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Multiple Fault Detection System in Transmission and Distribution

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ABSTRACT

Transmission and distribution companies normally measure their achievements by using various types of qualitative and quantitative assignments. They measure achievement of their objectives through monitoring a number of performance indicators. These indicators are known as Key Performance Indicators (KPIs).The proposed IOT based KPI will have complete details about grid, master feeder station and feeder stations. The proposed research will reduce losses which are not covered by present systems. The proposed system works at very higher speed on getting the real time data to the control room.

Keywords: *IoT (Internet of Things), ARM (Advanced RISC Microcontroller), KPI (Key Performance Indicators).*

1. INTRODUCTION

Multiple Fault Detection System (MFDS) plays a vital role in finding out the faults in transmission and distribution system. MFDS saves time, life, cost in many ways to the society along with greater security. Worldwide, for almost all the surveillance needs, people have started using MFDS. It consists of a sensing system coupled with a local transmitter, base station to receive various transmissions from different locations, an IOT device for communication, a computer along with powerful software for proper informative needs and decision making.

We would to like to implement the above said system to improve power system quality by improving the utility factor. At present India is losing more than INR 55,000 crores every year due to poor transmission and distribution system. If we could save even 1% of that, it will be a good profit to the power sector and also nature can be retained for some more extent.

In India, we rely on coal for higher power generation. It amounts for about 70% of the total power produced. Thermal power plants will be major contributors in the power sectors for at least another 80-100 years. After 100 years the word coal will be in the paper only. This can be extended by conservation. So this conservation of energy will be possible only when we conserve coal. To conserve coal, losses must be reduced, utility factors must be improved, and a proper distribution monitoring system must be developed. When all the said above things works better and in line, we can save power. Unfortunately all do not come under a single roof and are not possible because it is generally a network of hundreds of thousands of kilometers. When we analyze the above said matter, a common objective system is needed to remove the unwanted barriers of the power sector. MFDS is the remedy for the above and can be better implemented in power system environments, because it doesn't need hard wiring throughout the transmission and distribution.

We would like to automate the fault-finding system of the transmission and distribution to improve the utility factor, uninterruptable power, to reduce losses, to save the time and, thereby, saving the cost.

The state-of-the-art embedded technology will be used in this work to minimize the electronic hardware used. 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 IOT, CDMA, WAP, IR, and BLUETOOTH. Flash Embedded technology to achieve higher speed from MICROCHIP Corporation or ARM-7 controller will be used in my research along with appropriate electronic hardware to have better interface with the computer.

Visual Basic software will be employed for better visual and audio effect. A real time electrical hardware to prove our idea will be developed for reality, implementation and demonstration.

2. IMPLEMENTATION AND DESIGNING

1) Introduction

In this section, the construction of the Multi-Fault Detection System is explained.

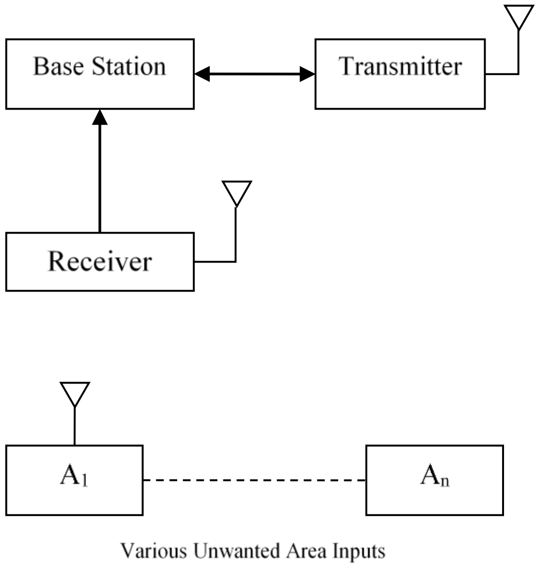


Fig 1. Basic Block Diagram

Faults are sensed using appropriate sensing transformer, processed using signal conditioners, computed using logic circuits and fed to an IOT modem for on line data transfer from sensing area to substation. Similarly from all the areas, the data will be sent through different IOT modems. The receiving area will consist of one IOT modem, which can receive and process many IOT inputs.

