filter (R and C in Fig. 1). Ideally, the currents track accurately their references i^*_{ck} (k = a, b, c, o).

The controllability of the "four switch-leg" inverter topology fig. 1(b) is better than the "split-capacitor" inverter topology fig. 1(a) [7], [8]. However, the conventional three-leg converter is preferred because of its lower number of power semiconductor devices [9], [10]. The problems related to the dc capacitor voltage control by using the topology of fig. 1(a) will be discussed below.

Table I Variation Conditions for the Capacitor Voltage VC1 and VC2

i_{fk}> 0 and $\frac{di_{fk}}{dt}$< 0	Increases the voltage in C1
i_{fk}< 0 and $\frac{di_{fk}}{dt}$< 0	Decreases the voltage in C1
i_{fk}< 0 and $\frac{di_{fk}}{dt}$> 0	Decreases the voltage in C2
i_{fk}> 0 and $\frac{di_{fk}}{dt}$> 0	Decreases the voltage in C2

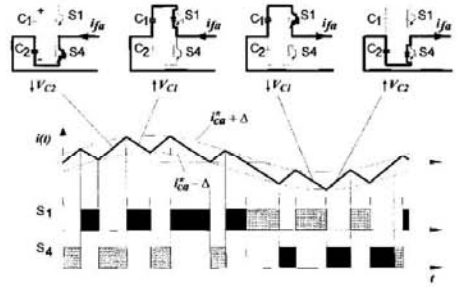


Fig 2.Hysteresis-band PWM current control.

Fig. 2 shows a typical motion of the a-phase VSI current controlled by a hysteresis-based PWM current controller.

If the current references i^*_{ck} are assumed to be composed from zero sequence component, the line i^*_{fk} (k = a, b, c) will return through the ac neutral wire. These forces, in the "split-capacitor" inverter topology, the current of each phase to flow either through C_1 or through C_2 and to return through the ac neutral wire. The currents can flow in both directions through the switches and capacitors. Table I summarizes the conditions that cause voltage variations in the capacitors C_1 and C_2 for a zero sequence current reference in the "split-capacitor" inverter topology.

When i_{fk}>0, Vc_1 rises and Vc_2 decreases, but not with equal ratio because the positive and negative values of $\frac{di_{fk}}{dt}$ are different and depend on the instantaneous values of the ac phase voltages. The inverse occurs when i_{fk}< 0. The dc voltage variation depends also on the shape of the current reference and the hysteresis bandwidth.

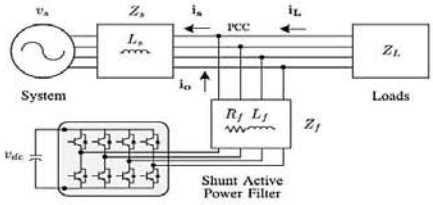


Fig.3. *Three Phase four wire equivalent circuit with non-linear load*

Therefore, the total dc voltage, as well as the voltage difference (Vc_2 — Vc_1) will oscillate not only at the switching frequency, but also at the corresponding frequency of i_0 that is being generated by the VSI.

In the example given in Fig. 2, the phase current i_{fa} causes voltage variations such that at the end of the period the voltage Vc_1 higher and Vc_2 *lower*. If a dynamic offset level is added to both limits of the hysteresis-band, it is possible to control the capacitor voltage *difference* and to keep it within an acceptable tolerance margin. For instance, a negative offset in Fig. 2 counteracts the above voltage variation.

III. Controller of Instantaneous Power Theory

Instantaneous power flow among the parts of the APF system is simplified in Fig. 3.The dc/ac VSC keeps a significant role in implementing a given control duty. At the dc side, the power concept is consistent.

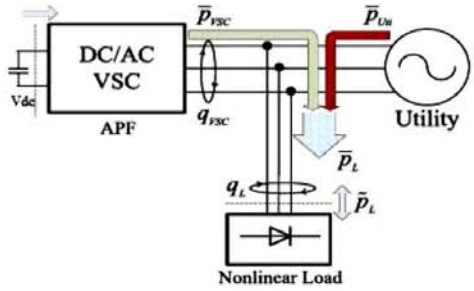


Fig.4. Instantaneous power flows among APF system.

However, at the ac side, the instantaneous power includes both the active part (p_{vsc}) and the imaginary part (q_{vsc})[11].

The load demand includes real power and imaginary power. The dc/ac VSC supplies harmonic and imaginary parts for the nonlinear loads (q_L). Different from pure linear loads that consume only average active power component, the nonlinear loads also consume the oscillating components. The APF function results in pure sinusoidal currents from the utility.There are an instantaneous power balance among the three parts at the point of common coupling (PCC).

The dc/ac VSC integrated by an APF function should provide the harmonic elimination and reactive power compensation. The controller is established based on the instantaneous power theory, where all the parameters are processed instantaneously. The input signals of that controller include utility voltages (v_{abc}), nonlinear load currents (i_{abcL}), output currents of dc/ac VSC (i_{abcVSC}), utility injected currents (i_{abcUti}), and dc-link voltage V_{VSC} (to prevent overcharge dc-link capacitor). Instantaneous power balance at the dc/ac VSC-utility-load connection point makes.

$$\boldsymbol{p_L = p_{VSC} + p_{Uti}}$$
$$\boldsymbol{q_L = q_{VSC} + q_{Uti}} \ldots (1)$$

Since the target is laid on the load, its consuming power is continuously measured and analyzed. Using the Clarke transformation, the instantaneous real power (p_L) and imaginary power (q_L) of the load can be calculated, as shown in the following equations:

$$\begin{bmatrix} v_\alpha\,(i_\alpha) \\ v_\beta\,(i_\beta) \end{bmatrix} = \sqrt{\frac{2}{3}} \begin{bmatrix} 1 & -\frac{1}{2} & -\frac{1}{2} \\ 0 & \frac{\sqrt{3}}{2} & -\frac{\sqrt{3}}{2} \end{bmatrix} \begin{bmatrix} v_a(i_{aL}) \\ v_b(i_{bL}) \\ v_c(i_{cL}) \end{bmatrix} \ldots (2)$$

