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Fault Detection using GSM Technology in Overhead Distribution Lines

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ABSTRACT: In this paper, the identification and alleviation of the single line fault in over head distribution line is presented. Due to the GSM technology is applied to measure, protect and control the distribution lines against various fault conditions. The variation in voltage and current due to open circuit fault and short circuit fault is monitored. The line temperature is measured using thermistor. If any increase /decrease in temperature level, then the message will be intimated thro' GSM. The sag in the distribution line is also detected using sag detector and monitored. Here we use GSM modem to detect the fault and to send the message.

KEYWORDS: distribution lines, short circuit fault, sag detector, GSM

I. INTRODUCTION

The power transmission utilities now have the capability to remotely monitor certain mechanical and thermal characteristics of their overhead transmission lines in real-time.[1] While electrical parameters such as line currents and bus voltages have routinely been measured and communicated. Open circuit and short circuit will be occur due to over current ,over voltage, and under current, under voltage.[2] To system operators, real-time line clearances, conductor temperatures, and weather data such as wind and solar heating in line corridors, have not.In recent years, relatively inexpensive, reliable and accurate instruments have become commercially available to measure weather (e.g. ultrasonic anemometers), transmission line sag-tension (e.g. precision, temperature-compensated load cells), and conductor temperature. Also, relatively low cost communication methods (e.g. spread spectrum radio, etc.) are now available to allow remote instrument data to be transmitted in real-time to the utility system operations centers [3]. The process of real-time line and weather data monitoring along overhead lines, and the calculation of dynamic line ratings (DLRs) based on it, is an excellent example of a practical "Smart Grid" application but an unusually demanding one. It is demanding because maintaining adequate electrical clearances and avoiding premature conductor system aging are essential to the public safety; and the calculated DLRs provided to the operator must be determined with unusual care with high instrument reliability. Our Overhead Line Monitoring Systems (OHLMS) monitor the integrity of overhead conductors and poles used to distribute electricity. Scalable across vast distances, the OHLMS reduces exposure of both public and operators to danger, whilst improving standards of distribution performance with a faster response to attend the site.

1. FAULT

Fault can be defined as the any abnormal condition of the system that involved the electrical failure of the equipment. EX: transformer, generator, bus bar etc……….

Generally, the fault is divided into two types. They are

1. Symmetrical fault
2. Unsymmetrical fault

***1.** Symmetrical fault:*

The flow of fault current in the three phase line is equal then, it is called Symmetrical fault. Short circuit fault or 3phase fault is the type of Symmetrical

2. Unsymmetrical fault:

When the fault current in three phase are unequal, then, it is called Unsymmetrical fault. One or two phases are involved

Voltages and currents become unbalanced and each phase is to be treated individually There are three types of Unsymmetrical fault

1. Single line-ground fault
2. Double line-ground fault
3. Line – line fault

Single line to ground fault are occur between line and ground. Double line to ground fault are occur between any two lines. Between two lines, line to line fault occurs.

Symmetrical components can be used to transform three phase unbalanced voltages and currents to balanced voltages and currents. Three phase unbalanced phasor can be resolved into following three sequences

1. Positive sequence components
2. Negative sequence components
3. Zero sequence components

II. BLOCK DIAGRAM OF THE PROPOSED PROJET WORK

In over head lines, the fault may occur either three phase fault or single phase fault. In this paper, we analyze the occurrence of fault in single phase Distribution line. The voltage will give through the step down transformer which is used to step down the voltage from over head line ranges from 230V AC to get 1V AC. Then, the rectifier allows the DC signal. The filter is used to produce pure DC (capacitor) voltage and it will be given to the MC. Sag Detector acts as a limit switch to detect the sag in the distribution line. Sag Detector gives message to the GSM. The complete block diagram of the project is shown in Figure 1.

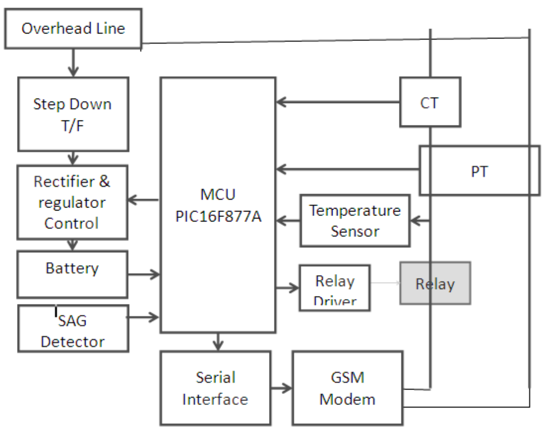

Figure1 Block Diagram of the Proposed Project Work

GSM will give tripping signal using relay drive circuit. Voltage calibration is done by placing a variable resistor with a value of 10k to adjust the resulting voltage. On the other end, series capacitor is installed to produce a pure DC voltage which is against compatible voltage needed by the ADC. The voltage sensor output is connected to the 2^{nd}pin of port A in PIC16F877A.