Various kinds of communications systems were established over five decades. The merits, demerits are discussed and derived towards IOT communication for KPI.

Real time hardware model developed to achieve better results are discussed as follows:

2) General Concept of *KPI using* IO*T*

India is losing around 23% of electric power as T&D losses. These losses have been estimated to be as high as more than 50% in some states. Therefore it is very important to estimate and reduce these losses. Transmission losses consists of technical losses, distribution losses consists of both technical and non-technical losses. Technical losses are due to energy dissipated in the conductors and equipment used for transmission, transformation, sub-transmission and distribution of power [1]. The non-technical losses are caused by pilferage, defective meters and errors in meter reading and in estimating unmetered supply of energy [2]. Theft and pilferage account for unauthorized/unrecorded supply by hooking or tapping the bare conductors of LT feeder or tampered service wires. In this paper we are considered the technical loss occurred in short transmission lines due to open and short circuit faults by using wireless communication.

Current differential protection using pilot wire mainly applied for short transmission lines protection. Vector difference between the currents at both ends of transmission line is used for relay operation [3]. Another type of differential protection is balanced voltage principle across two ends of transmission line [4].

The length of the transmission line that can be protected by the pilot wire is limited because of the resistance and capacitance of the pilot wire. The relay function may be lost due to line disconnection the link wire needs additional protection and high cost [5]. This can be overcome by using wireless communication protocol [7].

Performance of a current differential system is integrally related to the performance of its pilot communication channel. Nowadays, there are many advanced robust communication techniques [9] that can be used to improve protection, control, speed outage restoration, operation analysis, maintenance and planning. Historically current differential relaying has been applied using a wide variety of communications media such as twisted pair cable, coaxial cable, fiber optic cable, power line communication and wireless communication. Wireless communication is the challenging media for the upcoming deregulated power system and smart grid applications [6].

Single line diagram for the transmission line proposed in this paper is shown in Fig 2. It consists of two relays one at the sending end and other at receiving end. The two relays make final decision based on signals sent in both directions through a wireless communication network [8].

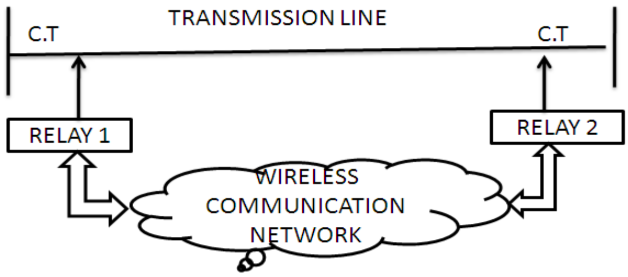


Fig 2. Block Diagram of General Concept

3. OVERALL STRUCTURE OF LABORATORY MODEL

The proposed technology is divided into five major categories to meet on line challenges on acquiring data from transmission line at the starting point, on the starting point the voltages, currents are monitored to make effective control mechanism.

The five sections are:

1) Sensing transformers.
2) Signal conditioning circuits.
3) Data conversion circuits.
4) Software required to display.
5) Communication devices

1. Synchronization element

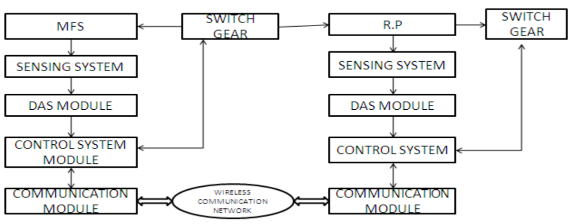


Fig 3. Synchronization Element

In order to evaluate the differential protection based on current signals measured at both ends of the transmission line, the current samples have to be taken at the same time intervals at both ends. This requires relay operation to be synchronized, any time difference between the relay signals will translate into differential current that may cause male operation of the relay.

There are many methods used for synchronizing the data measured at both ends of the transmission line [11-12]. In most of the techniques there is a need for additional equipment or connecting equipment to the satellites which increases the cost of manufacturing the relays.