The topology is well-known APF controllers based on instantaneous power theory. The APF applications mentioned in [12] use technique. The utility currents are not measured by this controller. Only the load currents and the outputcurrents of the APF are measured. Which are oscillating powers as in

$$\begin{Bmatrix} p_{VSC}^{ref} = \tilde{p}_L + \overline{p_{loss}} \\ q_{VSC}^{ref} = \tilde{q}_L \end{Bmatrix} or \begin{Bmatrix} p_{VSC}^{ref} = \tilde{p}_L + \overline{p_{loss}} \\ q_{VSC}^{ref} = q_L \end{Bmatrix} \ldots (3)$$

In this case, the utility must supply the constant dc-link voltage regulation $\overline{p_{loss}}$. After finding out the reference power for dc/ac VSC, using the reverse Clarke transformation [13], the reference current values in the three phases are generated as seen in the following equations:

$$\begin{bmatrix} i_{\alpha VSC}^{ref} \\ i_{\beta VSC}^{ref} \end{bmatrix} = \begin{bmatrix} v_\alpha & v_\beta \\ -v_\beta & v_\alpha \end{bmatrix}^{-1} \begin{bmatrix} p_{VSC}^{ref} \\ q_{VSC}^{ref} \end{bmatrix} \ldots (4)$$

$$\begin{bmatrix} i_{\alpha VSC}^{ref} \\ i_{\beta VSC}^{ref} \\ i_{cVSC}^{ref} \end{bmatrix} = \sqrt{\frac{2}{3}} \begin{bmatrix} 1 & 0 \\ -\frac{1}{2} & \frac{\sqrt{3}}{2} \\ -\frac{1}{2} & -\frac{\sqrt{3}}{2} \end{bmatrix} \begin{bmatrix} i_\alpha^{ref} \\ i_\beta^{ref} \end{bmatrix} \ldots (5)$$

The hysteresis control technique is used to switch insulated-gate bipolar transistor gates [14].

IV. SHUNT THREE-PHASE FOUR-WIRE ACTIVE FILTER

The shunt three-phase four-wire active power filter configuration that will be explored in this paper is presented in Fig. 4. It is composed from a conventional three-leg VSI with a dynamic hysteresis-band PWM current control and an active filter controller that realizes an "instantaneous" control algorithm. The inputs of this controller are the instantaneous phase voltages and line currents of the load.

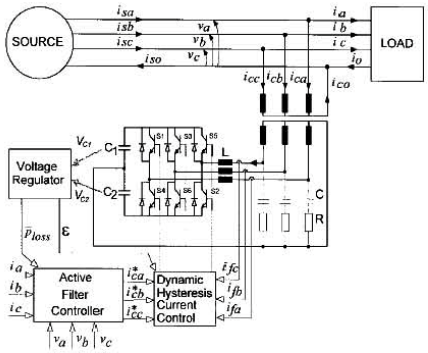


Fig. 5. Three-phase four-wire shunt active power filter using a conventional three-leg converter.

Its outputs are the instantaneous three-phase current referencesi_{ca}^*, i_{cb}^* andi_{cc}^*.The voltage regulator supervises the dc capacitor voltages and provides two control signals, $\overline{p_{los\,s}}$and ϵ, as shown in Fig. 5. The signal $\overline{p_{loss}}$ compensates for losses in the PWM converter, which tends to discharge the dc capacitors C_1 and C_2. The signal ϵ is the dynamic offset level used to control the capacitor voltage difference.

V. CONCLUSION

Improvement of power quality and reactive power compensation for renewable base generation by APF based PWM has been proposed in this system.Two control schemes for a shunt three-phase four-wire active power filter employing

a conventional three-leg converter were developed and a critical comparison between both approaches was carried out. The three-leg converter topology was preferred due to its lower number of power semiconductor devices, and a dynamic hysteresis current control was developed to overcome the problems related with the dc voltage difference between dc capacitors.

A three-phase active filter *without* neutral wire could be realized using a two-leg converter if the "split-capacitor" inverter topology and the dynamic hysteresis current control are applied, or generally use (n -1) leg converter in n-wire systems.

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PRATIBHA: INTERNATIONAL JOURNAL OF SCIENCE, SPIRITUALITY, BUSINESS AND TECHNOLOGY (IJSSBT), Vol. 6, No. 1, January 2018
ISSN (Print) 2277-7261

Aadhar enabled ration distribution and monitoring using smart card

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ABSTRACT :
This paper proposes Automatic Trailing Machine(ATM) based ration distribution using smart card and Aadhar card technology. Aadhar card contains all related information such as name, permanent address, mobile number, bank account number, biometric information and demographic data. Consumer details are stored in the central data base which is provided by the government authority. In this ATM system, we replace the conventional ration card by smart card (RFID based), which contains unique Aadhar identification number of all the family members, card holder type APL or BPL which is used for user authentication to buy their ration. OTP and SMS will be sent to the card holder and after each transaction the government data base will be updated. The system continuously monitors, alert and notify the government authority during theft. As customer purchases the material amounts get deducted from the registered bank saving account.
Keywords:- ATM, Ration, RFID, Smart card, Aadhar, UID etc

1. INTRODUCTION

The Public Distribution System (PDS) was launched in India on June 1997 and is recognized by the Ministry of Consumer Affairs, Food, and Public Distribution. The fair price shops are mainly used to distribute the goods with low cost or free of cost. It is a concern of India's public distribution System implanted by Government of India, which distributes rations at a subsidized price to the poor. In India approximately 500000 fair price shops are available. Here the Major commodities distributed include essential food grains, so much as wheat, rice, sugar, and kerosene, through a network of public distribution shops constituted in several states across the country. The central and state governments joint the responsibility of regulating the PDS. While the central government is obligated for procurement, storage, conveyance, and majority allocation of food grains, state governments holds the province for distributing the aforesaid to the consumers through the ingrained network of Fair Price Shops (FPSs). State governments are also responsible for functional obligation, including allotment and identity of families below the poverty line, issue of ration cards, superintendence and monitoring the functioning of FPSs. The Indian ration card is the authority of the Indian peoples. This is mainly used for buying supported food and fuel (LPG and kerosene). It is an important livelihood tool for the misfortunate, providing proof of personal identity and link with government databases.