Current sensor senses the current value and converts the Output current into voltage. The Conversion from current to voltage is achieved by using the shunt resistor. Voltage calibration is done by placing a variable resistor of 10k to adjust the resulting voltage.

A temperature sensor LM35 is interfaced with ADC port of PIC16F877A microcontroller. The output voltage from the LM35 is linearly proportional to the measuring temperature. The internal ADC converts the output voltages from the LM35 into digital signals, which correspond to the measured temperature. Three pins used in LM35 are VCC,

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Output and Ground. The output voltage of the LM35 increases by 10 mV per 1° rise in temperature. This LM35 can measure the temperature ranging from -55°C to 150°C. The input supply 5V supply is given to the 1st pin. The ground terminal GND is connected to the 3rd pin of LM35. The 2nd (output) of LM35 is connected to the 4thpin of PIC16F877A microcontroller.

A.CIRCUIT DIAGRAM

The circuit diagram for the proposed project work is
DC voltage to the device. Power supplies without shown in Figure 2. The explanation about the circuit diagram is given below.,

When AC is applied to the primary winding of the power transformer it can either be stepped down or up depending on the value of DC needed. In our circuit the transformer of 230v/15v is used to perform the step down operation where a 230V AC appears as 15V AC across the secondary winding. In the power supply unit, rectification is normally achieved using a solid-state diode. Diode has the property that will let the electron flow easily in one direction at proper biasing condition. As AC is applied to the diode, electrons only flow when the anode and cathode is negative. Reversing the polarity of voltage will not permit electron flow. A commonly used circuit for supplying large amounts of DC power is the bridge rectifier.

A bridge rectifier of four diodes (4*IN4007) is used to achieve full wave rectification. Two diodes will conduct during the negative cycle and the other two will conduct during the positive half cycle. The DC voltage appearing across the output terminals of the bridge rectifier will be somewhat less than 90% of the applied RMS value. Filter circuits, which usually capacitor is acting as a surge arrester, always, follow the rectifier unit. This capacitor is also called as a decoupling capacitor or a bypassing capacitor, is used not only to 'short' the ripple with frequency of 120Hz to ground but also to leave the frequency of the DC to appear at the output. The voltage regulators play an important role in any power supply unit. The primary purpose of a regulator is to aid the rectifier and filter circuit in providing a constant

regulators have an inherent problem of changing DC voltage values due to variations in the load or due to fluctuations in the AC liner voltage. With a regulator connected to the DC output, the voltage can be maintained within a close tolerant region of the desired output. The regulators IC7812 and 7805 are used to provide the +12v and +5v to the circuit.