2. Differential element

The differential element calculates the current deviation signals during the ¼ cycle using the following equation [1]

$$\Delta i^{R,Y,B}(P) = \sum_{q=1}^{p} [i_1{}^{R,Y,B}(q) - i_2{}^{R,Y,B}(q)]$$

Where:

Δi — Current deviation for R, Y, B phases;
P — Number of samples during ¼ cycle;
q — Index;
i_1 — Sending end current;
i_2 — Receiving end current.

4. DECISION ELEMENT

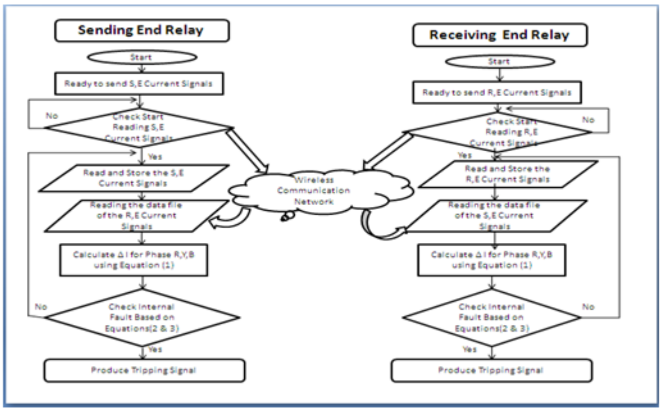


Fig 4. Block diagram of Decision Making Element

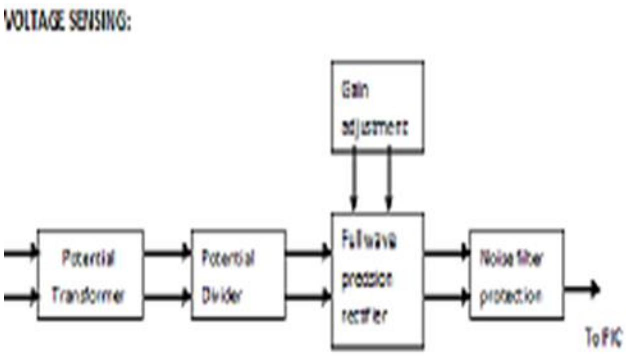


Fig 5. Block diagram of Voltage Sensing

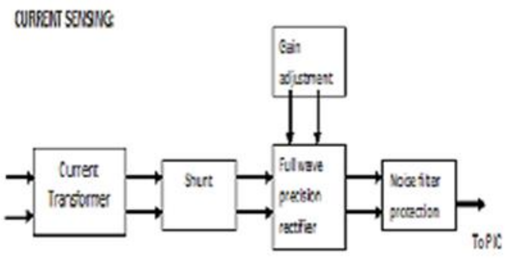


Fig 6. Block diagram of Current Sensing

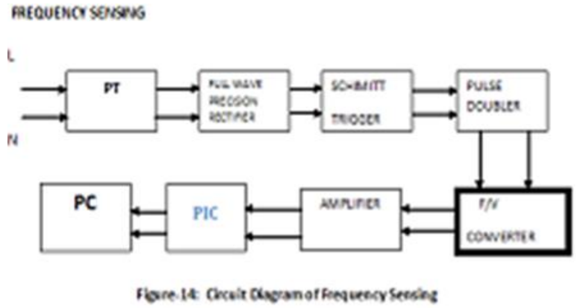
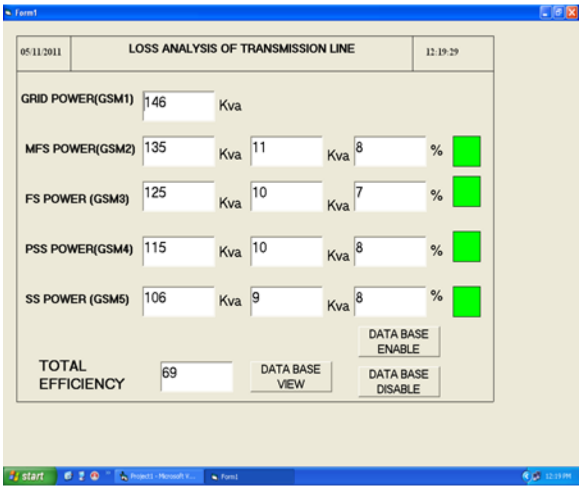


