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High Impedance Fault Detection and Location in a Power Transmission Line Using ZIGBEE

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ABSTRACT: An effective high impedance fault detection and location in a power transmission line is implemented using zigbee. When HIF is detected in the power transmission line the presence of the fault in the particular location in the transmission line made to transmit to the nearest substation. There by the power through that transmission line is shutdown and is made retransmit through the secondary transmission line. In doing this the accidents can be avoided caused due to the High Impedance Faults and efficient power transmission can be provided to the end users. The High Impedance Faults in the transmission line are detected and located by using the current sensor and the PIC microcontroller placed at each power transmission line pillar. The location of the High Impedance Faults is transmitted to the nearest substation by using zigbee through various transmission line pillars. By this the High Impedance Faults can be easily located and also can be corrected in very quick time. So this technique helps us to provide the efficient power transmission and distribution system to the society and accidents occurring due to High Impedance Faults can be avoided to the maximum extent.

KEYWORDS: Power Transmission Line, PIC Microcontroller, Fault Detection, Fault Location, Current Sensor, Zigbee Device, Substation

I. INTRODUCTION

Power distribution system protection is an important issue for the operational and the safety reasons. An efficient protection scheme has to be made available that the power system operates properly, protects the transmitting equipment and also protects the public from the hazardous over voltages. Most of the occurring faults in the power distribution system can be detected by the current relays installed in it and then cutoff the supply to the feeder containing the fault. The possibility of fault occurrence which will cause a slight increase in the line current and produce high impedance which cannot be detected by the available protection schemes has to be taken into the account. This leads us to design an enhanced protection scheme which will detect both low and high impedance faults thereby improving protection capability of the power distribution system.

Many protection schemes for the power distribution system have been proposed for protecting the transmitting equipment and the public from the High Impedance Faults. But the problem with the proposed protection schemes is its high investment cost in implementing those schemes in real time power distribution system. The ideal protection scheme for power distribution system should be cost effective, highly reliable and also should have high accuracy of detecting the High Impedance Faults in the transmission line system. In order to overcome these problems a new protection scheme has been proposed which uses a current sensor and the PIC microcontroller for the detection of the High Impedance Faults. After detection of the fault the faulted information is made to transmit to the nearest substation through various transmission line pillars with the help of zigbee device which is capable of transmitting and receiving the data wirelessly. The zigbee device is placed at each transmission line pillar for performing the above operation. In doing this the location of the fault can be easily found out and can be rectified in the least possible time.

II. RELATED WORK

The problem of High Impedance Faults in the power transmission line was founded out by the many people because of the many serious problems caused by them. Since then the research has been done in finding out an efficient protection

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scheme. Moreover many methods have been used such as over current relays, neural networks and fuzzy logic. But the problem with the most proposed systems is the need for high investments in order to incorporate them in the power distribution system. So a new protection scheme has been proposed called as smart grid equipment which can be provided as the protection functionality scheme in the power distribution system. The smart grid requires data communication and several other technologies for the protection scheme. Among several technologies power line communications (PLC) systems provides us more benefits and also have techno-economic advantages which don't require high investment for its installation in the power distribution system. But the power line communications (PLC) systems requires an additional functionality besides the data communication which is the main disadvantage in this power distribution protection scheme.

In order to overcome these disadvantages in the protection schemes that are already having, we are proposing a new protection scheme which uses the wireless technology for the detection and the location of the fault in the transmission line. This is an advanced protection scheme which is replaced with the power line communications (PLC) systems which reduces the investment cost in the scheme and is capable of detecting the fault effectively and also finding out the location of the fault by using wireless data communication technique with a zigbee device. Moreover in this paper High Impedance Fault detection and location technique in a power transmission line using the zigbee device is presented and analyzed.

III. PROPOSED SYSTEM

The proposed protection system aims to address both the High Impedance Faults detection and location in the power distribution and the transmission line system. The detection of High Impedance Faults utilizes the isolation of the high voltage with the low voltage in the transmission line so as to avoid the effects of variation in the load voltage in the power protection scheme. The former has proposed a protection scheme called as power line communications (PLC) systems which is addressed by the utilization of the differences that will be occurring at the network responses to impulse injections as measured by the installed PLC devices which are placed at the each transmission line pillar. But in the proposed system a new enhanced protection scheme has been designed which is capable of detecting the fault in the transmission line due to the variations in the current passing through it by using the current sensor and the wireless data communication technique.