India's public distribution system (PDS) runs based on the ration card, including its purpose of identification, eligibility, and entitlement. Ration card has three categories – extreme poverty level (AAY), below poverty line (BPL) and above poverty line (APL). The poverty lines are identified depends upon the annual income of that particular family. Depends upon the family incomes the ration card colour is decided. The different colours of ration cards are navy blue (BPL), white (APL) and orange (AAY). A below poverty line (BPL) correspondence bearer should be collected 35 kg of food grain and the card holder above the poverty line should be collected 15 kg of food grain as per the norms of PDS. Up to the age of 12 years, a half unit ration materials are issued and full unit ration materials is issued in case of age more than 12 years. In fair price shops presently the peoples are facing so many problems like corruption, wastage of time and no proper material distribution [1-10].

Figure 1.1: Queue in Ration Shops

Figure 1.2: Image of a Ration Shop

To overcome this problem here we proposed to dispense all the materials automatically and also maintain the stock details properly.

2. OBJECTIVES

The objective of the project is to automate the task of distribution of items efficiently. The project is aimed to stop corruption and discrepancies created in distribution shops. The system perform the following tasks.

1. To design and implement the ration material distribution system for people using advanced processor
2. To validate the ration card of the beneficiaries.
3. To validate the right beneficiaries.
4. To avoiding irregularities in distribution of grains.
5. To generate SMS notifications on the mobiles of the beneficiaries.
6. Stock maintenance in the distribution center.

3. NECESSITY OF THE SYSTEM [2-12]

Some problem regarding manual ration distribution system are discussed below.

- Bogus cards
- Illegal Usage
- Processing speed is slow
- Over crowd
- Materials theft
- Selection of households Targeting
- Hijacking of ration cards
- More than the prescribed rates are charged
- Cannot able to get the material at any time.
- Cannot able to get the accurate quantity of supplies

4. SYSTEM HARDWARE SETUP

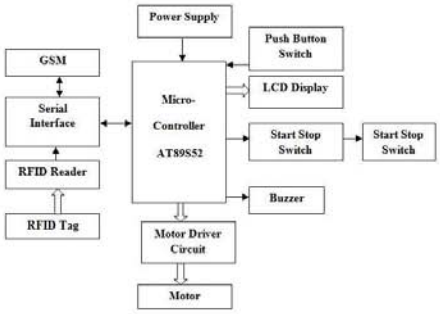


Figure 4.1 System Hardware Setup

1. POWER SUPPLY

A power supply is an electronic device that feed electric energy to the electrical device. The main function of a power supply is to switch one form of electrical energy to another and, as a result this is used to supply power to the ration distribution kit.

2. RFID

The RFID uses wireless technology to identify the object. It consists of RFID tag and the reader. The bidirectional communication between the tag and the reader is accomplished by the radio frequency (RF) part of the electromagnetic spectrum to carry the information between an RFID tag and reader. Passive RFID tags are used in this system as an e-ration card. It does not require any external power supply. The tag antenna receives the RF signal (13.56MHz) from the reader. This received signal is rectified and supplied to the chip to power it up. Now tag retransmits the signal to reader. The reader receives it. Then the signal is sent for further computation of the data [3-4].

3. GSM

The GSM (Global System for Mobile communication) module consists of GSM modem. It is a standard developed by the European telecommunication standard institute to describe protocols for 2G digital cellular networks used by mobile phones. It accepts SIM cards, and operates over a subscription to a mobile operator, just like mobile phones. It uses frequencies between 890-915 MHz UL and 935-960 DL (Band of 25MHz). Through this GSM modem, SMS is delivered automatically to the subscriber about availability of food grains at the ration distribution centre and about the transaction [4-6].

4. RS-232

The RS-232 is a communication cable, commonly used for transferring and receiving the serial data

between two devices. It supports both synchronous and asynchronous data transmissions. Many devices in the industrial environment are still using RS-232 communication cable. Rs-232 cable is used to identify the difference of two signal levels between logic 1 and logic 0.

The logic 1 is represented by the -12V and logic 0 is represented the +12V. The RS-232 cable work at different baud rate like 9600 bits/s, 2400bits/s, 4800bits/s etc. The RS-232 cable has two terminal devices namely Data Terminal Equipment and Data communication Equipment. Both device will sends and receives the signals. The data terminal equipment is computer terminal and data communication Equipment is moderns, or controllers etc [4-8].

5. LCD

Liquid Crystal Display is the technology use to display the various information to the consumer. In this system LCD is used to convey message with user. It shows the message and according to that the customer responds to the system [8].

6. Motor with Driver Circuit

The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor and an external magnetic field to generate rotational motion. In the proposed system we are using motor for the withdrawal of sugar or rice. The motor driver circuit is used to provide proper matching between motor and circuits [8-10]

7. Buzzer

It consists of piezo crystals between two conductors. When a potential is applied across these crystals, they push on one conductor and pull on the other. This, push and pull action, results in a sound wave.
If the RFID tag is invalid then AT89S52 will send signal to the buzzer. Buzzer will receive the signal coming from AT89S52 and it will produce some noisy sound [9].

8. Motor Driver Interface IC L293D

L293D is a dual H-bridge motor driver integrated circuit (IC). Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors.
L293D contains two inbuilt H-bridge driver circuits. In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction. The motor operations of two motors can be controlled by input logic at pins 2 & 7 and 10 & 15. Input logic 00 or 11 will stop the corresponding motor. Logic 01 and 10 will rotate it in clockwise and anticlockwise directions, respectively.

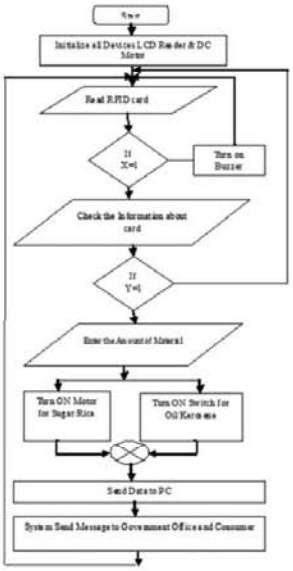
9. Amplifier circuitry design

INA 128P is a 8 pin instrumentation amplifier IC. This IC is used to amplify the voltage of load cell which is in millivolt. Wide range of gain can be slected by using single resistor which is connected between pin number 1 and 8. The amplifier gain is set to 178 for grain distribution sub system.

