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ON-LINE MONITORING AND ANALYSIS OF FAULTS IN TRANSMISSION AND DISTRIBUTION LINES USING GSM TECHNIQUE

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ABSTRACT

Increase in demand of electricity for entire applications in any country, need to produce consistently with advanced protection system. Many special protection systems are available based on volume of power distributed and often the load changes without prediction required an advanced and special communication based systems to control the electrical parameters of the generation. Most of the existing systems are reliable on various applications but not perfect for electrical applications. Electrical environment will have lots of disturbance in nature, Due to natural disasters like storms, cyclones or heavy rains transmission and distribution lines may lead to damage. The electrical wire may cut and fall on ground, this leads to very harmful for human beings and may become fatal. So, a rigid, reliable and robust communications like GSM technology instead of many communication techniques used earlier. This enhances speed of communication with distance independenncy. This technology saves human life from this electrical danger by providing the fault detection and automatically stops the electricity to the damaged line and also conveys the message to the electricity board to clear the fault. An Embedded based hardware design is developed and must acquire data from electrical sensing system. A powerful GSM networking is designed to send data from a network to other network. Any change in parameters of transmission is sensed to protect the entire transmission and distribution.

Keywords: *Global System For Mobile Communication (GSM),Special Protection System (SPS), Embedded Systems*

1. INTRODUCTION:

With the growing population of India and its rising electric power needs, the demands on the power grid continue to rise. This demand necessitates additional grid reliability. Special protection systems (SPS) are an example of a class of protection schemes that can benefit from the use of communication to increase their accuracy and reliability [1]. The job of an SPS is to detect system faults and take corrective action. Faults can be broadly classified into two main areas which have been designated “Active” and “Passive”. Types of faults in three phase system is shown in fig-1.

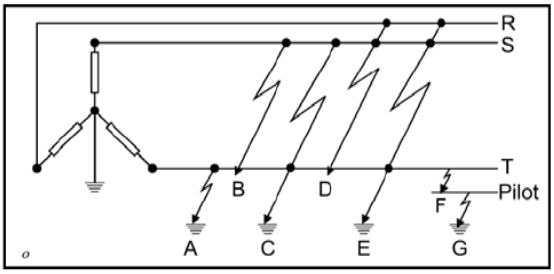

Fig-1Types of Fault in Three phase system.

(A) Phase-to-earth fault.
(B) Phase-to-phase fault.
(C) Phase-to-phase-to-earth fault.
(D) Three phase fault.
(E) Three phase-to-earth fault.
(F) Phase-to-pilot fault.
(G) Pilot-to-earth fault.

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The "Active" fault is when actual current flows from one phase conductor to another (phase-tophase) or alternatively from one phase conductor to earth (phase-to-earth). This type of fault can also be further classified into two subgroup, namely the "solid" fault and the "incipient" fault. The solid fault occurs as a result of an immediate complete breakdown of insulation. Passive faults are not real faults in the true sense of the word but are rather conditions that are stressing the system beyond its design capacity, so that ultimately active faults will occur[15]. Typical examples are: Overloading - leading to overheating of insulation (deteriorating quality, reduced life and ultimate failure). Over voltage - stressing the insulation beyond its limits.

2. FAULT CHARACTERISTICS WITH & WITHOUT FAULT CURRENT LIMITER:

Fig-2 shows the wave shape of a typical unlimited fault current [16] as well as the influence on this wave shape if FCL devices with and without fault current interruption capability are applied to the system. A distinction among the different types of FCL is made between passive and active fault current limiting measures. Passive measures make use of already initially high source impedance both at normal and at fault conditions whereas active measures bring about a fast increase of the source impedance at fault conditions only.

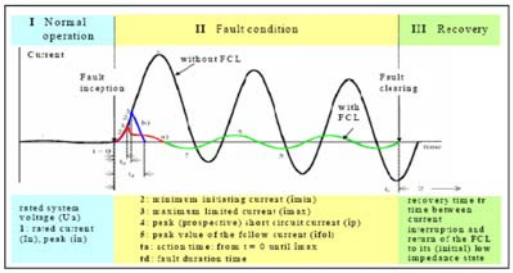

Fig-2. Typical fault current wave shape and characteristic data

Traditional SPS or special devices works with preplanning on load shedding. Many technologies were used in different periods like carrier power line communication, Radio frequency based control system, and Supervisory control and data acquiring systems, Distributed control systems and Internet based communications. Each of the above has merits and demerits. This paper is based on Robust GSM technology meets safety reliability and fastest in design. GSM 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.

3. . BACKGROUND AND LITERATURE REVIEW:

Many special protection systems are available based on volume of power distributed and often the load changes without prediction required an advanced and special communication based systems to control the electrical parameters of the generation.

