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REAL TIME ANALYSIS AND LOSS REDUCTION OF TRANSMISSION LINE USING GSM TECHNOLOGY

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ABSTRACT

Designing and implementing commercial as well as industrial systems based on Wireless. Robust communication has always been a prominent field of interest among many researchers and developers. The proposed GSM based system always calculates the utilization factor and plant efficiency and communicates to the subsystem. The sub system program architectures can be defined in such a way that, the set points can be altered (only increases) as per the transmission input. This paper presents design and implementation methodology of a real time fault analysis and loss reduction on transmission line using GSM Technology. Using GSM as the medium for fault analysis provides a cost-effective, wireless, always-connected and bi-directional communication as a message or data. The line losses expected at various levels are predefined and beyond that to be notified by smart data acquiring system, which can act fast and alert the electricity authorities about the same.

Keywords: Transmission line, GSM, data acquiring systems, Real time fault analysis.

1. INTRODUCTION

For increased demand and de-regulated power system an advanced technology is required to acquire, control and decision making purposes. By a proper monitoring and effective communication system, we can automate the fault-finding system of the transmission and distribution to improve the utility factor, uninterruptible power, reduce losses and save the time thereby saving the cost. A real time implementable model design suitable for all kinds of transmission lines and could be installed irrespective of the operating conditions need to be designed with robust communication techniques.

Many communication technologies were used in different periods like carrier power line communication, Radio frequency based control system, Supervisory control and data acquiring systems, Distributed control systems and Internet based communications. Out of which power line communication is widely used in many fields. Each of the above has its own merits and demerits.

Utilizing power network for data transmission is not a new idea [1-3]. It started as early as the beginning of the last century. Power line communication is used in many applications like automatic meter reading, [4], wireless communication for meter reading [5], power thefting, power system protection etc., It also has some drawbacks. When ever there is disconnection between two ends of transmission line, the communication can't be possible, which leads to reduction of utility factor and plant efficiency.

A Robust GSM technology is introduced in this paper to overcome the above mentioned drawback's is an open, digital cellular technology used for transmitting mobile voice and data services. It divides each 200 kHz channel into eight 25 kHz time-slots. GSM operates in the 900MHz and 1.8GHz bands. It has an ability to carry 64 kbps to 120 Mbps of data rates.

The visual basic (VB 6.0) version is used to interface hardware and computer for lucid way of communication between human and GSM.

2. RELATED WORK

This section provides a previous study of related work regarding the application of SMS services in a various fields. Some previous researches have been studied to gain more information about current existing GSM control system that was previously implemented. It is necessary to know and understand how the software and hardware were used in the SMS controlled system development. This is to ensure that the study that currently being conducted contribute at certain level of application thus it become more efficient and practical.

Several smart home projects such as Home Security with Messaging System [6], Security and Control System [7], and Remote and Security Control via SMS [9] were the three alarm system that were designed using SMS application to securely monitor the home condition when the owner are away or at night. The system developed [7] is automating the power reading meter to send the energy consumed to e-billing system at authorized office. The work presented by [8] is about the development of Integrated Water Billing System with SMS capability. The system was implemented using Visual Basic and database in order to perform the prototype and the system works successfully in sending SMS to user for notification. Furthermore, the system developed by [9] is to control the switch for lamp, door and alarm system using Visual Basic 6.0 software. Visual Basic was chosen because it can easily communicate between computer and mobile phone. Vehicle Speed Detection using SMS [10] presented the design of the black box for warning system to control the exceeding speed of express bus via SMS. There fore the accident can be prevented as well. Moreover, the projects for Acquiring Water Level and Temperature Status via

SMS [11] also have similarity with this project. This project utilized PIC 16F877 and MPLAB IDE software for programming. The project was designed to detect level and temperature of the water in a pool.