Table 1. Load cell sensor outputs

Weight (in Kg)	Load cell output Voltage	Amplifier Output
No Load	0.593 mV	0.169 V
1 Kg	2.79 mV	0.698 V
2 Kg	4.99 mV	1.309 V
3 Kg	7.28 mV	1.81 V
4 Kg	9.588 mV	2.219 V
5 Kg	11.82 mV	2.79 V

5. SYSTEM SOFTWARE



1. Every consumer is provided with a RFID card which is registered by the Government database.
2. At the time of ration distribution at ration shop, consumer scans the RFID card and enters the password.
3. First it check aadhar card linking, if aadhar card is not linked then it deny access otherwise it allow to process for ration material.
4. Password of consumer is verified with the database provided by the Government authority which is verified online.
5. Once verification is successful, User ID is displayed on LCD, consumer is asked for a select type of material through keypad.
6. Based on type of material chosen, the consumer is asked for the amount of quantity through keyboard.
7. The motor or solenoid valve is activated based on the material chosen.
8. After dispensing exact quantity of material motor or solenoid is disabled.
9. The information in form of SMS is send through GSM module to the user as well as PDS authority.

6. RESULTS

Fig.2 Initial Positions "Ration Distribution System"

Fig.3 Adhar Card Linking Window

Fig.4 Adhar Card Not Linking Window

Fig.5 Material Selections (Wheat/Rice/Sugar)

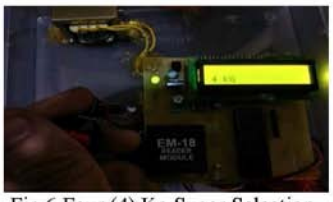


Fig.6 Four (4) Kg Sugar Selection

Fig.7 Material Selections (Oil / Kerosene)

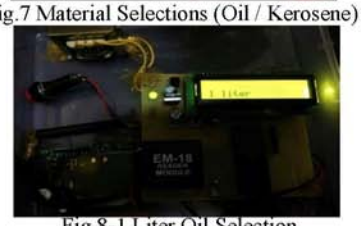
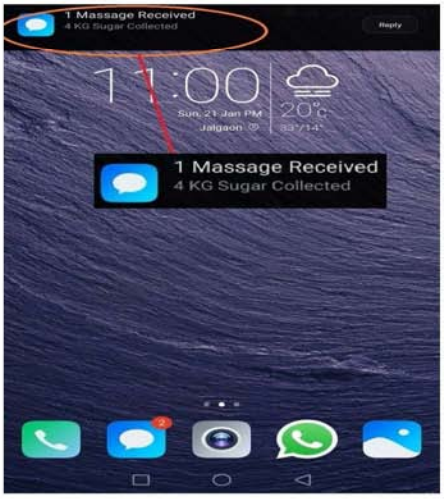


Fig.8-1 Liter Oil Selection

Fig.9 SMS Sending Window



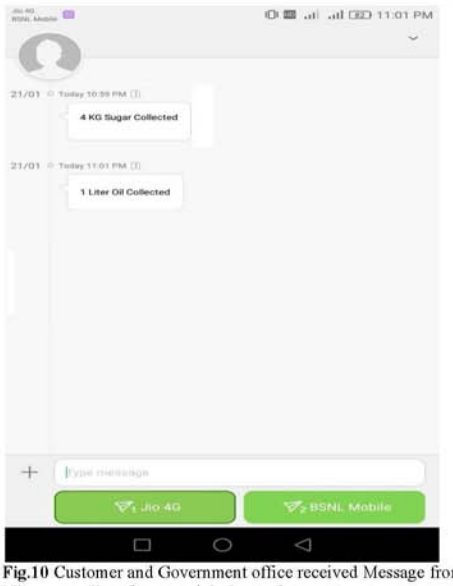
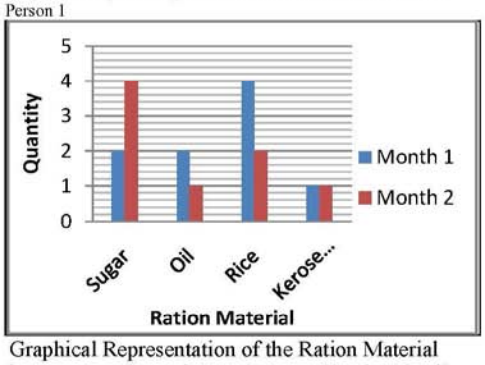


Fig.10 Customer and Government office received Message from Microcontroller after materials drawn from system

Graph 5.1 Graphical Representation of the Ration Material for Person 1



Graphical Representation of the Ration Material for Person 1 shown in graph 5.1. Following details is needed while getting ration

Person 1
Name: J. D. INGALE
Card No. 0005073995
Adhar No.: 360431213571
Delivered Material: 4.36pm, 20/1/2018
Sugar-4 Kg., Oil-1 Liter

Person 2
Name: P. V. FEGADE
Card No.: 123456789102
Invalid User

7. CONCLUSION

This is an excellent automated trailing system for distribution of ration material, the ration Materials (wheat, rice, sugar, pulses, oil, kerosene, etc)

distributed through automatic mechanism without any help of humans. The system is successfully implemented and tested using aadhar card and RFID technology, the government authorities can monitor and control of ration material the distributing material. The government money and public time is saved; poor people are greatly benefited and the database can be maintained for long years easily without any illegal activities. System is transparent and it control over corruption and distribution of ration in open market. Dealer as well as fraud customer will not be able to keep duplicate ration cards. It helps to modernize traditional rationing system and fight against corruption up to a great extent.

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PRATIBHA: INTERNATIONAL JOURNAL OF SCIENCE, SPIRITUALITY, BUSINESS AND TECHNOLOGY (IJSSBT), Vol. 6, No. 1, January 2018
ISSN (Print) 2277-7261

Design of Systems for Headlights Tilting according to Steering

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ABSTRACT :

You're driving for home from a weekend vacation. It's late at night, and the winding two-lane road has no streetlights. You approach a curve at 60 kmph slow enough to make the turn, but too fast to stop suddenly if you need to. What's waiting there, just beyond the range of your headlights. In this paper we are mainly dealing with Standard headlights shine straight ahead, no matter what direction the car is moving. When going around curves, they illuminate the side of the road more than the road itself. With the topic "Headlights Tilting According to Steering", there will be no guessing game. The lights will turn their beams around each bend in the road, giving you a better view of what's ahead. Improved night driving isn't a trivial matter - over 46 percent of fatal accidents in 2006 occurred at night, a number much higher than the proportion of driving done at night. In this paper, we'll develop how "Headlights Tilting According to Steering" differ from standard headlights and make it possible that they can make night time driving safer. We'll also try some headlight innovations in the works. In this paper we are more focusing on the A car with "Headlights Tilting According to Steering" will use electronic sensors to detect the position of the car wheels to give input to the controller to turn the headlight. The sensors will direct small electric motors built into the headlight casing to turn the headlights. A typical "Headlights Tilting According to Steering" would turn the lights up to 16 degrees from center giving them a 32-degree range of movement.

