# DISTRIBUTION TRASFORMER LOSSES & CONSUMER MONITORING SYSTEM BY FULL VIRTUALIZATION

[1] Dr. Rakesh Rathi (HEAD Of Dept.)
Department of Computer Engineering, Government Engineering College Ajmer
Ajmer, 305001, Rajasthan, India

[2]Vinesh Jain (Asst. Professor)
Department of Information Technology, Government Engineering College Ajmer
Ajmer, 305001, Rajasthan, India

[3]Richa Mishra(M.Tech IV semseter)
Department of Computer Engineering, Government Engineering College Ajmer
Ajmer, 305001, Rajasthan, India

## Abstract
This work will focus on saving resources and generating reports by system based on dot net platform; this system keeps accountability of transformer losses and generates report on timing bases by using MATLAB software.
Any officials having access rights governed by main administrator, Rights are given on the basis of "NO READ UP AND NO WRITE DOWN "model can check details accordingly. Information related to consumer is also governed by this system and details are kept handy.
Reports need to be same without fail and mismatch for analysis at all stations, to avoid these issues Full virtualization is used. Virtualization can provide answers to optimum utilization, speed and cost efficiencies.
This shall also bring us closer to green computing. Desktop Virtualization provides better endpoint Control through centralized management.

***Keywords-Full-virtualization,RD virtualization,VM,Benefits,DTR.***

## 1. Introduction

These days' organizations are moving to green computing to reduce paper wastage and avoiding bundles of hard copy materials, which is not going to be used much in future [11]. Merely officials need those data's for analysis. Saving resources and using it in optimal ways is needed, as electric power i.e. energy distribution system, consumer monitoring and reducing losses is very complicated procedure [1]. If these issues can be handled will be enormous saving for future usage. Other benefits from a system can increase system capacity, and possible rescheduling of capital investments for organization expansion and improvement [2].

An increase in loading will result in an increase of current flow and correspondingly greater amount of loss in the Transformer. Moreover, an unbalance in the system load will increase transformer losses. The harmonic currents will cause a small increase in copper losses; however, the high frequency harmonic voltage can cause large core losses. Frequently, utilities are forced to use an oversized transformer to compensate when a large harmonic presence is indicated [3].

MATLAB software is used for transformers with harmonic loads for calculating losses finally; the obtained results are compared, Efficiency of transformer is measured and reports are generated; Electricity distribution companies could use the total owning cost method to make transformer purchasing decisions. Impact of harmonics is also be important considerations which should be taken in account, Supplying non-linear loads by transformer leads to higher losses, early fatigue of insulation, and reduction of the useful life of transformer.

## 2. Proposed Problems:

1. To avoid paper wastage-Green computing is a solution.

2. Analysis of losses at feeders of transformer –By MATLAB software
   2.1. Before automation products
   2.2. After automation products
   2.3. Daily and hourly bases reading of transformer.

3. To avoid mismatch while generating report for analysis of transformer losses-
   Remote and desktop virtualization is used.( Assumption is -remote location stations may not have same hardware and same operating system to work on, To avoid confusions, mismatch in results and errors in repot generation -remote virtualization and desktop virtualization will be used so same kind of reports will be generated anywhere in a system).

4. To handle and maintain consumer details-Software based on asp.net is developed on the basis of access rights.

Distribution Transformer Losses & Consumer Monitoring System is the role based system to find theft and malpractices area/pockets in distribution network. It defines the distribution of power from power station to consumer's home. MGVCL Supplies power to 23 lack, domestic,

non domestic, small/medium/ large industrial and agricultural consumers of middle Gujarat. The company requires such a system through which they can identify the DTR losses. And by detecting this they can improve their network to reduce power losses soon. So we are here came out with the system which satisfies their requirement which is divided into various modules and it is role based intranet system.

It saves your valuable amount of time and resources of the company and gives platform to the user to fetch the information efficiently. It helps for vigilance activities to identify probable theft in UNITS. This system will helpful to mail the monthly detail of losses to the Circle users so that they can improve the network pattern. This mail will be done by Sub-Division Users. Also Users of any of the Division, Circle or Sub-Division will get mail from Admin that whether they are successfully registered or not as well as they will receive Birthday Wishes from Admin on their respective Birthdays.

This system will be based on hierarchy of Users. The top on this will be the Circle User having access to see all the Sub-Division & Division level Working. Then Comes the Division User will have access to update data as well as to see the Working of respective Sub-Division of that of the Divisions. Then last but not in the least comes Sub-Division User will have access to see Losses reports and other reports of the respective Sub-Divisions as well as access to mail the monthly loss details to the Circle User. These all Users can chat with each-other when they will be online as chat module will be going to implement in this system. Power Supply will be from Power station to Sub Station to feeder to transformer and finally from pole to consumer's home. Basically this system is for monitoring the consumer's consumption pattern, arrears pattern and helpful to find theft and malpractices Area/pockets as well as Transformer and Feeder wise Losses in distribution network.

