

Fault Detection in Transmission Line Distribution System

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ABSTRACT: Electricity has become the most sought-after amenity for all of us. Gone are the days when electricity would be only limited to cities. It is now reaching to every distant parts of the world. So we have now a complex network of power system. This power is being carried by the transmission lines. These fault occurring is natural. These fault damages many vital electrical equipment's like transformer, generator, transmission lines. For the uninterrupted power supply, we need to prevent these faults as much as possible. Lines travel very long distances so while carrying power, So, this project needs to detect faults within the shortest possible time. Microprocessors and microcontroller-based systems used for these fault detections have been advancing rapidly. The proposed paper simulates Numerical Over current relay that detects faults using PIC microcontroller and ADC current sensor. These relays are more reliable and have faster response than the traditional electromechanical relays and Static relays. They have increased range of setting, high accuracy, reduced size, and lower costs, along with many other functions, such as fault event recording, auto-resetting, etc.

A smart GSM based fault detection and location systems was used to adequately and accurately indicate and locate the exact spot where fault had occurred. This will ensure a shorter response time for technical crew to rectify these faults and thus help save transformers from damage and disasters. The system uses a current transformer, a voltage transformer, PIC 16F877 Microcontroller, RS-232 connector, and a GSM modem. The system automatically detects faults, analyses and classifies these faults and then, calculates the fault distance from the control room using an impedance-based algorithm method.

Finally, the fault information is transmitted to the control room. This project is about designing the Numerical relay where the fault is detected when the input value exceeds the reference value set in the relay which then gives the trip signal to the circuit breaker. In conclusion, the time required to locate a fault is drastically reduced, as the system automatically and accurately provides accurate fault location information.

KEYWORDS: PIC microcontroller, ADC current sensor, GSM.

I. INTRODUCTION

A developing country mainly needs a power transmission to improve their growth economically. Especially India, Sri Lanka and other developed countries are transmitting power through wires. A power source is the basic requirements for human life. People directly depend upon the power resources. Somehow, power sources cause human beings indirectly. The power transmission breakage occurred due to natural disasters or manmade mistakes may affect human beings. Prevention can be done by detecting these types of faults and correcting it immediately. This project mainly focuses to save the human beings. In addition to grouping the fault position, the accurate spot where breakage occurs are transmitted to an authority person by using a SMS. It also auto trips the whole units before correcting the breakage.

II. PROBLEMSTATEMENT

To reduce the duration of outages and minimize response time to major faults, and to optimize reliability of supply, it is inevitable for power transmission companies such as GRID to search for a low-cost communicating device with low power consumption that will relay accurate fault information at real-time back to the control centre.

This proposed work seeks to design automatic and efficient fault detection and location system for both overhead and underground power transmission network system using both existing fault indicator technology and commercially proven communication technology to quickly and accurately pin point faulted sections of a transmission system.

III. OBJECTIVES

To devise and program a PIC microcontroller based Numerical relay using Assembly Language to detect fault in Transmission lines. A smart GSM based fault detection and location system was used to adequately and accurately indicate and locate the exact spot where fault had occurred

The time required to locate a fault is drastically reduced, as the system automatically and accurately provides accurate fault location information. To design an efficient impedance-based and robust automatic fault detection and location system for overhead and underground power transmission lines. To reduce response time needed to rectify and save expensive transformers from damage or theft which usually occurs during longer power outages. To increase productivity of technical crews since the time needed to locate faults will be minimised. To ensure stability and reliability of the power supply system in the country to boost economic growth.

IV. PIC MICROCONTROLLER

PIC is a family of Harvard architecture microcontrollers made by Microchip Technology, derived from the PIC16F877A originally developed by General Instrument's Microelectronics Division. The name PIC initially referred to "Peripheral Interface Controller".

PICs are popular with developers and hobbyists alike due to their low cost, wide availability, large user base, extensive collection of application notes, availability of low cost or free development tools, and serial programming (and re-programming with flash memory) capability. These devices feature a 12-bit wide code memory, a 32-byte register file, and a tiny two-level deep call stack. They are represented by the PIC10 series, as well as by some PIC12 and PIC16 devices. Baseline devices are available in 6-pin to 40-pin packages.

Generally, the first 7 to 9 bytes of the register file are special-purpose registers, and the remaining bytes are general purpose RAM. If banked RAM is implemented, the bank number is selected by the high 3 bits of the FSR. This affects register numbers 16–31; registers 0–15 are global and not affected by the bank select bits.