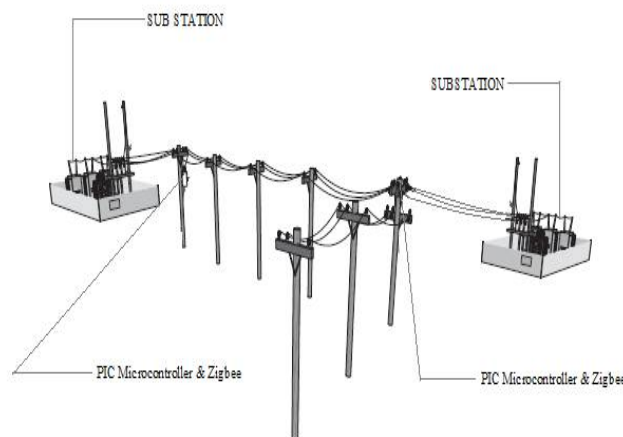


Fig 1: Diagram of proposed system

In this protection scheme technique the variation in the voltages or current are detected by using the current sensor placed in between the transmission line. The detected variations in the voltage or current levels in between the each transmission line are monitored with the PIC microcontroller which is placed at the each transmission line pillar and those detected values are stored in the microcontroller. Those stored detected values which are in the microcontroller

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are sent to the nearest substation for knowing the location of the fault present in the transmission line. This process is done by transferring the data through the all transmission line pillars which are all in the way to the nearest substation by using the zigbee device placed at the each pillar with the help of wireless data communication technique. With the proposed system High Impedance Faults can be easily detected and located when compared with the other protection schemes and even they can be easily rectified without the occurrence of any serious damage. The cost of investment for this proposed system is less when compared with the power line communications (PLC) systems and even it is also effective when compared to it. The devices and its configuration used in the proposed system are explained in detail in the following sections.

A. PIC MICROCONTROLLER

The microcontroller used in the proposed system is PIC 16F877A microcontroller. It is a 8 bit powerful microcontroller. The PIC 16F877A features 256 bytes of EEPROM data memory, self programming, an ICD, 2 comparators, 8 channels of 10 bit Analog to Digital (A/D) converter, 2 PWM functions, the synchronous serial port can be configured as either 3-wire serial peripheral interface or the 2-wire Inter-Integrated circuit bus and a Universal Asynchronous Receiver Transmitter (USART).

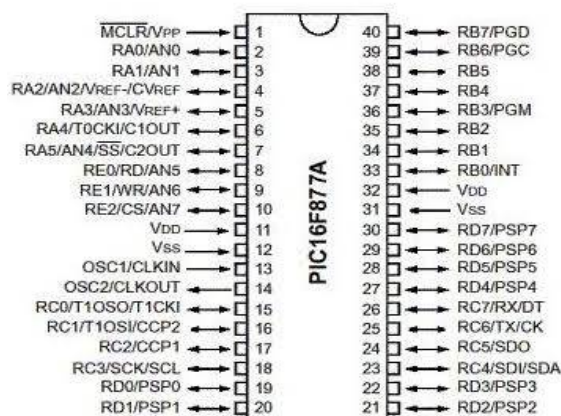


Fig 2: Pin diagram of PIC16F877A Microcontroller.

All the features made this microcontroller used in the advanced applications. The purpose of this microcontroller in the proposed system is to monitor the detected fault values in the transmission line and to store those values in it for further process.

B. ZIGBEE DEVICE

Zigbee is a device which can transmit the data as well as receive the data. Zigbee low power consumption limits transmission distances to 10-100 meters line of sight, depending on power output and environmental characteristics. Zigbee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones.

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Fig 3: Zigbee device

Zigbee is typically used in low data rate applications that require long battery life and secure networking. Zigbee has a defined rate of 250 Kbit/s, best suited for intermittent data transmissions from a sensor or input device. In the proposed system the zigbee device is used to transmit and receive the data information about the fault location which is stored in the microcontroller to the nearest substation through various transmission lines that are in the way to the nearest substation. By using the proper zigbee device high data transmission rate can be achieved. This device helps in transmitting the data wirelessly.

C. CURRENT SENSOR

The current sensor is used in the proposed system in order to know about the amount of current passing through the primary transmission line. A current sensor is a device that detects electric current either AC or DC in a wire and then generates a signal proportional to it. The generated signal could be analog voltage or current or even digital output.