For achieving solutions for desired problem issues this model can be followed, i.e. green computing, avoiding theft & malpractices, major focus is on utilizing resources at fullest by using FD-virtualization concept.

## 3.THREE SCHEMAS ARCHITECTURE OF SYSTEM

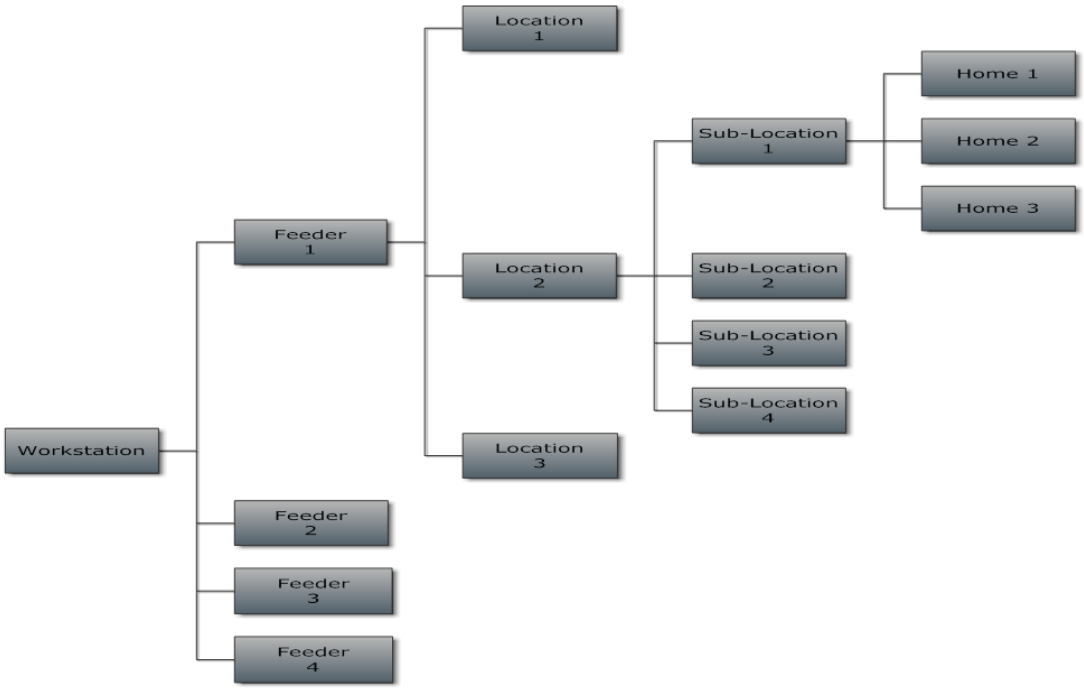



**Figure**: **1**

FIRST SCHEMA- starts from workstation and all transformer feeders.