A very similar project also have been implemented by Serasidis Vasilis [12], who has developed and designed a device that can control variety of electrical home appliance using SMS. The system works based on the order message from user through mobile phone which is ON or OFF. This system also utilized mobile phone as a receiver which connected to the microcontroller. The circuit can control 8 electrical home appliances at any one time. It is used AT 9052313 microcontroller and Ericsson T10s mobile phone as a receiver at home. The software for programming that was used is MPLAB IDE. Besides that, Noraini [13] presented the used of RS232 devices computer and controlling system as hardware and RS232 interface with Visual Basic 6.0 as software to control lamp and fan. The system activates when microcontroller send ON or OFF to the devices via computer.

3. PROPOSED WORK

Many data acquiring systems are available in the commercial markets, but, often fails to meet electrical environment, which need to work in the open area (Hostile environment). The data acquiring system works at hostile environment to be specially designed to meet all types of electrical disturbances. The device should acquire the data at the below mentioned conditions.

- Electromagnetic interference
- Radio frequency interference
- Voltage sag/swell
- Harmonics of various levels

With extreme fluctuations of frequency and current. The data acquiring system design accepts the AC voltage & AC current and produces power output with four quadrant analog multiplier. The data acquiring system is entirely free from all electrical, electronic, software attacks. The proposed data acquiring system is shown in Figure-1 consists of the following devices.

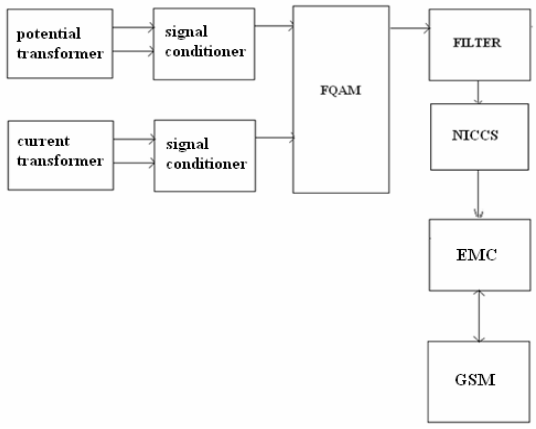

Figure.1. Data acquiring system.

- Isolation transformer
- Signal conditioning circuits
- Four quadrant analog multiplier
- Embedded controller with serial function
- GSM modem-dedicated

The above said devices must be housed together and powered by photo voltaic charging system for greater reliability. The solar powered devices on transmission line ensures the status of the line irrespective of the power status apart from the above domestic power requirement is complicated in transmission line. Power requirement for GSM devices and other computing circuits will be challenge near the high power transmission line. Using of low power distribution network will often costly and requires more space and may not withstand open environment condition.

Figure-2. Existing transmission line with proposed DAS box.

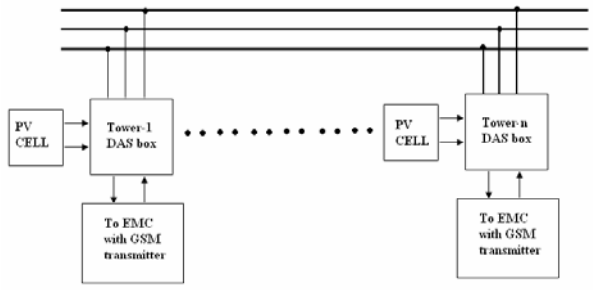

Figure-3. Proposed sensing block with PV.

A low power distribution network designed for one transmission line may not be suitable for all the transmission lines because voltage level differs. To consider all these solar is inexpensive, easy to maintain and of course we have bright sun around 340 days minimum in southern parts of India. Storage of power also will be an issue that can be solved using better self life batteries or super capacitors. Extreme care has taken for reduction of power consumption by the data acquiring system and GSM device. The expected power consumption of overall system may be around 3w at extreme case and will be less than 1w at normal case.

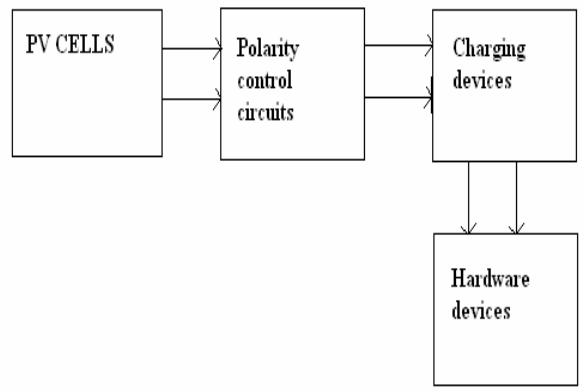

Figure-4. Power module without high frequency switching.