1. CONVENTIONAL METHODS:

1. 1 The conventional remote operating and monitoring system**:**

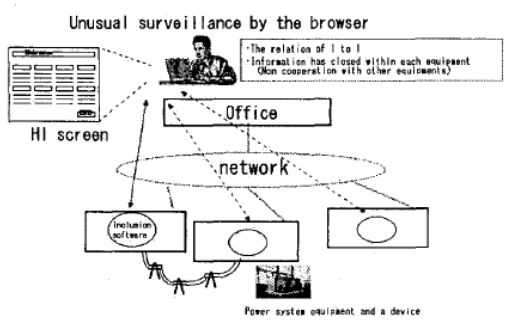

Fig.1: The conventional remote operating and monitoring system

Fig.1 shows the example of a conventional remote operating and monitoring system (agent technology is not applied). In this system, the protection relay equipment serves as a server, the PC in an office serves as a client, and the PC and relay equipment communicate by 1 to 1. We can perform and follows some personal computer in an office; download of the voltage and current data stored in the relay equipment when relay equipment is activated by some power failure; checking and changing the setting values of the protection relay; detecting an abnormal occurrence and the relay activation caused by power system faults. As an excellent information terminal which can acquire the real time data from a power system. It is important that the information in a relay can be

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easily accessed from an office and of which mechanism for performing the function described above is simple. Because of the reason described above, the remote operating and monitoring system has expanded steadily. Thus, although the remote operating and monitoring system has outstanding features, the PC and protection relay equipment are connected with the relations of 1 to 1, and while operating this system, it is necessary that the operator looks at the PC browser continually all the time. Moreover, in order to acquire information from a numbers of relay equipment, an operator must specify the address of each relay to access them in turn, which is complicated and time consuming. Furthermore, in this system, even when relays are connected within the same network, the relays can not communicate and cooperate with each other. That is to say, relay equipment works only as a server providing data to PCs located in the remote office

1.2 POWER LINE COMMUNICATION (PLC):

It offers the possibility to use the well-developed infrastructure of the electrical energy distribution grid for data transmission. For the time being, there is no harmonized international standard for broadband PLC [8]. But IEEE started standardization of PLC physical and MAC layer in June 2005. In Europe, broadband PLC is limited to frequencies between 1 and 30 MHz, because of restrictions regarding electromagnetic compatibility (EMC). Future communication systems are expected to use much higher data rates as today's wireless local area networks (WLANs) [9]. In this paper, we study an approach to boost high data rate wireless communications by using existing power lines in a flexible and cost-efficient way.
In wireless networks, spatial diversity and spatial multiplexing gains are achieved by multiple antennas at the transmitter and at the receiver. Using *cooperative relaying strategies* [10]–[14] these gains are also possible for single-antenna nodes. Spatial multiplexing is mandatory to achieve the high bandwidth efficiency that is necessary for future Gigabit/s wireless Communication systems [9] .

1.3 RADIO FREQUENCY (RF):

Radio frequency (RF) is a rate of oscillation in the range of about 3 kHz to 300 GHz, which corresponds to the frequency of radio waves, and the alternating currents which carry radio signals. Electric currents that oscillate at radio frequencies have special properties not shared by direct current or alternating current of lower frequencies. The energy in an RF current can radiate off a conductor into space as electromagnetic waves (radio waves); this is the basis of radio technology. RF current can easily ionize air, creating a conductive path through it.

One of the biggest disadvantages to radio communication technology is the limited range of a radio signal.

4. PROPOSED METHODOLOGY:

The proposed methodology is based on Robust GSM technology meets safety reliability and fastest in operation. It consists of a sensing system, signal conditioning electronic circuits, advanced embedded hardware for middle level computing, a powerful computer network for further transmission of data to various places. The above said system can able to communicate with one grid and its subsequent related actions. This system is an Advanced intelligent Electronic device (AIED). The Whole system must be employed to make perfect grid control system. The system design is shown fig 2.
The Sub elements of proposed system are

- Sensing Transformers.
- Signal Conditioners.
- Embedded based electronic Hardware.
- GSM technology for Data transfer.
- Powerful software to generate control signal

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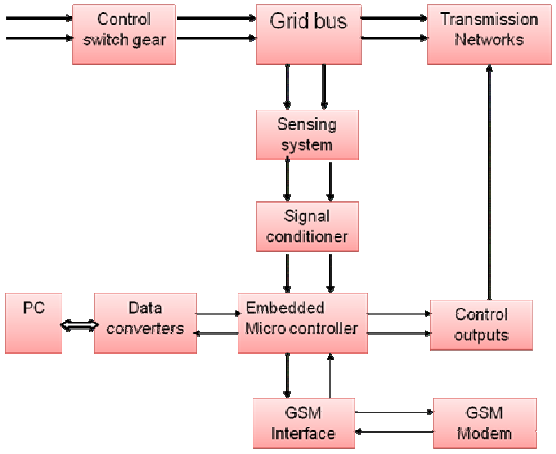