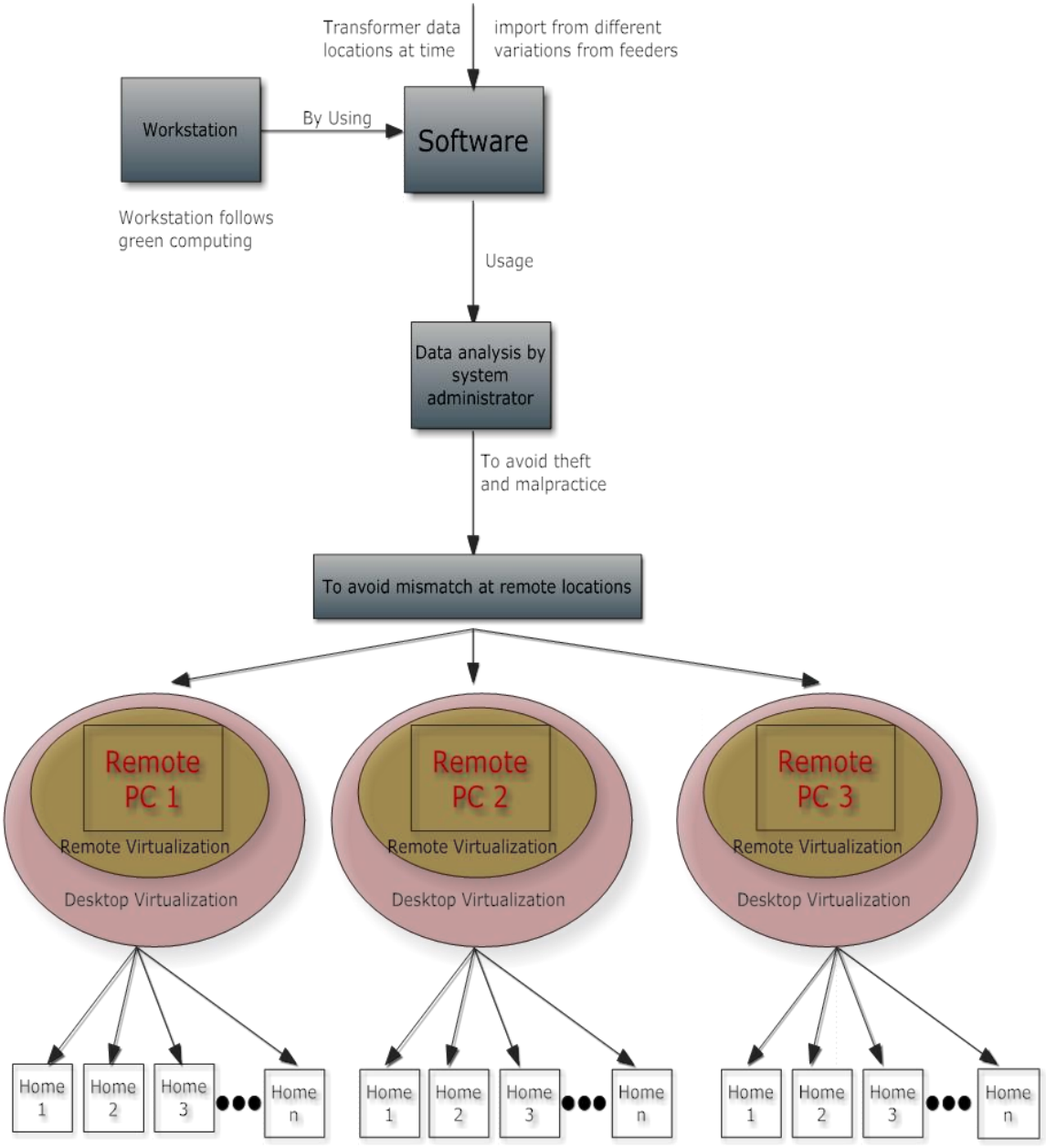
SECOND SCHEMA-starts from all locations covered in that zone like location 1, 2, and 3.

THIRD SCHEMA- starts from sub location1, 2, 3 and home 1, 2, 3.

Electricity flows from workstation to feeders and from there it flows to locations & sub-locations. From there goes to home's attached to it.

## 4.DIAGRAM OF PROPOSED MODEL OF SYSTEM

For achieving solutions for desired problem issues this model can be followed, i.e. green computing, avoiding theft & malpractices, major focus is on utilizing resources at fullest by using FD-virtualization concept.




## 5. TRANSFORMER DETAILS

**Technical data** can be calculated with the help of system like wise;

Rated Power: The rated power of each transformer.

Transformers of different rated power can also be compared

Non load losses: The non load losses given by the manufacturer of the transformers.

Load losses: The load losses given by the manufacturer of the transformers.

Extra losses: The percent of DT current that corresponds to extra losses. (Optional, set 0 if unknown).

Stray losses: The percent of DT current that corresponds to stray losses. (Optional, set 0 if unknown).

Purchase cost: The purchase cost of each transformer. The users can use this field in order to obtain a possible maximum expense for buying a new transformer.

**TABLE-1**

| | | |
|---|---|---|
| RATING | MVA | 50/70/100 |
| RATED VOLTAGE | HV | 220KV |
| | LV | 66KV |
| FULL LOAD CURRENT | HV | 131.2/183.7/262.4 A |
| | LV | 437.4/612.3/874.8 A |
| BASIC INSU LEVEL IMP | HV | 1050/460 KV |
| | HV(N) | 95/38 KV |
| | LV | 350/160 KV |
| | LV(N) | 95/38 KV |
| PHASE | | 3 |
| FREQUENCY | HZ | 50 |

| Transformer Technical Data | | | |
|---|---|---|---|
| | | Existing DT | New DT |
| Rated Power | (kVA) | 1000 | 1000 |
| Non load losses | (W) | 1750 | 1100 |
| Load losses | (W) | 13500 | 10500 |
| Extra losses | (%) | 6 | 6 |
| Stray losses | (%) | 5 | 5 |
| Purchase Cost | (EUROS) | 25000 | 27500 |

**Economical data** can also be taken into considerations like

**Rate of interest:** The current rate of interest.

**Calculation Period:** The period that will be used for the calculations.

**Energy price:** The current energy price

| Economical Data | | |
|---|---|---|
| Rate of interest | (%) | 5 |
| Calculation Period | (Years) | 15 |
| Energy price | (Euros/MWh) | 62.76 |