Keywords: Headlights, Steering System.

I. INTRODUCTION

A headlamp is a lamp, usually attached to the front of a vehicle such as a car or a motorcycle, with the purpose of illuminating the road ahead during periods of low visibility, such as darkness or precipitation. Headlamp performance has steadily improved throughout the automobile age, spurred by the great disparity between daytime and night time traffic fatalities: the U.S. National Highway Traffic Safety Administration states that nearly half of all traffic-related fatalities occur in the dark, despite only 25% of traffic travelling during darkness. While it is common for the term headlight to be used interchangeably in informal discussion, headlamp is the technically correct term for the device itself, while headlight properly refers to the beam of light produced and distributed by the device. A headlamp can also be mounted on a bicycle (with a battery or small electrical generator), and most other vehicles from airplanes to trains tend to have headlamps of their own. Additionally automotive night vision systems work to supplement headlights. The goal behind developing the paper titled "Headlights Tilting According to Steering" is to illuminate the vision of driver at the time of turning and cornering in night time driving, and hence avoiding the night time accidents. We have tried to develop a system combination of "Mechanical" and "Electronics" technology. In this system head beam of headlight will be so guided to swivel by the steering system, that it will illuminate the sideways during turning and cornering.

II. LITERATURE SURVEY

The earliest headlamps were fueled by acetylene or oil and were introduced in the late 1880s. Acetylene lamps were popular because the flame was resistant to wind and rain. The first electric headlamps were introduced in 1898 on the Columbia Electric Car from the Electric Vehicle Company of Hartford, Connecticut, and were optional. Two factors limited the widespread use of electric headlamps: the short life of filaments in the harsh automotive environment, and the difficulty of producing dynamos small enough, yet powerful enough to produce sufficient current. In 1912, Cadillac integrated their vehicle's Delco electrical ignition and lighting system, creating the modern vehicle electrical system.

"Dipping" (low beam) headlamps were introduced in 1915 by the Guide Lamp Company,

but the 1917 Cadillac system allowed the light to be dipped with a lever inside the car rather than requiring the driver to stop and get out. The 1924 Bilux bulb was the first modern unit, having the light for both low (dipped) and high (main) beams of a headlamp emitting from a single bulb. A similar design was introduced in 1925 by Guide Lamp called the "Duplo". In 1927, the foot-operated dimmer switch or dip switch was introduced and became standard for much of the century. The last vehicle with a foot-operated dimmer switch was the 1991 Ford F-Series. International headlamp styling, 1983–present. In 1983, granting a 1981 petition from Ford Motor Company, the 44-year-old U.S. headlamp regulations were amended to allow replaceable-bulb, nonstandard-shape, architectural headlamps with aerodynamic lenses that could for the first time be plastic. This allowed the first U.S.-market car since 1939 with replaceable bulb headlamps – the 1984 Lincoln Mark VII. These composite headlamps were sometimes referred to as "Euro" headlamps, since aerodynamic headlamps were common in Europe.

Recent developments:

Complex-reflector technology in combination with new bulb designs such as H13 is enabling the creation of European-type low and high beam patterns without the use of a Graves Shield, while the 1992 US approval of the H4 bulb has made traditionally European 60%40% optical area divisions for low and high beam common in the US. Therefore, the difference in active optical area and overall beam light content no longer necessarily exists between US and ECE beams. Dual-beam HID headlamps employing reflector technology have been made using adaptations of both techniques.

III. METHODOLOGY

The methodology for the design of Headlights Tilting According to Steering is explained by following steps,

- Determining the turning angle of the wheel and hence the angle through which the strut has been turned.
- Calculating the time range required to tilt the headlights while turning.
- Calculating the change in resistance of potentiometer per degree rotation of strut.
- Selecting stepper motor of required specification.
- Selecting appropriate rotational sensor.
- Establishing relation between potentiometer rotation & headlight rotation. i.e. stepper motor rotation.

IV. COMPONENTS OF MECHANICAL SYSTEM

A. Role of Steering System:

a. Role of Conventional Steering System: The steering system components are a common source of driver complaints. Tire wear is almost completely dependent on the condition and adjustment of the steering components. This chapter covers the construction and operation of both conventional steering systems.

b. Role of Power steering: Power assisted steering is composed of a set of simple components that magnify the force that the driver applies to the wheel to steer the vehicle. At the heart of the power steering pump is a rotor driven by a belt from the engine that regulates the flow of hydraulic fluid into the sealed system of hoses.

B. Role of Rack & Pinion: A circular gear called "the pinion" engages teeth on a linear "gear" bar called "the rack"; rotational motion applied to the pinion causes the rack to move relative to the pinion, thereby translating the rotational motion of the pinion into linear motion.

VII. COMPONENTS OF ELECTRONICS SYSTEM

A. Role of Electronic Components: The main component of the adaptive headlight system is the electronic circuit. It consist of the various electronic components such as Printed circuit board (PCB), Micro-controller, A/D convertor, ULN 2003A IC, the short description of these components are given below.

B. Printed circuit board.

C. Analog to Digital Convertor.

D. Potentiometer.

E. Microcontroller.

F. ULN 2003A IC.

G. Stepper Motor Working: Stepper motors consist of a permanent magnet rotating shaft, called the rotor, and electromagnets on the stationary portion that surrounds the motor called the stator.

V. Applications:

a. The rack and pinion arrangement is commonly found in the steering mechanism of cars or other wheeled, steered vehicles.

b. This arrangement provides a lesser mechanical advantage than other mechanisms such as recelculating ball, but much less backlash and greater feedback, or steering "feel".

c. The use of a variable rack (still using a normal pinion) was invented by Arthur Ernest

Bishop,[1] so as to improve vehicle response and steering "feel" especially at high speeds, and that has been fitted to many new vehicles, after he created a specialized version of a net-shape warm press forging process to manufacture the racks to their final form, thus eliminating any subsequent need to machine the gear teeth.

d. For every pair of conjugate involutes profile, there is a basic rack. This basic rack is the profile of the conjugate gear of infinite pitch radius.
e. A generating rack is a rack outline used to indicate tooth details and dimensions for the design of a generating tool, such as a hob or a gear shaper cutter.