The general simple and commercially used charging technique is shown in Figure-4, but the proposed will have improved version of this charging system is shown in Figure-5, which can charge the battery at lower sun lights. Existing transmission line with proposed DAS box is shown in Figure-2. Proposed Sensing block with PV is shown in Figure-3.

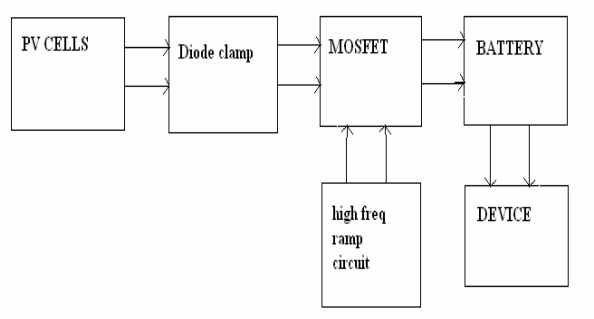

Figure-5. Power module with high frequency switching.

The above circuit will be employed to charge the battery and can be continuously used.

3.1 Potential transformer

Potential transformer (PT) used here suits to all the standards of electrical transmission and distribution. The PT provides greater isolation along with ratio metric reduction of voltage. This could be class-I accuracy comes under Instrument transformer. The general specification will be 330kv/110v AC. The circuit diagram of the voltage sensing is shown in Figure-6.

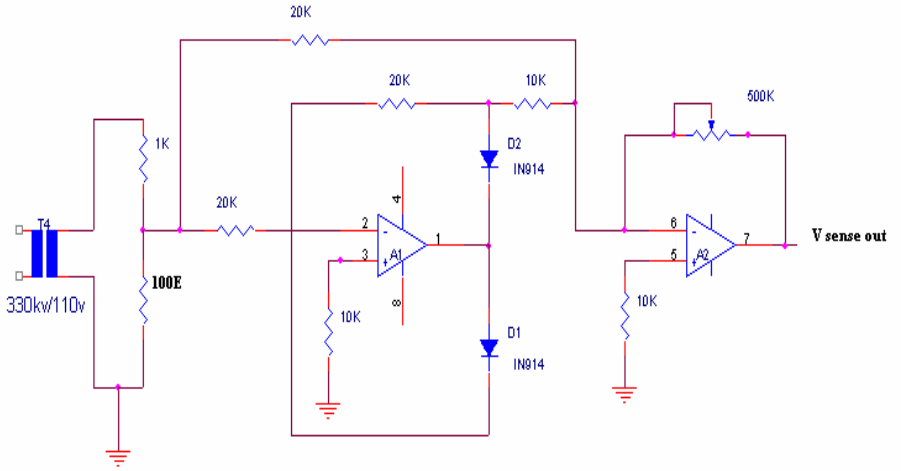

Figure-6. Transmission line voltage sensing.

3.2 Current transformer

Current transformer (CT) used here is xxx/5Amps. Its sensing transmission line current is shown in Figure-7. Extreme care for shunting is taken to avoid accidents. The perfect specification of CT will be 1000 Amps/5Amps with shunt resistance of 0.1Ω whose burden will be 5VA according to the industry standard.