Fig 7. Block diagram of Frequency Sensing

5. RESULT AND SIMULATION

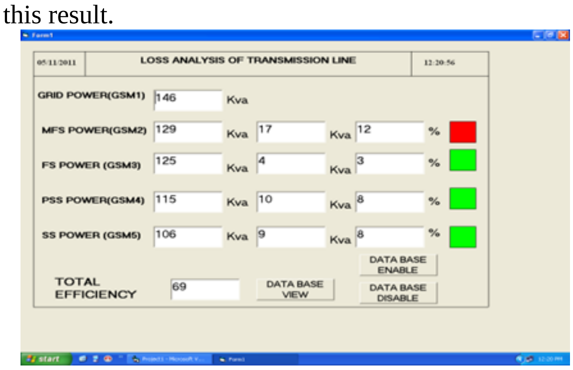
Various data's received from remotely located IOT transmitter is processed using hub and fed to visual basic software. The serial data's received from IOT modem are fed to multichannel RS232, the serial to parallel conversion is done, the data's are separated and organized to their appropriate column, the real time data's received directly from the field is denoted as IOT data's. Each IOT data's are received from different locations all the values 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., location1 to location2). 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.
he results shown here is a real-time data obtained from different IOT 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 (fig) is a normal transmission line without any failures.

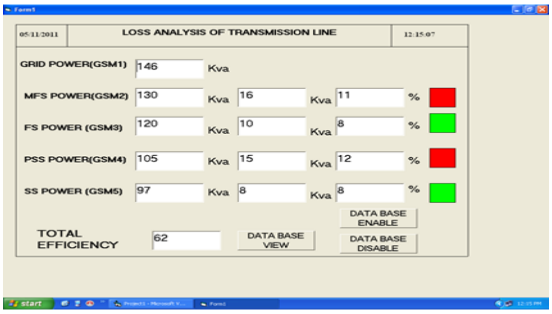
The database (fig) received from the real time system is presented here for future verification of loss levels at different and equal time interval at various points of transmission line.



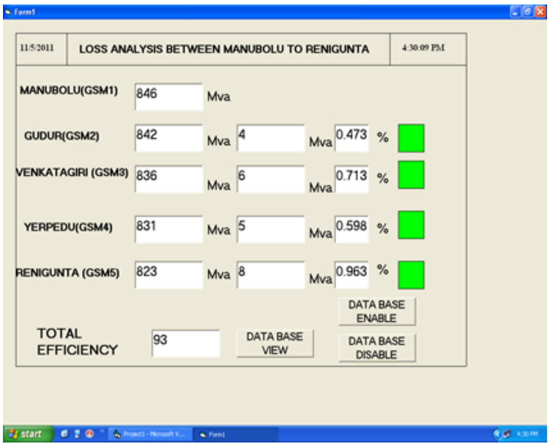
The data's obtained on real time environment(fig) with more loss on point 1 to point 2, so the losses between the points is noted high, exceeds 2% beyond the limit. The decision can be made manually or automatically to remove and divert the loads as per the load dispatch analysis. Once if the loss goes beyond the permissible limit the concern switch gear can be turned off (trip) and optimized path can be analyzed by IOT network and the load will be connected to optimized path. The optimized path will be identified using various interconnected IOT networks. Thereby utilization factor can be maintained throughout the time and keeping the plant efficiency constant.

The database shows (fig) the losses beyond the permissible limit between point1 and point2 at one particular instant. The duration of higher loss can be visually seen on this result.





The data's obtained on real time environment (fig) 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.



The database shows (fig) the losses beyond the permissible limit between point1 and point2, point3 and point 4 at one particular instant. The duration of higher loss can be visually seen on this result.

6. CONCLUSION

The proposed model is developed as electrical, electronics, instrumentation hardware and evaluated for perfection in results. The Evaluation consists of transformers, associated hardware, relay circuits, software for the same.

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