VI. Advantages & Disadvantages:

a. Although it is a popular choice, due to its simplicity and low manufacturing cost, the design has a few disadvantages in the quality of ride and the handling of the car.
b. Geometric analysis shows it cannot allow vertical movement of the wheel without some degree of either camber angle change, sideways movement, or both.
c. It is not generally considered to give as good handling as a double wishbone suspension, because it allows the engineers less freedom to choose camber change and roll center.
d. Another drawback is that it tends to transmit noise and vibration from the road directly into the body shell, giving higher noise levels and a "harsh" feeling to the ride compared with double wishbones, requiring manufacturers to add extra noise reduction or cancellation and isolation mechanisms. Also, because of its greater size and robustness and greater degree of attachment to the vehicle structure, when the internal seals of the shock absorber portion wear out replacement is expensive compared to replacing a simple shock absorber.
e. Despite these drawbacks, the MacPherson strut setup is still used on high performance cars such as the Porsche 911, several Mercedes-Benz models and nearly all current BMWs (including the new Mini but excluding the 2007 X5,[6] 2009 7-series, 2011 5-series and 5-series GT).

VII. SCOPE OF THE SYSTEM

- Adaptive headlights automatically adjust the light to match the direction of travel, that enables the driver to react more quickly because he/she will see the road ahead more clearly.
- Steering angles to assure the proper distribution and control of beam pattern.
- Electronic control system, which switches the headlights to full-beam, dipped or cornering system.
- All the above advantages of this system will attract the customer for safety rides for both driver and the pedestrian.
- Today's world of competition will also call the automobile manufacturers to use this advanced system.
- It would also be possible that Government and RTO could compulsory the use of this system in all automobiles to reduce the road accidents.

VIII. CONCLUSION

The Headlight tilting according to steering is the concept necessary for the fast moving world. This concept prevents the accidents occurrence at the highway at night. This system is easily fitted in the small available space in car. It is less costly so a vehicle of low cost can also afford it. It is of less maintenance as mechanical linkages are not so much.

ACKNOWLEDGEMENT

Authors are thankful to the SSBT`s, College of Engineering and Technology, Bambhori, Jalgaon for providing library facility. The authors would like to thank the staff and colleagues for useful discussions.

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PRATIBHA: INTERNATIONAL JOURNAL OF SCIENCE, SPIRITUALITY, BUSINESS AND TECHNOLOGY (IJSSBT), Vol. 6, No. 1, January 2018
ISSN (Print) 2277-7261

A Voltage Controlled DSTATCOM for Power Quality Improvement

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ABSTRACT :
DSTATCOM (Distribution Static Synchronous Compensator) is used for Mitigation of Power Quality Problems under unbalance caused by various loads and faults in distribution system. The paper discusses the modelling and analysis of custom power controllers, power electronic-based equipment aimed at enhancing the reliability and quality of power flows in low voltage distribution networks using DSTATCOM. A new PWM- based control scheme has been proposed that only requires voltage measurements the operation of the proposed control method is presented for D-STATCOM. Simulations and analysis are carried out in MATLAB/SIMULINK with this control method for two proposed systems.

Keyword : PWM, Quality, Sag , Surge.

I. Introduction

In recent years, the custom power technology, the lowvoltage counterpart of the more widely known flexible ac transmission system (FACTS) technology, aimed at high voltage power transmission applications, has emerged as a credible solution to solve many of the problems relating to continuity of supply at the end-user level. Both the FACTS and custom power concepts are directly credited to EPRI. At present, a wide range of very flexible controllers, which capitalize on newly available power electronics components, are emerging for custom power applications. The distribution static compensator (DSTATCOM) based on the Voltage source Converter (VSC) principle has been used to perform the Modelling and analysis of such controllers for a wide range of operating conditions based PWM control reported in this seminar for the DSTATCOM. It relies only on voltage measurements for its operation, i.e., it does not require reactive power measurements. The sensitivity analysis is carried out to decide the impact of the dc capacitor size on DSTATCOM performance. When used in low-voltage distribution systems the STATCOM is normally identified as Distribution STATCOM (D-STATCOM). It operates in a similar manner as the STATCOM (FACTS controller), with the active power flow controlled by the angle between the AC system and VSC voltages and the reactive power flow controlled by the difference between the magnitudes of these voltages. In terms of STATCOM, the capacitor acts as the energy storage device and its size is chosen based on power ratings, control and harmonics considerations. The DSTATCOM controller continuously monitors the load voltages and currents and determines the amount of compensation required by the AC system for a variety of disturbances. A D-STATCOM (Distribution Static Compensator), which is shown in Fig.1consists of a two-level Voltage Source Converter (VSC), a dc energy storage device, a coupling transformer connected in shunt to the distribution network through a coupling transformer. The VSC converts the dc voltage across the storage device into a set of three-phase ac output voltages. The above voltages are in phase and coupled with the ac system through the reactance of the coupling transformer. Suitable adjustment of the phase and magnitude of the DSTATCOM output voltages allows effective control ofactive and reactive power exchanges between the DSTATCOM and the ac system. Such arrangement allows the device to generate controllable active and reactive power. The VSC connected in shunt with the ac system provides a multifunctional topology which can be used for up to three quite distinct purposes:

1. Voltage compensation, regulation of reactive power
2. Correction of power factor
3. Elimination of current harmonics

The device which is employed to provide continuous voltage regulation using an indirectly controlled converter.

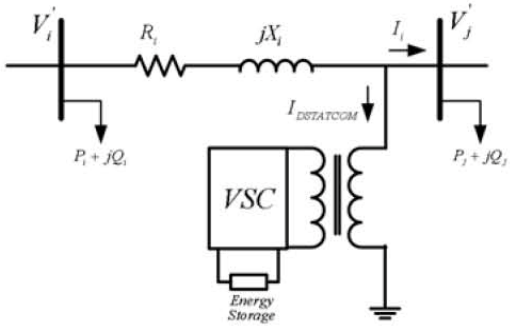


Fig. 1. Single line diagram of D-STATCOM connected distribution system

II. Objectives

1) To cancel the effect of harmonics due to load so that the current drawn from the source is nearly sinusoidal.