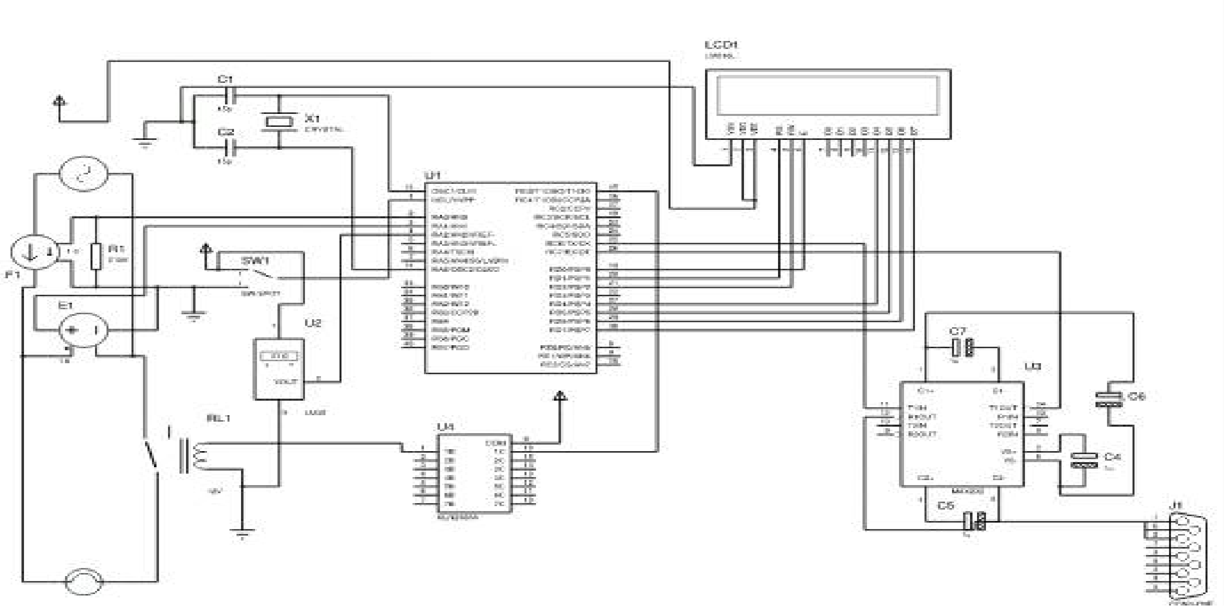

Figure 2 circuit diagram of the proposed project work
Figure 2 circuit diagram of the project work

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3.3. About PIC16F877A

PIC16F877A is a 40 Pin DIP pack IC with 33 I/O pins. Out of which 9 pins can be used either as Digital I/O pins or Analog Input pins. The micro controller is having 5 ports Port A, Port B, Port C, Port D and Port E. Here Port A consists of 6Pins and can be used as Analog Pins and Digital Pins, in the same way Port E consists of 3Pins all of them can either be used as Analog Pins or Digital Pins. The Port pins of Port D are connected to LCD pins. RD0 to RD3 pins are data pins and RD5 to RD7 pins are control pins. The Pins 13 and 14 are connected to Oscillators. This Oscillator provides required clock reference for the PIC microcontroller. Either Pins 11 and 12 or 31 and 32 can be used as power supply pins.

The 5v supply is given to the 11^{th} and 32 pin and GND is connected to the 12^{th} and 31^{th} pin of microcontroller. Pins 25 and 26 of Port C are used for serial Port communications; these pins are interfaced with MAX232 for PC based communications. Pins 39 and 40 are used for In-Circuit Debugger Operations, with which the hex code is downloaded to the Chip. Pin 33 is used as external Interrupt PinPin 1 is used as Reset Pin. This Pin is connected to Vcc through a resistor. The LCD we have used in this project is HD1234. This is an alphanumeric type of LCD with 16 pins. Of which Pins 7 to 14 are used as data pins, 11 to 14 pins are connected to port D of PIC16F877A microcontroller. There are 3 control pins RS (Pin-4), RW (Pin-5) and EN (Pin-6). The RS pin is connected to the 20^{th} Pin of micro controller.

The RW pin is usually grounded. The RW is connected to 21^{th} Pin. The EN pin is connected 19^{th} pin. The LCD has two Rows and 16 Columns. The LCD is powered up with 5V supply connected to Pins 1(GND) and 2(Vcc). The Pin 3 is connected to Vcc through a Potentiometer. The potentiometer is used to adjust the contrast level. Here in our project we use the PIC controller in 4-bit mode. Here only 4 data pins are connected and are used as Data Port.

The relays are connected to microcontroller through ULN2003 relay driver IC. The ULN2003 has 16 pins. The 9^{th} pin of ULN2003 is Vcc and 8^{th} pin of the ULN2003 is GND. The 12V supply is given to the 9^{th} pin of the ULN2003. The ULN2003 has 7 input pins (1-7) and 7 output pins (10-16). The ULN consists of Darlington arrays. The 1^{st} pin of ULN2003 is connected to the 40^{th} pin of the PIC16F877A microcontroller. The 16^{th} pin of the ULN2003 is connected to the relay, which drives the relay.

Voltage sensor is used a step-down transformers in general, which senses the voltage. Output from the sensor is in the form of voltage, sinusoidal wave-shaped. From voltage transformer to convert the voltage into 220 volt and 12 volt signal directed with full direct waves.

3.4 ABOUT GSM

GSM stands for Global System for Mobile Communications. Given below is a simple pictorial view of the GSM architecture. Figure 3 shows the GSM network along with the added elements.