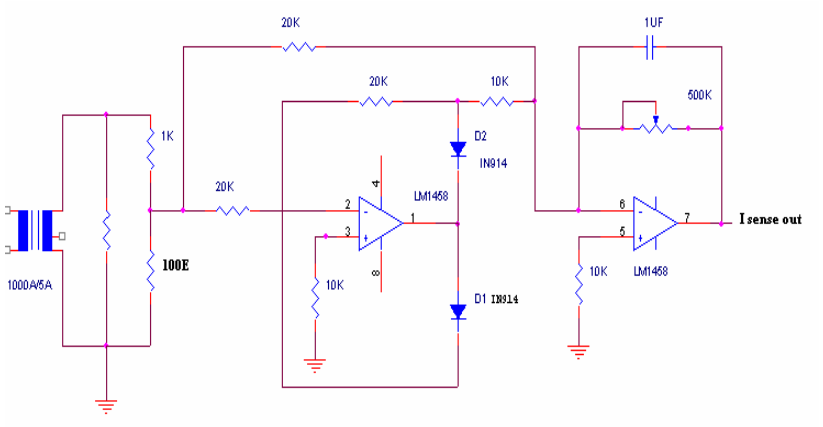

Figure-7. Transmission line current sensing.

3.3 Signal conditioners

Signal conditioners are linear integrated circuit based full wave precision rectifier produces rectified but unfiltered signals of the actual value of voltage and current. This provides 100Hz signal along with real voltage and current magnitude. The reason to avoid filtering at this stage is to set four quadrant multiplications to set true power. These circuits will have built in protection circuits for high voltage and short circuit hazards.

3.4 Four quadrant analog multiplier

Four quadrant analog multiplier (FQAM) shown in Figure-8 is essential to convert the voltage and current as power with four quadrant calculation. Timeless multiplication can be achieved and all sorts of multiplication errors can be removed by multiplier trimming procedure. These devices have five zero correction, gain control and perfect impedance matching with other linear circuits. Filter will be added in this stage to avoid 100Hz signal.

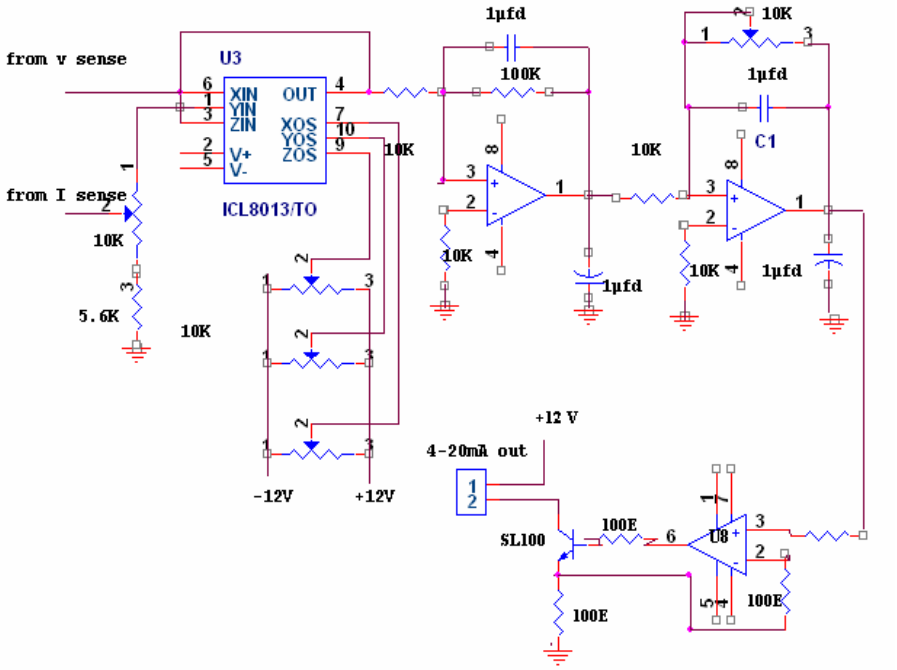

Figure-8. FQAM with NICCS.

Output of the FQAM will be fed to a 4-20mA transmitter circuits to meet international signal transmission standards through wire to avoid losses and to create signal isolation. The standard 4-20mA provides excellent safety functions, entirely free from electrical noises and transient effects, avoids losses, provides isolation, least components are required and compatible with all types of controllers in the world. These devices use Non Inverting Constant Current Source (NICCS)

concept. According to the available data maximum permissible loop resistance should be less than 600 ohms.