**Loading data** can also be taken into considerations in software like;

**Annual average load:** The average load that is expected on the transformers on the first year.

**Power Factor of average load:**The power factor that is related to the average load.

**Power Factor of peak load:**The power factor that is related to the peak load.

**Expected annual increase of the load:**The expected presentence of annual load increase. A negative load means decrease of load

**Equivalent time of peak load utilization:** The equivalent time of peak load utilization in hours in one year.

| Loading Data | |
|---|---|
| Annual Average Load (kVA) | 400 |
| Power Factor of average load | 0.85 |
| Power Factor of peak load | 0.82 |
| Expected annual increase of the load (%) | 3 |
| Equivalent time of peak load utilization (hours) | 5500 |

**Annual cost** of losses can also be taken into account

Non load losses: The cost of non load losses in one year.

Load losses: The cost of load losses in one year.

**Capitalized Losses** can also be calculated

**Cost of non load losses:** The capitalized losses cost related to non load losses for the defined calculation period.

**Cost of load losses:** The capitalized losses cost related to load losses for the defined calculation period.

**Cost of additional losses:** The capitalized losses cost related to extra and stray losses for the defined calculation period.

**Total costs:** The summarized costs each transformer.

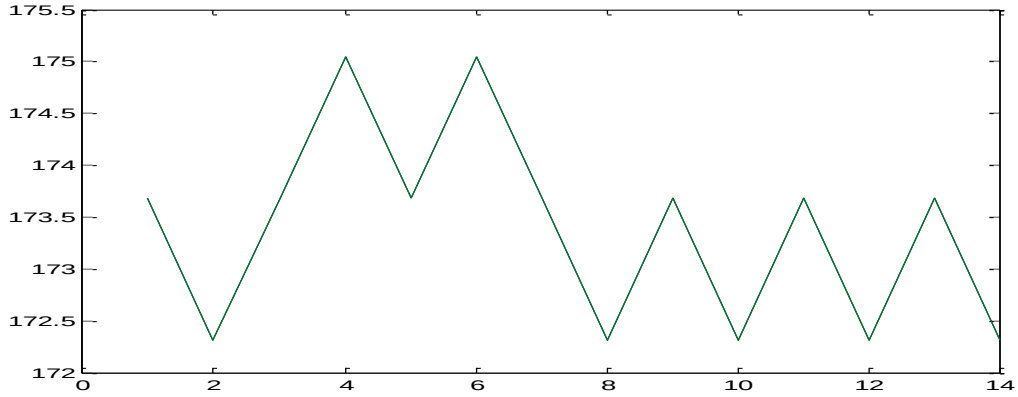
The column named “Existing DT” concern to the distribution transformer that is about to be compared with a new one. This data of table 2 is of MW (active Power) at LV (Input) and HV (output side) of transformer having below details. This data is for one date, we can choose the

points each at half an hour duration or so, and can plot waveforms of digital to analog in MATLAB.

**TABLE-2**

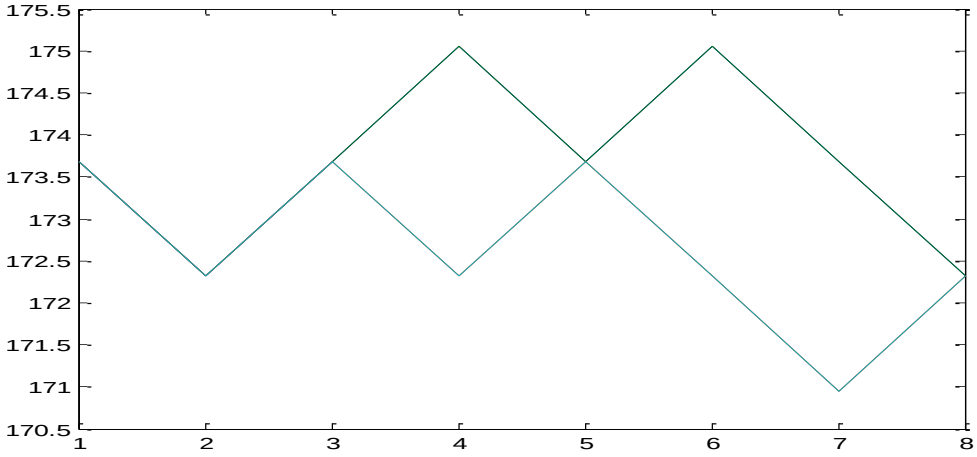
| | | | |
|---|---|---|---|
| 25:JUN:2012 | 22:34:19 | 185.985840 | 185.985840 |
| 25:JUN:2012 | 22:34:31 | 187.353058 | 187.353058 |
| 25:JUN:2012 | 22:34:43 | 185.985840 | 185.985840 |
| 25:JUN:2012 | 22:37:19 | 187.353058 | 187.353058 |
| 25:JUN:2012 | 22:37:55 | 185.985840 | 185.985840 |