Fig 2: Block diagram of robust communication based SPS for power system

Control switchgear refers to the combination of circuit breakers, fuses and other electrical disconnections to isolate electrical equipment. The purpose of switchgear is to shut down or de-energize specific equipment, which will then allow work to be carried out further down the line. It is shown in Fig.3

Fig 3: Control switchgear

Signal conditioners are essential to improve received signals. Removing the unwanted frequencies during amplification. It consumes very low current from the source. It consists of voltage sensing, current sensing, Frequency sensing. The voltage sensing will senses any changes in the input voltage and output of the circuit is given to PIC.shown in Fig 4

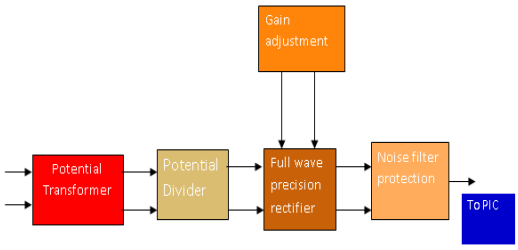

Fig 4: Block Diagram of voltage sensing

Current Sensing will senses any changes in the input current converted in to voltage and given to the PIC shown in Fig 5

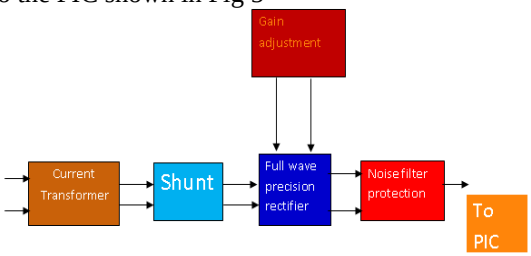

Fig.5: Block Diagram of Current sensing

Frequency Sensing will sense any changes in the frequency is converted into voltage and given to the ADC. Schmitt trigger is used to convert any waveform in to square waveform. XOR gate is used to double the frequency Shown in Fig 6

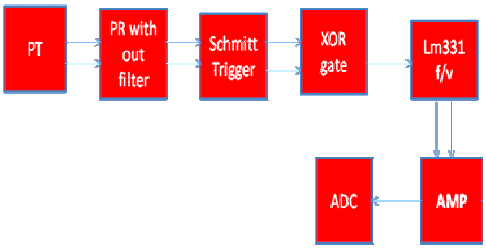

Fig 6: Block Diagram of Frequency sensing.

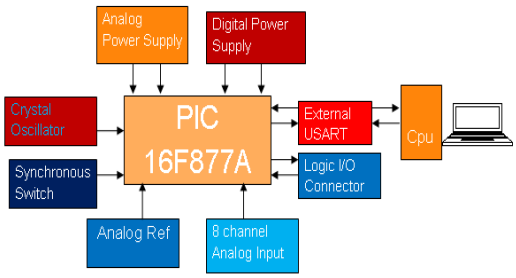

Fig 7: PIC Block diagram

Design Features:

Fig 7 shows the block diagram of PIC 16F877A. Individual power supply for Analog and Digital circuits is required to avoid drift on analog portion. Double regulated filtered reference source is needed to ensure safest ADC operation. External clock source must be used which enables the user to design the required speed. External CPU Synchronous circuit must be Designed incase of PC requirement.

External RS-232 is used for data transmission .

Power Supply Unit to Embedded consist of step down transformer to reduce the voltage, rectifier to convert AC to DC, filter to remove unwanted AC signal and voltage regulator to avoid the incoming voltage fluctuation and Keeps the

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output voltage(5V) as constant for embedded controller.

To perform the various operations and conversions required to switch, control and monitor the devices a processor is needed. The processor may be a microprocessor, micro controller or embedded controller. In this work an embedded controller has been preferred because of its industrial advantages in power electronics like built in ADC, RAM, ROM, ports, USART, DAC. And also the speed of embedded controllers is more compared to other processors. The embedded controller selected for this work is PIC16F877A due to its various features.

A Relay driver is an Electro-magnetic Switch which is useful for a low voltage circuit. The relays used in this work are compact, self-contained devices, which respond to abnormal conditions.

In personal computer, data transfer takes place serially. RS-232standard is used for serial communication. PIC Micro controller is linked to PC through the RS-232 port. The hardware design of the above system is shown Fig 8.