3.5 Non inverting constant current source

NICCS will be made up of one OP-AMP and a transistor, whose output will be in the form of current, by shunting with 250Ω resistor, the current can be converted into 1-5v order. If the voltage goes lower than 1v, we can conclude that a loop failure occurs.

3.6 Embedded microcontroller

Output of the transmitter can be connected to an embedded microcontroller (EMC) is shown in Figure-9. for digitizing. The digitized signal can further be converted into RS232 standards to interface with GSM device.

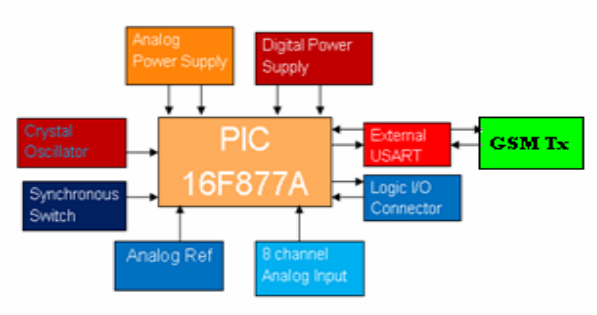

Figure-9. Block diagram of EMC.

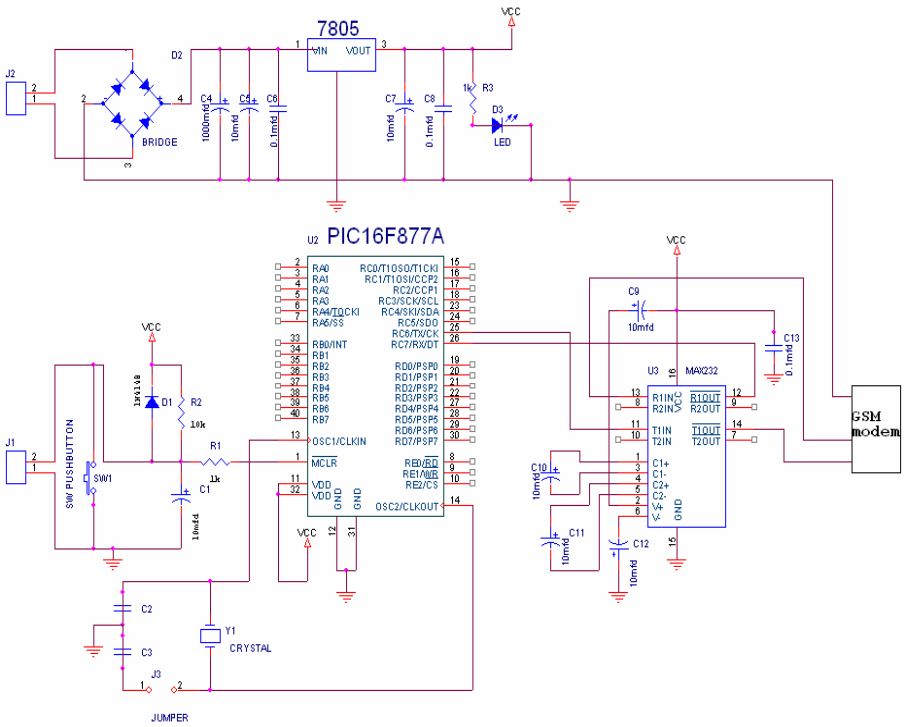

Figure-10. Circuit of EMC.

The state of art embedded technology is used in this work to minimize the electronic hardware. Embedded technology is used everywhere to minimize the cost and maximizing the work ability. Embedded systems will have all the needs of industrial control, monitoring, interfacing with any latest communication systems like GSM, CDMA. Flash Embedded technology to achieve higher speed from MICROCHIP Corporation or ARM-7 controller is used in the present work along with appropriate electronic hardware to have better interface with the computer. The EMC circuit is shown in Figure-10.