**Figure-2**



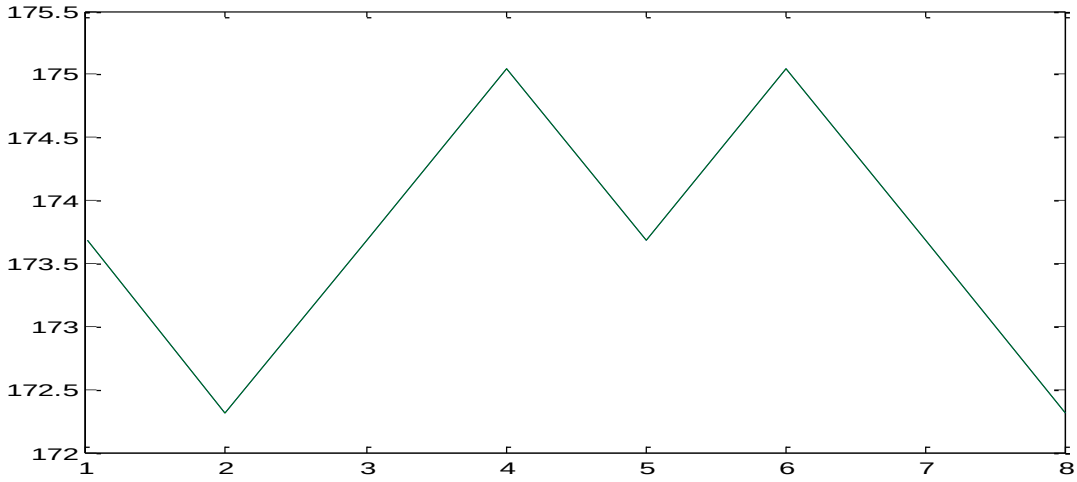

Power fluctuation shown in figure-2, input and output relationship of transformer is done on Matlab

**Figure-3**




Transformer losses are shown in Figure-3

**Figure-4**




Average losses is shown in figure-4

## 6. MODELING AND SIMULATION

From the manufacturer data and test report provided by HONEYWELL AUTOMATION INC. The parameters of the transformer were calculated from the equivalent circuit, Table -1 presents the parameters for the 220kV (HV) and 66KV (LV) for rated voltage. The full load current HV (131.2/183.7/262.4 A) and LV (437.4/612.3/874.8 A).

Types of Losses has been calculated in previous work [4,7,8], but in this work we need to calculate percentage of loss at feeders so malpractices can be reduced by considering preventive measures calculated by using different methods[5,6].By using formulas which can be feed to software and analysis can be done on that basis electricity department can take decisions.

## 7. Formula's used by software to evaluate results

Related work and other formulas calculated [9]

The data available at workstation and sub-station can be accessed by using this system which can give more advantages likewise

- Real Time monitoring and control of substations
- Load forecasting
- Fault localization
- Power factor control
- Offline use
- User friendly
- Detailed help
- Calculation methods

***Annual Energy Losses, (KWh):***

**Annual No-Load Losses** = 8760 · (NLL), where:
- NLL, non load losses (KW).
- 8760, total hours per year.

**Annual Load Losses** =
= (Total Current) · (1 - Extra Losses - Stray Losses) · (LL) · $\beta av^2$ · 8760, where: 2
-Total current, see below.
-LL, loads losses (KW).
-Extra Losses & Stray Losses (%).
- βav = Sav/ Sn, where Sav(Annual average load) and Sn the rated power of the DT ( KVA).

**Annual Additional Losses** =
= (PFactor Windings Extra Losses + Pfactor Stray× Stray Losses) · (LL) · $\beta av^2$ · 8760,
where:
-Pfactor Windings & Pfactor Stray, see below.

**Annual Total Losses** =
= Annual (No-Load Losses + Load Losses + Additional Losses)

**Total Capitalized Cost** =
= (Purchase Cost) + (Capitalized Cost of No-Load Losses) +
+ (Capitalized Cost of Load Losses) + (Capitalized Cost of Additional Losses)

***Capitalized Cost (€):***
**Cc** = PC + A · Po + B · Pκ, where:
-PC, DTs purchase cost.
-Po, Non load losses in Watt (W).
-Pκ, Load losses in Watt (W).
-A,B in € / W.