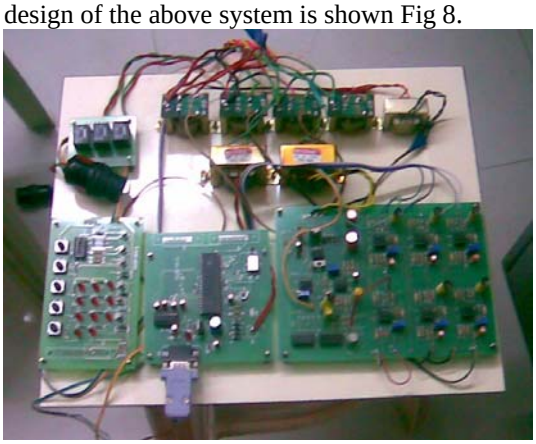

Fig. 8: Hardware Implementations of special protection systems

Algorithm without GSM:

Step1: Initializing the PIC values i.e analog and digital values
Step2: Get voltage, Temp, Freq from PIC
Step3: Analog values from PIC will be read and display in the system
Step4: Plot voltage, Temp, Freq values
Step 5: Press the switch either in Kit or System
Step 6: If it checks for switch1 is pressed or not if sw1 is pressed then it is on otherwise it goes for switch2 conditions
Step7: Plot current values
Step8: It will check for overload condition, if it is overload and the circuit is tripped and shows the corresponding message in the system
Step9: If it is exists then end otherwise it goes to the step2

Algorithm with GSM

Step1: Initializing the PIC values i.e analog and digital values
Step2: Initializing the corresponding components of the GSM settings
Step3: Get voltage, Temp, Freq from PIC
Step4: Analog values from PIC will be read and display in the system
Step5: Plot voltage, Temp, Freq values
Step 6: Press the switch either in Kit or System
Step 7: If it checks for switch1 is pressed or not if sw1 is pressed then it is on otherwise it goes for switch2 conditions
Step8: Plot current values
Step9: It will check for overload condition, if it is overload and the circuit is tripped and then send the corresponding message to the mobile through the GSM
Step10: If it is exists then end otherwise it goes to the step2.

Results and Discussions:

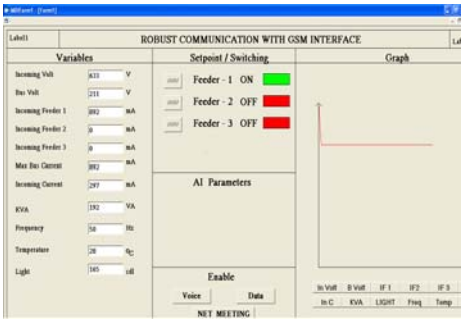

Fig 9: shows with out GSM when the feeder1 is ON, in green color and the corresponding values are displayed

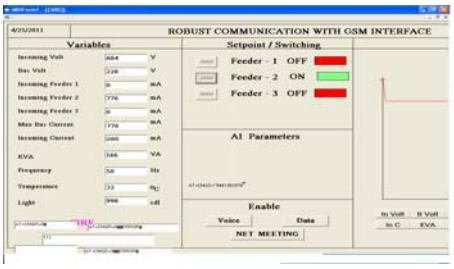

Fig 10: shows with GSM when the feeder2 is ON, in the green colour and the corresponding values are displayed.

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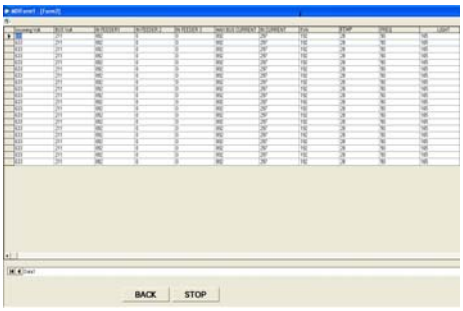

Fig.11: shows the database results of voltage, incoming current, frequency, kvA, light and temperature for every second.

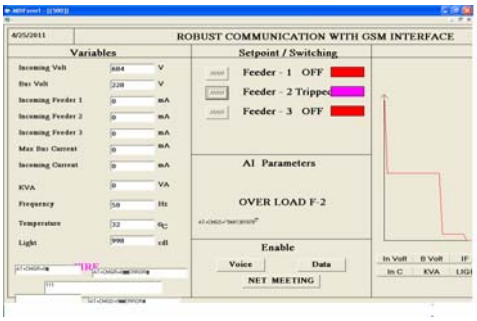

Fig 12: shows with GSM when the feeder2 is Tripped ; it shows in pink color and the message will be send to the mobile through the GSM when feeder2 is over loaded.

5. CONCLUSIONS:

This paper shows that a GSM technique can be successfully apply to the earlier developed communication based special protection systems to increase its reliability during network interruptions.
The GSM enhances speed of communication with distance independentancy. A suitable authenticated hardware is designed to meet the credibility of the networking.
An Embedded based hardware is designed to acquire data from electrical sensing system, it sends from one network to other and change in parameters of transmission to be sensed to protect the entire transmission and distribution.
GSM enables bi-directional communication as a message or data.

Visual Basic software is used as interpreter among various tools and systems.

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