2) To help maintain near unity power factor by cancelling the effect of poor load power factor.

3) To help offset the effect of unbalanced loads such that the current drawn from the source is balanced.

III. Power Quality Problems

2.1 Voltage SAG:
The voltage sag is a momentary decrease between 0.1to0.9 per unit, with a duration ranging from half cycle up to 1 min. It is considered as the most serious problem of power quality. It is caused by faults in the power system or by the starting of large induction motor.

2.2 Voltage Swell:
Voltage swell is defined as an increase in the root mean square (RMS) voltage from 1.1 to 1.8 perunit for duration from 0.5 cycles to 1 min. Voltage swells are not as important as voltage sags because they are less common in distribution systems. The voltage swell is introduced by switching of large capacitors or start/stop of heavy loads.

2.3 Harmonics:
The fundamental frequency of the AC electric power distribution system is 50 Hz. A harmonic frequency is any sinusoidal frequency, which is a multiple of the fundamental frequency. Harmonic frequencies can be even or odd multiples of the sinusoidal fundamental frequency. The harmonic distortion is introduced in rectifiers and all non-linear loads, such as power electronics equipment including VSDs.

2.4 Voltage Transients:
They are temporary and undesirable voltages that appear on the power supply line. Transients are high over-voltage disturbances (up to 20kV) that last for a very short time.

2.5 Flicker:
The voltage oscillation, amplitude modulated by a signal with frequency of 0 to 30 Hz. The main causes are frequent start/stop of electric motors (for instance elevators), oscillating loads. The following Fig. 1 shows the sketch of a voltage waveform.

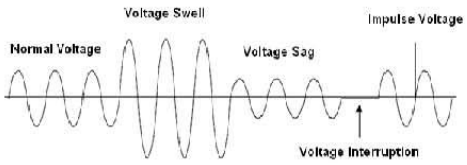


Fig.1 voltage waveform.

IV. Solution of Power Quality Problems

To tackle the power quality problem two approaches are defined (a) Actions taken from the customer side or (b) Actions taken from the utility side. The first approach is called load conditioning, which ensures that the equipment is less sensitive to power disturbances, allowing the operation even under significant voltage distortion. Second approach highlights line conditioning systems that suppress or counteracts the power system disturbances. Currently, line conditioning systems are based on pulse width modulation (PWM) converters connected to low voltage and medium voltage distribution system in shunt mode or in series. However, with the reorganization of the power sector and with shifting trend in the direction of distributed and dispersed generation, the line-conditioning systems or utility side solutions will play a major role in improving the inherent supply quality .Though there are many different methods to mitigate voltage sags and swells, the use of a custom Power device is considered to be the most efficient method. In a distribution system the custom power is referred to use of power electronics controllers, especially, to deal with various power quality problems. There are many types of Custom Power devices. Some of these devices include: Active Power Filters (APF), Battery Energy Storage Systems (BESS), Distribution STATIC Synchronous Compensators (DSTATCOM), Distribution Series Capacitors (DSC), Distribution static compensator(DSTATCOM), Surge Arresters (SA), Static Electronic Tap Changers (SETC), Solid - State Transfer Switches (SSTS), Solid State Fault Current Limiter (SSFCL), Static Var Compensator (SVC), Super conducting Magnetic Energy Systems (SMES), Thyristor Switched Capacitors (TSC), and Uninterruptible Power Supplies (UPS). In this paper,an overview of the DSTATCOM, its functions, configurations, components, operating modes, voltage injection methods and closed loop control of the DSTATCOM limitations.

V. Problem Definition

A voltage sag can be define as an r.m.s (root mean square) reduction in the AC voltage at the power frequency, for duration from a half cycle to a few second. A voltage swell can be define as an r.m.s (root mean square) increase in the AC voltage at the power frequency, for duration from a half cycle to a few second. Voltage outage is define as complete loss of voltage or current for time period, due to faults and reclose operation the momentarily interruption in supply (few cycles) occurred. It is also term as momentary outage. Transient is define as "sub cycle disturbance in the A.C. waveform, evident by sharp, brief Discontinuity of the waveform. Notch is defined as," disturbance in the A.C. waveform, evident by sharp, brief discontinuity of the waveform lastingness than half cycle (mostly occurs just once in half cycle)" Harmonic is defined as sinusoidal component of a periodic wave having a frequency that is an integral multiple of fundamental frequency.

VI. Implementation and Detail

A. Voltage Sag

One of the most common power frequency disturbances is voltage sag. By definition, voltage sag is an event that can last from half of a cycle to several seconds. Voltage sags is introduced due to switching of large loads, such as an arc furnace, electric motor. Induction motors draw starting currents ranging between 600 and 800% of their nominal full load currents. The current starts at the high value and tapers off to the normal running current in about 2 to 8 sec, based on the motor design and load inertia. Depending on the instant at which the voltage is applied to the motor, the current can be highly asymmetrical. The standard 1159-1995 recommends practice for power quality is "Decrease in RMS value of voltage or current at power frequency for duration from half cycle to one minute, reported variation between 1 P.U. to 0.9 P.U.

Type of voltage sag	Duration	Magnitude
Instantaneous	0.5 – 30 cycle	0.1-0.9pu
Momentary	30cycle – 3second	0.1-0.9pu
Temporary	3second -1min	0.1-0.9pu

Table 1: Voltage Sag

The Voltage sag or Dip is caused by abrupt increase in reactive loading such as switch on the motors, switch on the transformer, severe short circuit fault. Voltage sag is most of the time described by two essential characteristics, one magnitude and one duration. However, the sag magnitude is not constant, due to the induction motor load present in many industrial systems. Voltage sags are most common power disturbances; It contributes more than 80% of power quality problems. Voltage sags are not tolerated by sensitive equipment used in used in industrial plants such as process controllers, programmable logic controllers [PLC], Adjustable speed drives [ASD] and robotics. It has been reported that high intensity discharge lamps used for industrial illumination get extinguished at voltage sag of 20%, the other equipment like PLC & ASD are adversely affected by 10% of voltage sag.