4. RECEIVER BLOCK DIAGRAM

The block diagram of receiver module is shown in Figure-11. Many GSM receivers will be connected in a single hub, the hubs are multiplexers. The output of hubs will be connected to a microcontroller. The microcontroller will have two functions. One will be selecting the GSM by generating control signal to the multiplexers; secondly the data received from the GSM receiver must be converted into serial and again converted into RS232. The RS232 output will have 9600 baud rate speed and connected with software. As per the software algorithm simultaneous data of all GSM receivers will be presented on a single screen and corrective measure software will be enabled.

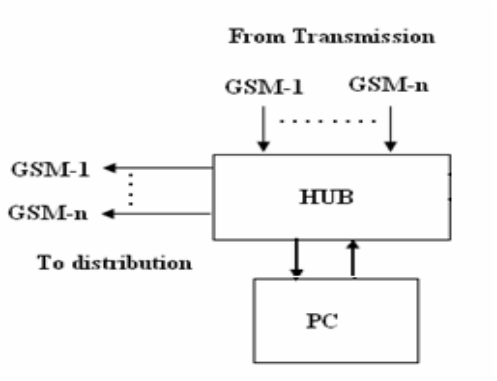

Figure-11. Block diagram of receiver module.

According to the proposed scheme of fault finding, more numbers of GSM transmitters installed in various levels of transmission towers will be transmitting data to the both ends like grid and feeder stations. A possibility of removal of loads ratio on one particular line and that can be added to other feeding lines. Balancing the loads and keeping the loads constant as per the plant efficiency (sum of all feeding) will reduce most of the losses occurred in the power sector.

The proposed scheme collects the power handled by each transmission tower and passes the data to the control ends and collective decision taken will be possible. More number of GSM receivers connected to a single computer, analysis made, losses calculated, utility factor calculated, final data will be passed to various distribution ends to plan their demand based on UF (or) Automatic updating of demand percentage time to time.

The UF based demand management will reduce various burdens on transmission line and keeps devices perfectly. The proposed scheme present data like power handled by tower to tower, losses on exact MVA between tower to tower, loss percentage at each tower, overall efficiency of starting to end transmission line, data losing of various events like real values, loss MVA at various points, loss percentage with real time.

And as a decision making system, our scheme will deliver control outputs in the form of digital and will be converted into RS232 standard. The RS232 data will be converted into GSM signals and passed to distribution end.

5. RESULTS AND DISCUSSIONS

Various data received from remotely located GSM transmitter is processed using hub and fed to visual basic software. The serial data received from GSM modem is fed to multi channel RS232, the serial to parallel conversion is done, the data is separated and organized to their appropriate column; the real time data received directly from the field is denoted as GSM data. Each GSM data received from different locations are manipulated and the exact loss between points is presented in column-2 and the final is percentage of loss between locations to location. (e.g., location 1 to location 2). The last column is animated box represents green color under normal transmission loss, where red color considered being the loss greater than 10%. As per the requirement criteria the database can be enabled, disabled and viewed.

The results shown here is a real-time data obtained from different GSM receivers from different places. The power delivered from the grid, power received of various points of transmission, the losses occurred at each level, percentage of losses at each level and animating the tolerance limit of losses fixed by department of Electricity regulation authority. The result shown in Figure-12 is a normal transmission line without any failures.

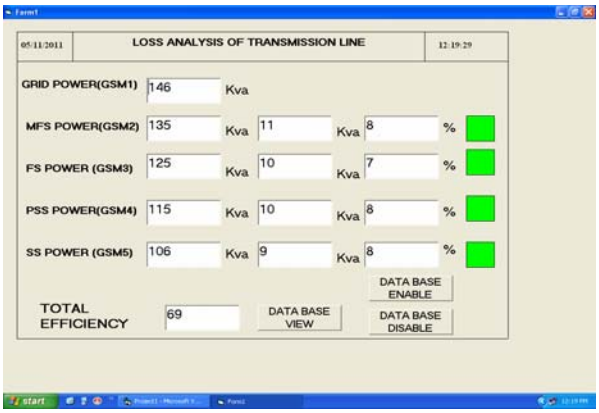

Figure-12. Transmission line without failure.

The database is shown in Figure-13 received from the real time system is presented here for future verification of loss levels at different and equal time interval at various points of transmission line.