**Formula to calculate percentage error**

$$\boldsymbol{R = \frac{x'}{x} \times 100}$$

**R= percentage error**
**$x'$ =sum of output values i.e. HV of MW**
**$x$ = sum of input values i.e. LV of MW**

According to data provided by the company, HONEYWELL AUTOMATION INC. lets calculate average error.

**11849/11851*100=9.998**
**Average error is 9.998**

## 8. FULL VIRTUALIZATION

Free remote and desktop software products are available like Alpemix, Ammyy Admin,Remote Utilities for the usage accordingly but only difficulty will be faced by this system i.e. different configuration, hardware & operating systems at remote PC's will create trouble by generating mismatch at desired reports, so full virtualization technique is used to subside all issues. Virtualization is one kind of simulator of the hardware/software upon which other software runs. This is called as virtual machine (VM) and full virtualization means two or more Oss and the applications run on the top of virtual hardware, each instance of an OS and its applications runs in a separate VM called a guest operating system.

The guest Oss on a host are managed by hypervisor, which controls the flow of instructions between the guest OSs and the physical hardware, such as CPU, disk storage, memory, and network interface cards, this increases operational efficiency but has some negative security implications

## 9. PURPOSE

The purpose of the Consumer Monitoring System is to build a system, which can be use to manage the consumer's details with DTR wise losses summary, Feeder wise loss summery, Tariff or Status Wise Consumer's Details, Meter status history, etc. It is to monitor the consumer's consumption pattern. It is useful to find out losses pattern after system improvement work and feeder bifurcation etc. The purpose of this system is that to implement the system in such a way so that every respective User of Respective Circle/Division/ Sub-Division can use it as per their roles.

Users who are the company employees, based on their role they can register to the system and make his/her profile and as per their roles they will be provided various facilities to Summarize the data as well as they will have various authorities like to send mail and update entries or import any other data etc.

The administrator covers the whole system and he/she is having the permissions to add or remove the role based users. The administrator can update the Circular, New or Events etc. The administrator is responsible to maintain all users, and all user types. Administrator has the authority to send Birthday greetings to the respective Users and as well as recruit them.

## The main objective of this system is:

- To improve efficiency of the system
- To improve the processing of power losses recognisation.
- To find theft and malpractices area/pockets in distribution network.
- To provide up-to-date information for all kind of data of consumers.
- To report on DTR losses status and Feeder wise losses and many more.

### a) SCOPE

The Web Based Consumer Monitoring System provides the Consumer Whole history of billing details & master details on the desktop of the employee for better monitoring of consumer consumption pattern. Through this system billing data available which is useful to the company like in revenue protection activities, T&D Loss reduction, Vigilance activities, consumer satisfaction etc. The web based Consumer Monitoring System provides the LT consumer the history in the form of units, with billing & payment details & in graphical formats & master details on the desktop of the employee for better monitoring of consumer consumption pattern. So thus corporate office available on desk.

The system also provides information about the various available events.

- **Security:** System can be used by only those employees who are assigned a login and password. No other user can access the system.

- **Clear Visibility:** the user of the system has the clear form of analysis based on his access and they can have the idea about to manually handle the area where more losses of electricity are generated as soon as they come to know through monthly data analysis.
- **Better Decision Making Ability:** With more information readily available, company department can make better decisions time.
- **Consumer Details:** It provides master details of all consumers to the respective Users and department to handle it out and to verify.
- **Mail**: Losses mail will be sent to circle user. Admin will give registration verification to the Users of this system.
- **Efficiency to admin:** admin can manage the whole system and can recruit the Users as per their profiles.

### b) USER CHARACTERISTICS

This system is basically for providing support for monitoring the power consumption pattern for particular company and also provides detail information about the various consumers.

This System has four types of Users.

1. Administrator
2. Circle user
3. Division user
4. Sub-divisions user

### c) CONSTRAINS

**Regulatory Policies**

- The software will work using 3-Tier architecture. Hence necessary software is needed to be installed.
- The system is relatively heavy and therefore requires huge bandwidth.

**Hardware Limitations**

- Requires a large sized RAM.
- Require only the company server to mail and message.

**Reliability Requirements**

- User is ensured that the system would be reliable at the time of Power Failure.