The ROM address space is 512 words (12 bits each), which may be extended to 2048 words by banking. CALL and GOTO instructions specify the low 9 bits of the new code location; additional high-order bits are taken from the status register. Note that a CALL instruction only includes 8 bits of address, and may only specify addresses in the first half of each 512-word page. The instruction set is as follows. Register numbers are referred to as "f", while constants are referred to as "k". Bit numbers (0–7) are selected by "b". The "d" bit selects the destination: 0 indicates W, while 1 indicates that the result is written back to source register.

PIN DIAGRAM OF PIC16F877A

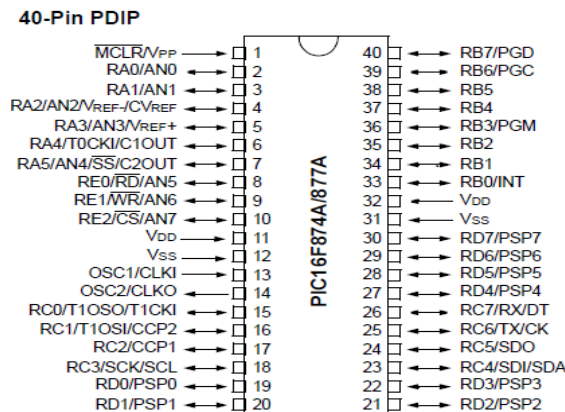


Figure 1: Pin diagram of PIC16F877A

V. TRANSFORMER

The potential transformer will step down the power supply voltage (0-230V) to (0-6V) level. Then the secondary of the potential transformer will be connected to the precision rectifier, which is constructed with the help of op-amp. The advantages of using precision rectifier are it will give peak voltage output as DC; rest of the circuits will give only RMS output.



VI. GSM

This GSM Modem can accept any GSM network operator SIM card and act just like a mobile phone with its own unique phone number. Advantage of using this modem will be that you can use its RS232 port to communicate and develop embedded applications. Applications like SMS Control, data transfer, remote control and logging can be developed easily.

The modem can either be connected to PC serial port directly or to any microcontroller. It can be used to send and receive SMS or make/receive voice calls. It can also be used in GPRS mode to connect to internet and do many applications for data logging and control. In GPRS mode you can also connect to any remote FTP server and upload files for data logging.

This GSM modem is a highly flexible plug and play quad band GSM modem for direct and easy integration to RS232 applications. Supports features like Voice, SMS, Data/Fax, GPRS and integrated TCP/IP stack.

VII. LIQUID CRYSTAL DISPLAY

A liquid crystal display (LCD) is a flat panel display, electronic visual display, video display that uses the light modulating properties of liquid crystals (LCs). LCs don't emit light directly.

They are used in a wide range of applications, including computer monitors, television, instrument panels, aircraft cockpit displays, signage, etc. They are common in consumer devices such as video players, gaming devices, clocks, watches, calculators, and telephones. LCDs have displaced cathode ray tube (CRT) displays in most applications. They are usually more compact, lightweight, portable, less expensive, more reliable, and easier on the eyes. They are available in a wider range of screen sizes than CRT and plasma displays, and since they do not use phosphors, they cannot suffer image burn-in.

LCDs are more energy efficient and offer safer disposal than CRTs. Its low electrical power consumption enables it to be used in battery-powered electronic equipment. It is an electronically modulated optical device made up of any number of segments filled with liquid crystals and arrayed in front of a light source (backlight) or reflector to produce images in color or monochrome. The most flexible ones use an array of small pixels. The earliest discovery leading to the development of LCD technology, the discovery of liquid crystals, dates from 1888. By 2008, worldwide sales of televisions with LCD screens had surpassed the sale of CRT units.

VIII.METHODOLOGY

This project is using 5V supply condition means all the devices i.e. ADC, Microcontroller, LCD are working on 5V supply. The 5V is the voltage reference to the ADC and fed a continuous analog sinusoidal voltage signal to the ADC channel number 0 by selecting the values of A=0, B=0, C=0. Clock converting frequency to ADC 0808 is 691.1875 KHz by the help of two D-flip-flops IC 74LS74 each containing two D-flip-flops. ADC performs sampling, quantization and encoding of the analog signal thus producing digital binary data. This binary output digital data is obtained from the 8 output pins of the ADC. The output from the ADC is fed into the port 1 of the microcontroller. The output of the microcontroller is fed into the LCD from the port 0 through external pull-up resistor pack of 8 resistors each of 10KΩ. Output from the ADC is represented as:

The proposed system is intended to automatically detect faults when they occur, analyse the fault to determine the type and then send information based on the fault type and fault location to the control room via GSM. The device location is determined by the SIM card in the modem, each SIM card having a unique identification and hence is used as the device's address.