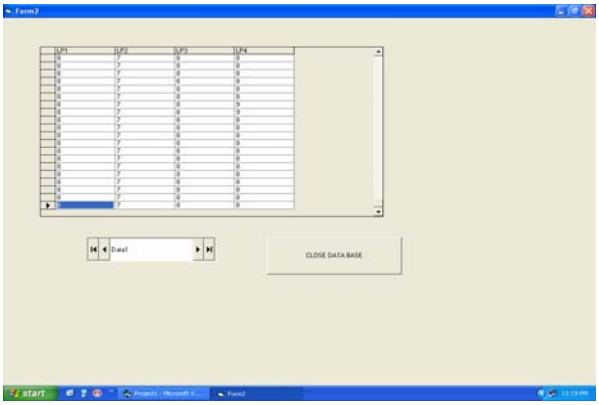

Figure-13. Database of transmission line without failure.

The data obtained on real time environment (Figure) with more loss on point 1 to point 2, so the losses between the points is noted high, exceeds 2% beyond the limit is shown in Figure-14. The decision can be made manually or automatically to remove and divert the loads as per the load dispatch analysis. Once if the loss goes beyond the permissible limit the concern switch gear can be turned off (trip) and optimized path can be analyzed by GSM network and the load will be connected to optimized path. The optimized path will be identified using various

interconnected GSM networks. There by utilization factor can be maintained throughout the time and keeping the plant efficiency constant.

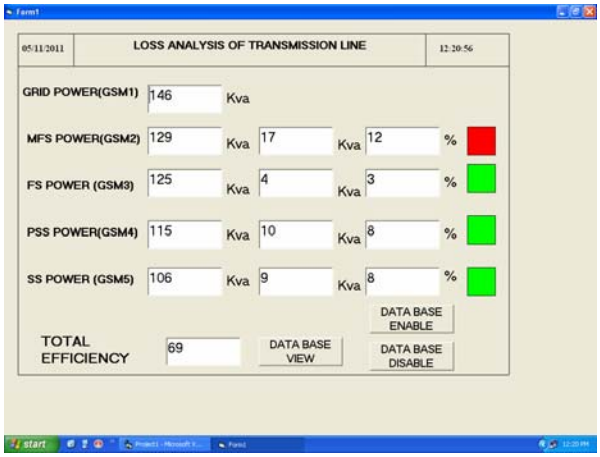

Figure-14. Transmission line with loss at one point.

Database is shown in Figure-15 shows the losses beyond the permissible limit between point 1 and point 2 at one particular instant. The duration of higher loss can be visually seen on this result.

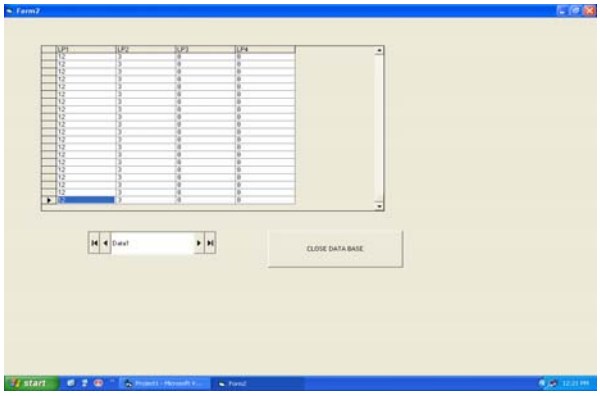

Figure-15. Database of transmission line with loss at one point.

Figure-16. shows with more loss between point 1 and point 2, point 3 and point 4 so the losses between the points is noted high, exceeds 1% and 2%, respectively beyond the limit.