**Criticality of the Application**

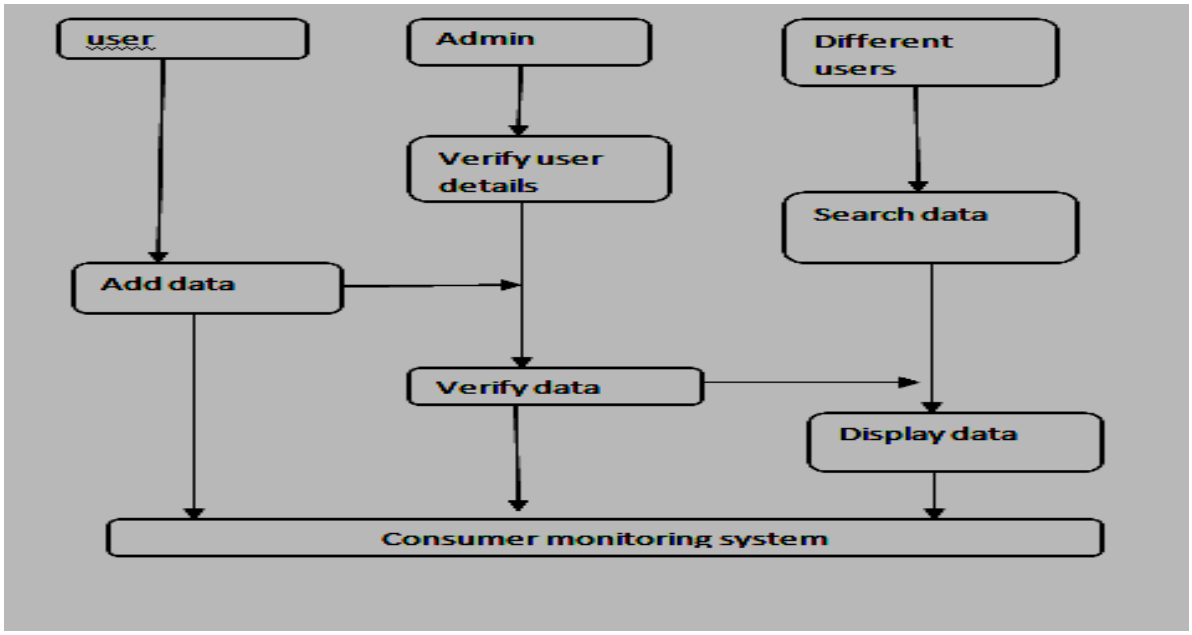
- If the user enters the wrong command at the wrong time then the system may not work according to desire.
- If the user forgot the username or password then the system may get some time to remind it by mail or message.
- Dummy Report generation may take place when the data is not accurate.

**Safety and Security Consideration**

- The software does not encourage the entry of any malware that can cause any problems with the computer of the user.
- The user is ensured that there would be no data loss while using this software.

## 10. MAIN MODULES OF NEW SYSTEM

**Figure: 6**




System flowchart based on Dotnet.

# 11. SELECTION OF HARDWARE AND SOFTWARE JUSTIFICATION

**Hardware Technology:**

The end user of the company doesn't have the knowledge when problem occurs in the client machine. Due to any internal errors machine may get hanged and the user will not be able to understand he must have to wait until situation is resolved. So to overcome this all, client user needs highly configured system at his machine with LAN connections. This project is based on the internal users of the MGVCL. Minimum requirement of the tools used in the development process are requested for the developer's machines. As the development process should not be affected due to any type of hardware failure or software error.

**Software Technology:**

The only software is needed on the client machine: Internet Explorer 6.0 or higher version of it as the browser should be capable enough to understand the advance html responses generated by the server. We are using the Microsoft visual studio Microsoft SQL server 2008 as they both provide best tolls with configuration.

The .NET Framework is designed to fulfill the following objectives:

To provide a consistent object-oriented programming environment whether object code is stored and executed locally, executed locally but Internet-distributed, or executed remotely. To provide a code-execution environment that minimizes software deployment and versioning conflicts. To provide a code-execution environment that promotes safe execution of code, including code created by an unknown or semi-trusted third party. To provide a code-execution environment that eliminates the performance problems of scripted or interpreted environments. To make the developer experience consistent across widely varying types of applications, such as Windows-based applications and Web-based applications.

## a) MODULE SPECIFICATION

**Following programs/modules are included in my system:**

1) Admin

2) User
3) Feeder
4) DTR
5) Mail
6) Report
7) Chat
8) Security

- **Admin Module:**

Admin registers the different types of circles, Divisions, Sub-Divisions and Departments as well as Designations. Admin also updates the news and events and circulars. Admin also recruit Users.

- **User Module:**

User modules having different types of users.

1) Circle User: Circle User can see the whole system with its respective division and sub-division. Circle User can do analysis of all the reports
2) Division User: Division User can update the master as well as ledger data of the system ad can see the respective reports of the divisions having sub-divisions.
3) Sub-Division User: Sub Division User can import the new data in the system and he/she can see all the reports of respective Sub-divisions.

- **Feeder:**

Feeder module contains various reports like Feeder wise Tariff wise total load as well as total consumers, Feeder wise total loss of power and Feeder wise all consumer Details etc. In this module we have found sent out and sold out units of the particular year and month and with respective Feeder No.