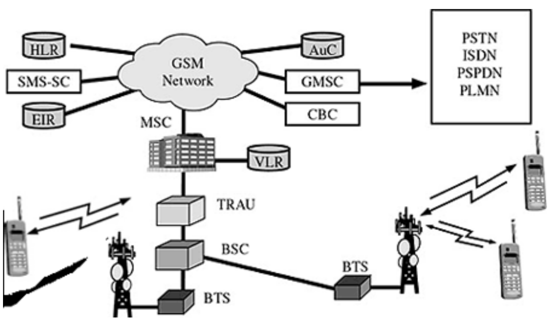

Figure 3 GSM network with components

The additional components of the GSM architecture comprise of databases and messaging systems functions:

Home Location Register (HLR)

Visitor Location Register (VLR)

Equipment Identity Register (EIR)

Authentication Center (AuC)

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SMS Serving Center (SMS SC)
Gateway MSC (GMSC)
Chargeback Center (CBC)
Transcoder and Adaptation Unit (TRAU)

The MS and the BSS communicate across the Um interface. It is also known as the *air interface* or the *radio link*. The BSS communicates with the Network Service Switching (NSS) center across the *A* interface.

GSM Module:

GSM module is used to establish communication between a computer and a GSM-GPRS system. Global System for Mobile communication (GSM) is an architecture used for mobile communication in most of the countries. Global Packet Radio Service (GPRS) is an extension of GSM that enables higher data transmission rate. GSM/GPRS module consists of a GSM/GPRS modem assembled together with power supply circuit and communication interfaces (like RS-232, USB, etc.) for computer. The MODEM is the soul of such modules. The GSM module diagram is shown in Figure 4.

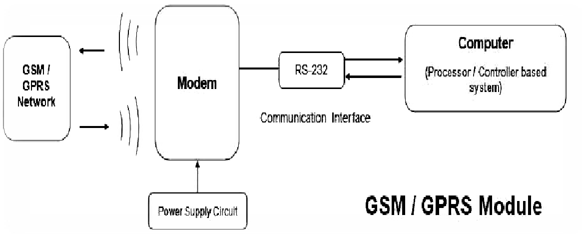

Figure4GSM module

SIM 900A is a GSM/GPRS-compatible Quad-band cell phone, which works on a frequency of 850/900/1800/1900MHz.

SIM 900 can be used not only to access the Internet, but also for oral communication.

The module is managed by an AMR926EJ-S processor, which controls phone communication, data communication (through an integrated TCP/IP stack), and (through an UART and a TTL serial interface) the[5] communication with the circuit interfaced with the cell phone itself.

Advantages:

The PIC architectures have these advantages:

Small instruction set to learn RISC architecture Built in oscillator with selectable speeds Easy entry level, in circuit programming plus in circuit debugging PICKit units available from Microchip.com for less than $50 Inexpensive microcontrollers Wide range of interfaces including I²C, SPI, USB, USART, A/D, programmable comparators, PWM, LIN, CAN, PSP, and Ethernet

Limitations:

The PIC architectures have these limitations:

One accumulator Register-bank switching is required to access the entire RAM of many devices Operations and registers are not orthogonal; some instructions can address RAM and/or immediate constants, while others can only use the accumulator The following stack limitations have been addressed in the PIC18 series, but still apply to earlier cores:

The hardware call stack is not addressable, so preemptive task switching cannot be implemented Software-implemented stacks are not efficient, so it is difficult to generate reentrant code and support local variables With paged program memory, there are two page sizes to worry about: one for CALL and GOTO and another for computed GOTO (typically used for table lookups). For example, on PIC16, CALL and GOTO have 11 bits of addressing, so the page size is 2048 instruction words. For computed GOTOs, where you add to PCL, the page size is 256 instruction words. In both cases, the upper address bits are provided by the PCLATH register. This register must be changed every time control transfers between pages. PCLATH must also be preserved by any interrupt handle.

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IV. CONCLUSION

The project “FAULT DETECTION IN OVERHEAD POWERLINES” has been completed successfully and the output results are verified. The results are within the expected output. The project has been checked with both software and hardware testing tools. In this work “LCD, Microcontroller, Current Transformer, Potential Transformer, Temperature sensor and GSM Module” are chosen to prove for more appropriate and intended application. The project is having enough avenues for future enhancement. The project is a prototype model that fulfills all the logical requirements. The project with minimal improvements can be directly applicable for real time applications. Thus the project contributes a significant step forward in the field of “Monitoring system”, and further paves a road path towards faster developments in the same field. The project is further adaptive towards continuous performance and peripheral up gradations. This work can be applied to variety of industrial and commercial applications.

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