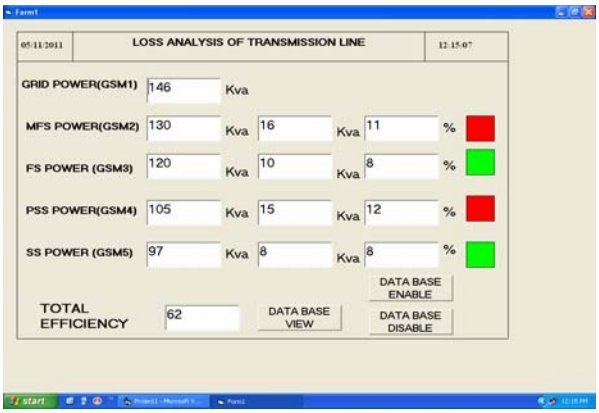

Figure-16. Transmission line with loss at two points.

The database shown in Figure-17 shows the losses beyond the permissible limit between point 1 and point 2, point 3 and point 4 at one particular instant. The duration of higher loss can be visually seen on this result.

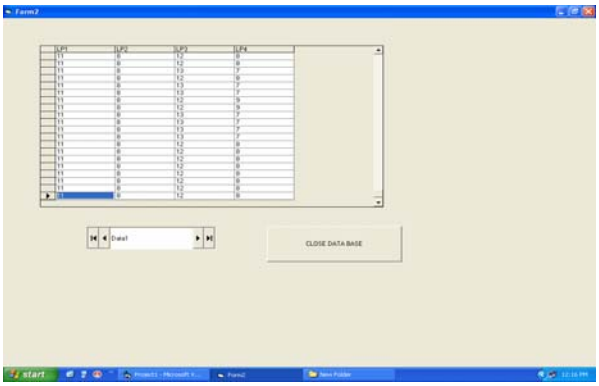

Figure-17. Database of transmission line with loss at two points.

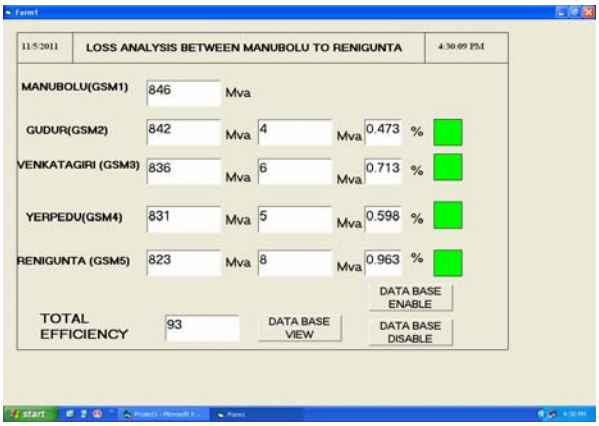

Figure-17. Manubolu to Renigunta TL without fail.

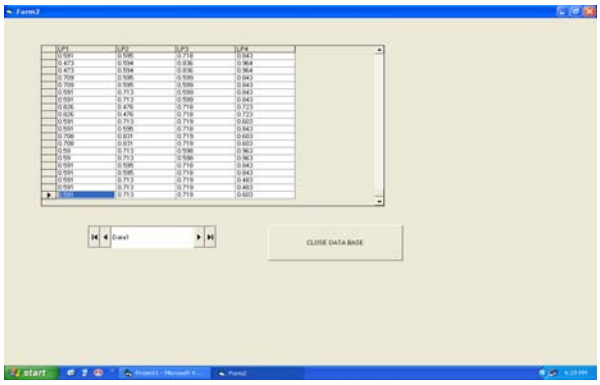

Figure-18. Database of Manubolu to Renigunta TL.

Figure-17. Shows the loss analysis of real data taken between the Manubolu to Renigunta 220kv feeder. The results shows losses are within the limit.

Figure-18. Shows the loss analysis data base of real data taken between the Manubolu to Renigunta 220kv feeder.

6. CONCLUSIONS

The real-time hardware, software, GSM network is a designed for robust environment and implemented in the electrical environment for observation. The true data obtained from the device is plotted using VB6.0 and subsequent data base. The fault percentage at each place of transmission line is displayed, and used to generate data to GSM transmitter to the distribution network for effective distribution management to keep utility factor at higher side.

Future scope

Exact cost analysis between various communication systems and their loss profile towards cost to be designed based on tariff system and with help of electricity regulation authority.

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