The system senses, analyses and transmits. It does this with the microcontroller which analyses, interprets and sends digital signals to the I/O devices for the system to operate. By programming, the microcontroller is made to perform these functions. The automatic fault detection and location system comprises of a current transformer, a voltage transformer, a microcontroller, an RS-232 connector and a GSM modem as shown in the block diagram.

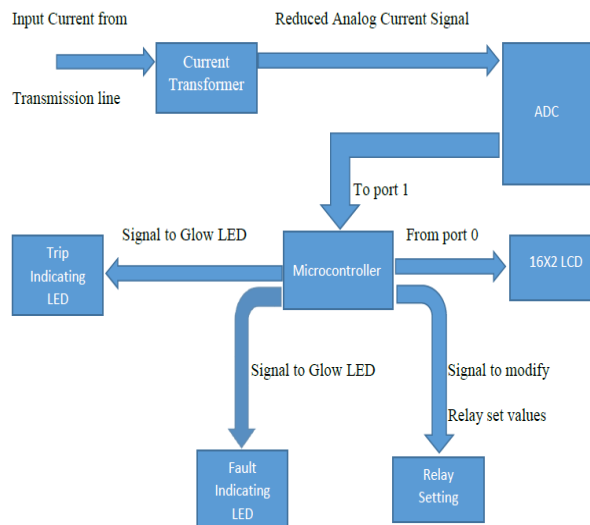


Figure 2: Block Diagram

The set up or field device consists of 3 major components, instrument transformer (CT and VT), GSM modem and microcontroller. The primaries of the CT and VT which are connected to the line sense the corresponding current and voltage values of the system and feed the output to the ADC of the microcontroller which converts the signal to a digital form in order to be processed by the CPU of the microcontroller.

The microcontroller serves as the central point of the set up. It contains a set of programming codes which have been stored in the EEPROM which enables it to classify the fault type based on the voltage and current values. Based on the program, the microcontroller compares these values to see whether they are within the range required. If the voltage and current values are out of range as compared to the reference, it gives an indication of a fault.

The microcontroller also calculates the fault distance, relative to the device based on an impedance-based algorithm and then relays this information to the modem for transmission. In summary, the microcontroller classifies, calculates the fault distance and relays the information to the modem for transmission via the serial communication interface (SCI) which serves as an interface between the microcontroller and the modem. The RS-232 serves as the connector between the microcontroller’s serial communication port and the modem.

The device is placed in the boundary of the sectionalized regions in the transmission system and the location of the fault is calculated relative to the position of the device. The unique identity of the SIM card in the GSM modem is used as an address for the device.

IX. EXPERIMENTAL RESULT

MPLAB Integrated Development Environment

Microchip produces over 900 different development tools, including an integrated development environment, compilers, debuggers, programmers and software and development boards for specific applications. Most of our software tools have free download versions available and a free trial. Our comprehensive line of development tools are designed to work with or as a part of the MPLAB® X IDE environment and are engineered to be compatible with all of Microchip’s many devices. This development ecosystem fits together seamlessly with a user-friendly interface.

PROTEUS 8.5 PROFESSIONAL

Proteus 8 is a single application with many service modules offering different functionality (schematic capture, PCB layout, etc.). The wrapper that enables all of the various tools to communicate with each other.