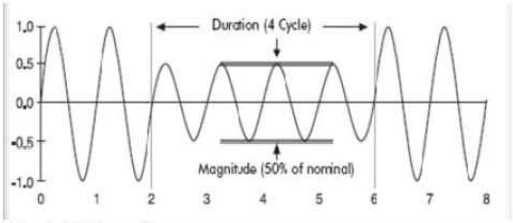


Fig. 2: Voltage Sag

B. Sag Causes - Distribution System

Similar to the transmission system cause, weather (lighting, wind, ice), animal contact, contamination of insulators, construction accidents, motor vehicle accidents, falling or contact with tree limbs can result in voltage sags. Such faults may be 3-phase, line-to-line, or single line-to-ground. The 3-phase faults are the most severe, but are relatively unusual. "Single line-to-ground faults on the utility system are the most common cause of voltage sags in an industrial plant". Preliminary results from the IEEE study indicate that most important cause of momentary voltage sags is lightning strikes. In the majority of sags, the voltage drops to about 80% of nominal value on the parallel feeders, while the faulted feeder may have a lower sag value, it result into an outage if the fault is not cleared. Distribution system sags tend to cluster around several duration ranges, based on the fault protection schemes: 6-20 cycles (typical distribution fault clearing times, 30-60 cycles (the instantaneous reclosing time for breakers) or 120-600 cycles. A typical distribution substation is show in Figure 4. A fault on the 115KV primary side of the transformer (transmission level) will effects all of the feeders, as the 13.8KV bus voltage will be lowered. A fault on a single feeder occurs due to an outage to loads on that feeder, as well as sag on the parallel feeders. The closer the fault is to the substation bus, the more of an effect it will have on the parallel feeders. The fuse blows and Customer located on that branch will

experience an outage, which will last until whichtime that the fuse is replaced. The breaker operates during the fault, all the customers on that feeder experience an interruption of a duration that depends on the reclose setting.

C. Voltage Swell

As per 1159-1995, voltage swell is define as rise in RMS voltage level to 110% -180% of nominal ,at power frequency for duration of half cycle to one minute. It is also short duration voltage variation phenomena, which is opposite to voltage sag or dip.

Types of voltage swell	Duration	Magnitude
Instantaneous	0.5 – 30cycle	1.1 – 1.8pu
Momentary	30cycle 3second	1.1 – 1.4pu
Temporary	3second - 1min	1.1 – 1.2pu

Table 2: Voltage Swell

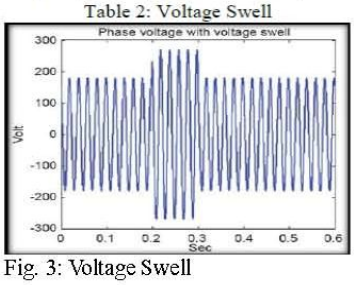


Fig. 3: Voltage Swell

The performance of DVR for a voltage swell condition is investigated. Here, the supply voltage swell is generated. The supply voltage amplitude is increased about 125% of nominal voltage. The injected voltage is formed by DVR in order to correct the load voltage and the load voltage, respectively. As can be seen from the results, the load voltage is kept at the nominal value with the help of the DVR. In comparison with voltage sag, the DVR reacts quickly to inject the appropriate voltage component (negative voltage magnitude) to correct the supply voltage.

The performance of the DVR with an unbalanced voltage swell. In this case, two of the three phases are higher by 25% than the third phase. The injected voltage produced by DVR correct the load voltage. Notice the constant and balanced voltage at the load throughout the simulation, including during the unbalanced voltage swell event.

Voltage swell is described as a drop of 10-90% of the rated system voltage lasting for half a cycle to one minute. The causes of voltage swell are.

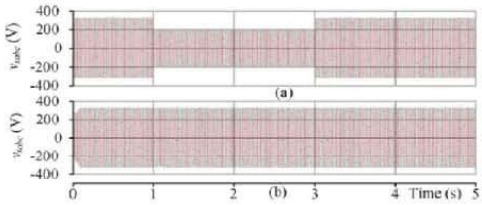
1) Voltage swell are caused by system faults.

2) It can also be caused by energisation of heavy loads.

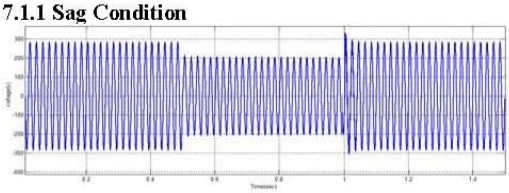
3) In the swell waveform obtained above it can be observed that there is an increase in value of R.M.S voltage during swell. The error signal will show smooth variation during swell period and finally the adoption error will be reduced to zero.

VII. Simulation Results

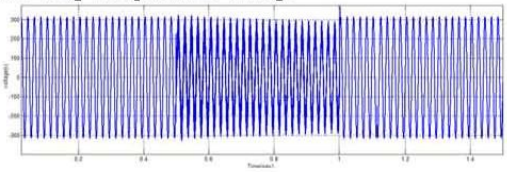
7.1 Conventional Sag Condition and Sag Compensated Voltages



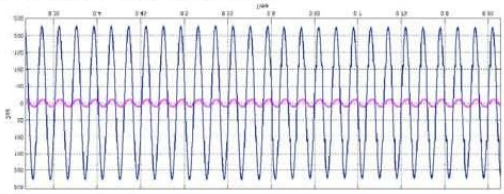
7.1.1 Sag Condition



7.1.2 Sag Compensated Voltage



7.1.3 Power Factor Correction



VIII. Conclusion

The traditional voltage controlled DSTATCOM performance is compared with the proposed scheme. The proposed method has following advantages- at nominal load, the compensator injects harmonic and reactive components of load currents, resulting in UPF; nearly UPF is maintained for a load change; fast voltage regulation has been achieved during voltage disturbances and losses in the VSI and feeder are reduced considerably, and have high sag supporting capability with the same VSI rating

compared to the traditional scheme. Different types of voltage sag conditions should applied compensated in simulink environment. In addition the power factor correction and voltage regulation the harmonics are also tartan, 21% voltage sag eliminate under t=0.49 to 1.1sec, thus the simulation results demonstrate that the proposed scheme provides DSTATCOM, a ability to get better Power Quality problems (related to voltage and current).

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PRATIBHA : INTERNATIONAL JOURNAL OF SCIENCE, SPIRITUALITY, BUSINESS & TECHNOLOGY (IJSSBT)

Vol. 6, No. 1, January - 2018

ISSN (Print) : 2277-7261

ISSN (on-line) : 2278-3857

http : www.ijssbt.org

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COLLEGE OF ENGINEERING & TECHNOLOGY,
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ISSN 2277-7261