- **DTR:**

DTR module contains various reports like DTR wise Tariff wise total load as well as total consumers, DTR wise total loss of power and Feeder wise all consumer Details etc. In this module we have found sent out and sold out units of the particular year and month and with respective Transformer No.

- **Mail Module:**

The Admin will send greetings to the User of any of the division, circle or sub-division on Birthday through mail. The Sub-Division User can mail losses of feeder and Transformer to the Circle at every month. If any User forgot the password then it will be provided by mail to him.

- **Report:**

There are various types of crystal reports here in this system like Transformer wise consumer details, feeder wise consumer details, status wise consumer details, Feeder wise loss, DTR wise loss, Feeder wise tariff wise total load, Dtr wise tariff wise total load as well as total consumers etc.

**Chat:**

Here in this module various types of Users can interact with each-other through chat and send each-other direct information.

**Security:**

The security will be provided by encryption of password through MD5 algorithm. Users can have answer of security questions to remind them their passwords as well as username. Another thing is that User only can login to the system if and only if admin recruit him/her whether User has registered or not

## b) SECURITY FEATURES

In this application Login id and password verification is required. User should Login with authenticate Login id and password as well as user should verified his/her password. Failure to do this will not allow to user to access the application.

- User passwords are encrypted with MD5 algorithm so that hackers cannot access the passwords

## c) Samples of Forms, Reports and Interface

## HOME PAGE & ADMIN LOGIN:

**Figure -7**


Description: The Homepage Of the main website contains the circular with news/events.

**Figure -8**


Description: The Admin Homepage Of the main website contains the circular with news/events and time.

## 12. CONCLUSIONS

Created software can help in achieving green computing and also land up to solutions regarding issues which electricity department faces; likewise maintaining consumer details and making handy information to view anytime from any remote locations on the basis of access rights given to users.

Transformer details can be calculated easily as technical data, economical data and loading data can be inserted easily in software and analysis can be done for capitalized losses, Average losses, transformer efficiency and annual cost of losses for transformers, used at workstation and remote locations.

To avoid mismatch in results, concept of full virtualization is made applicable to avail the benefits of the concept, technique fully virtualizes the main server to support software, and it creates the environment as if it is working on a unique server, this technique enables the administrators to run unchanged and totally virtualized operating system, this helps in reducing the physical space and increasing the overall performance of the electricity department as it grants the potential to combine existing systems on to the newer machines with increased efficiency and a well organized hardware. It also helps to cut down the operating costs consumed in wear and tear of older systems.

## 13. FUTURE SCOPE

This concept can be used online more efficiently in future with enhanced security features and optimal results as output.

Compatibility can be increased so it can easily use any type of environments and circumstances.

It leads to big achievements in the area of green computing and distributed computing ultimately leads to green cloud, which is topic of interest in future.

## 14. REFERENCES

**1**. Targosz, R. and Topalis, F.V Energy efficiency of distribution transformers in Europe", 9th International Conference on Electrical Power Quality and Utilization, 9-11 Oct. 2007 pp.1 – 5.

2. Lowenstein, M.Z., "Eliminating harmonic neutral current problems", IEEE/PES Transmission and
Distribution Conference and Exposition, 21-24 April 2008, pp. 1-4.

3. Losses Reduction in Distribution Transformers. IMECS, 2011, international multi conference of engineers and computer scientist vol-2

4. Comparison of Distribution Transformer Losses and Capacity under Linear and Harmonic Loads.2nd IEEE International Conference on Power and Energy (PECon 08), December 1-3, 2008, Johor Baharu, Malaysia

5. Determination losses and estimate life of distribution transformers with three Computational, measurement and simulation methods, despite harmonic loads in renewable energy and power quality journal 12th may 2011, reference paper.

6. IEEE Std C57.110-1998, IEEE Recommended Practice for Establishing Transformer Capability when Supplying Non-Sinusiodal Load Currents

7. S .B. Sadati , A . Tahani , B . Darvishi , M . Drgahi , H . Youefi "Comparison of Distribution Transformer Losses and Capacity under Linear and Harmonic Loads "PECon 2008, IEEE 2nd International Power and Energy Conference 2008,1-3
Dec.2008, pp.1265-1269

8. Performance Monitoring of Energy Flow in the Power Transmission and Distribution System Using Grid Computing, Journal of Computer Science 3 (5): 323-328, 2007 ISSN 1549-3636 © 2007 Science Publications by C.Senthamarai,A.Krishnan and 3R. Hemalatha, Key Skill/Key Soft Solutions, Bangalore, India

9. LiteGreen: Saving Energy in Networked Desktops Using Virtualization by *Pradeep Padala*.