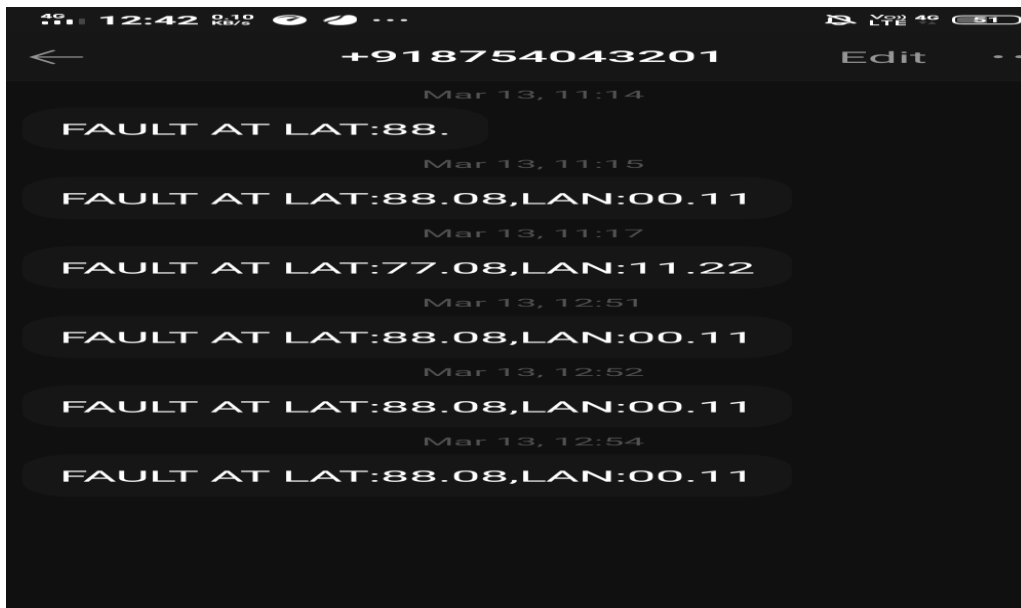


Figure 3: SMS from GSM

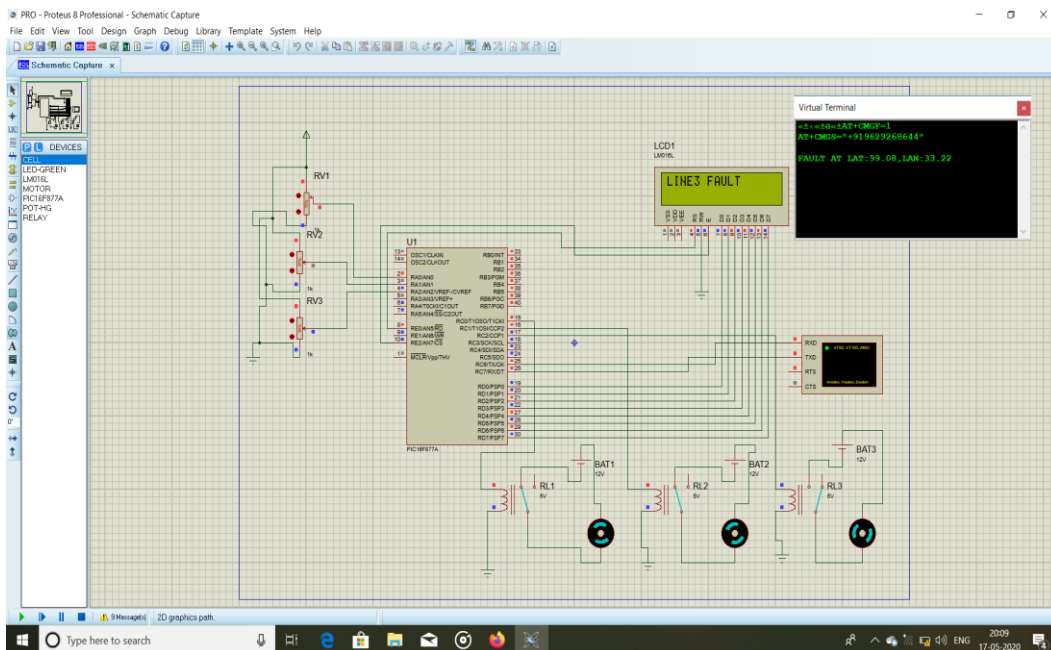


Figure 4: Output in Proteus 8.5

X. CONCLUSION

In this project detection of fault is by using ADC and Microcontroller by taking both the input voltage as DC and AC Sinusoidal. It is observed that when the current value obtained from the secondary current value of the current transformer is greater than the present value of the relay then the fault is detected by the microcontroller. The result is displayed on the LCD screen. By this project it can be ensured faster detection of faults than the electromechanical relay on the power lines and their advanced analysis can be studied from the recorded data by the microcontroller. It will also allow operators such as GRID to correctly detect and locate faulted segments on their transmission lines and, therefore, minimize power disruptions to distribution substations.



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