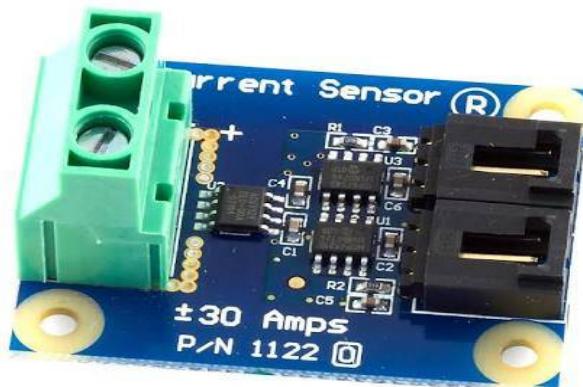


Fig 4: Current Sensor

It can be then utilized to display the measured current in an ammeter or can be stored for further analysis in a data acquisition system or can be utilized for control purpose. In the proposed system the current sensor continuously senses the current values through the primary transmission lines and gives the data to the microcontroller. When it detects a current value more or less than the predetermined value then a High Impedance Fault is present in the transmission line.

4. WORKING OF PROPOSED SYSTEM

The main aim of the proposed system is the detection and the location of the High Impedance Faults in the power transmission line. A current sensor is placed in between the each primary transmission line for knowing the amount of current passing through the each line. A fixed amount of current is made to transmit through the primary line, if it exceeds the predetermined value that is fixed then current sensor generates a signal by detecting the High Impedance Fault and the generated signal is given to the microcontroller which detects the fault. By detecting the fault the power through the particular transmission line is made to shutdown in order to avoid accidents.

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The fault location is made to know by transmitting the generated signal to the nearest substation using the zigbee device placed at the each transmission line pillar. The signal is made to transmit to the substation by using the wireless data communication technique. To provide continuous power supply to the end users in the presence of fault in the primary transmission line, a secondary transmission line is inserted in the power protection scheme. This secondary transmission line helps us to transmit the power when the power through the primary transmission line is shutdown due to any fault. As we are using the wireless data communication technique the data transmission rate will be much higher which helps in fast detection and the location of the faults.

IV. SOFTWARES USED

- I. PROTEUS 7 PROFESSIONAL: This software is used for designing the complete design of power distribution and transmission system protection scheme.
- II. MPLAB IDE v8.36: This software is used for writing the program to the microcontroller in the C language.

6. SIMULATION DIAGRAM

The complete circuit diagram for the proposed protection scheme has been designed by using the Proteus 7 Professional software and the program for the microcontroller was written in C language using the MPLAB IDE v8.36 software. The efficient simulation diagram has been achieved for the proposed system using the above mentioned softwares. The simulation diagram for the proposed system has shown in the below Fig 5.

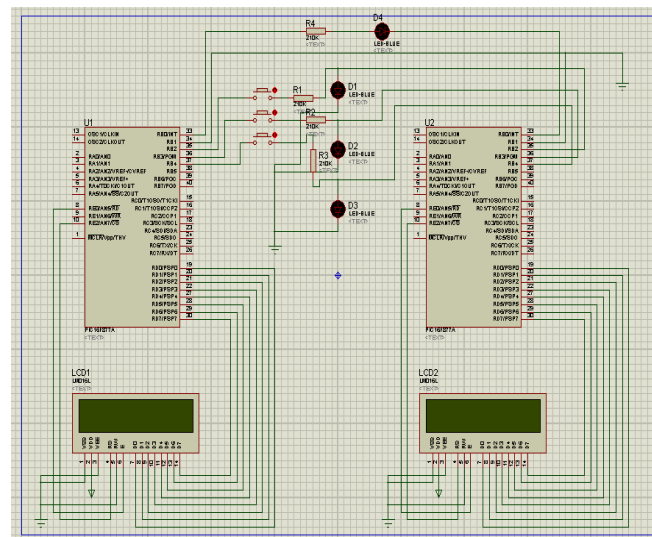


Fig 5: Simulation diagram for proposed system

V. CONCLUSION

The proposed system is the new enhanced protection scheme for the power distribution and transmission system. Proposed system is efficient in protecting the transmission lines from the over voltages. The cost investment of proposed is very much less when compared with the Power Line Communication systems. So the proposed system can be implemented in the transmission line system to protect the society from the problems caused due to the High Impedance Faults.

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