Transmission Line Fault Detection Using IoT

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Abstract

The occurrence of fault on a transmission line is extremely dangerous for the community which decreases the reliability of the transmission line. In HV and EHV transmission lines rarely occurs fault, but in localities, the fault occurrence is higher than in outer transmission lines. In this prototype, a model is created that tracks transmission line faults by doing the comparison between the voltage signal of transmission line and a reference value. The information regarding the event of a fault in a specific phase is sent to a web page via an Internet of Things (IoT), NODE MCU (Esp8266), and is also displayed on the display. The opto-coupler is used to sense the voltage and send output to the microcontroller IC. The voltage signal and output to the IoT module and display are handled by the microcontroller IC ATMEGA 16.

Keywords

Internet of Things (IoT), Microcontroller, Transmission Line.

1. Introduction

In power system network 85-87% of power system faults are occurring in transmission lines [1]. When a fault occurs in an overhead transmission line system, then instantaneous changes in voltage and current at the point of the fault generate a high frequency signal, that Electromagnetic impulses are called travelling waves, which propagate along the transmission line in both directions away from the fault point. Many types of natural and physical events irritate the electrical power infrastructure, which can have a negative impact on the grid's overall performance and stability [2]. The impedance of the fault is extremely low. The fault current is relatively high during the fault. The power flow is diverted towards the fault and the supply to the neighbouring zone is affected. It is important to detect the fault as soon as possible [3]. It is incredibly difficult to find underground faults [4]. That is why a prototype is being made using a microcontroller to make the process faster. The transmission line conductor resistance and inductance are distributed uniformly along the length of the line. Travelling wave fault location methods are usually more suitable for application to long lines.

Many power transmission companies have primarily depended on circuit indicators to detect faulty sections of their transmission lines. However, there are still challenges to identifying the exact location of these faults. Wireless sensor-based transmission line monitoring system solves several of these issues, including real-time structural awareness; faster fault localization, accurate fault diagnosis by distinguishing electrical faults from mechanical faults, cost reduction due to condition-based maintenance rather than periodic maintenance, and so on. These implementations identify stringent requirements, such as fast delivery of enormous amounts of highly reliable data. The success of this appeal is dependent on the development of low-cost, dependable network architecture with a quick response time. The network must be able to transport confidential information such as the current state of the transmission line and control information to and from

International Conference on Emerging Technologies: AI, IoT, and CPS for Science & Technology Applications, September 06–07, 2021, NITTTR Chandigarh, India
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the transmission grid. This study provides a cost-effective substructure for designing a real-time data transmission network. The status of the power system in real time, sensors is put into various components of the power network. These sensors are able to take fine-grained measurements of a variety of physical or electrical parameters and generate a lot of information. Sending this information to the control center at a cost-efficient and appropriate time is a critical challenge to be addressed in order to build an intelligent system.

The internet of things (IoT) is a system which is connected to devices, analog, mechanical and digital machines, objects, animals or people that are provided with Unique Identifiers (UIDs) and the ability to send data over a network without requiring human-to-human or human-to-computer interaction [5]. The Internet of Things is simply a network of Internet-connected objects capable of collecting and transmitting data [6]. In the fifth generation of mobile technology 5G, a huge number of smart phones and based on IoT (Internet of Things) devices will produce a huge amount of data traffic varying from low number bytes up to numerous gigabytes [7].

2. PROPOSED SYSTEM

Fig.1. Indicates proposed system. It comprises different components which explained as below:

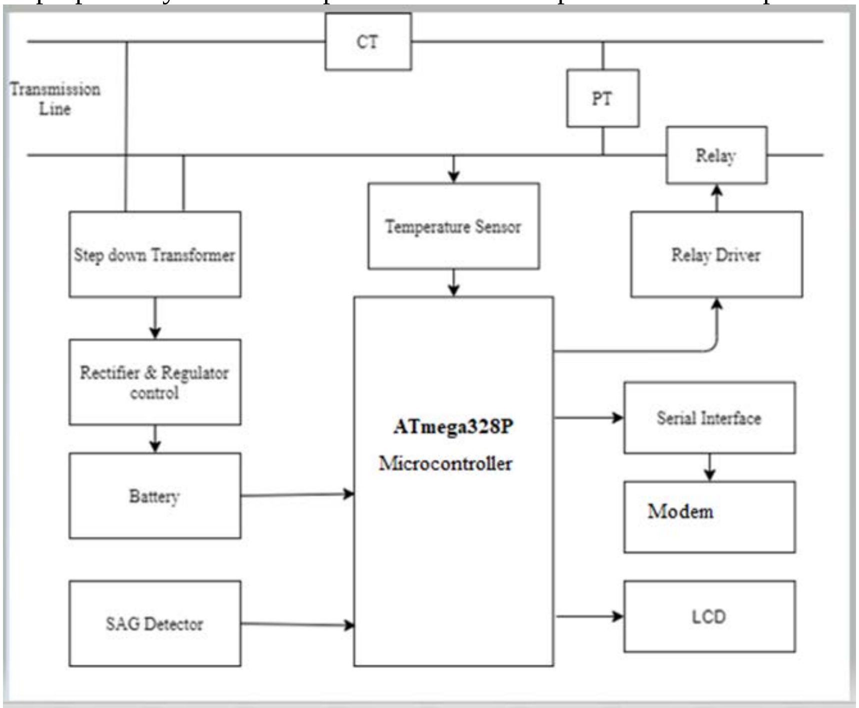

Figure 1: Proposed system block diagram.

I. ATmega328P Microcontroller
The ATmega328P is a high-end, feature-rich microcontroller. It is a microcontroller from Atmel's megaMVR microcontroller’s family. The internal circuitry of the ATmega328P haslow current consumption characteristic. The hold contains 32kB of internal flash memory, 1kB of EEPROM and 2kB of SRAM.

II. ESP8266-01 Wi-Fi Module
The ESP8266 Wi-Fi Module is a self-contained System on Chip (SOC) with an inbuilt TCP/IP protocol stack that allows any microcontroller to access your Wi-Fi connection. The ESP8266 may run a programme or delegate all Wi-Fi networking tasks to another CPU.
JHD162A LCD
It's a vivid LCD display that communicates with the microcontroller using the I2C protocol.

2.1 Operation

Fig.2 shows proposed hardware implementation of the system. There are two Step-down transformers; one of which is centre tapped transformer and the other is a general purpose step down transformer connected to the main power supply. The center tapped transformer is used to generate faults, while the step down transformer is used to power up the circuit. General purpose the step down transformer has a 230V AC input and a 12V AC output. 12V AC output supply of the transformer is given to the diode bridge rectifier. The diode bridge rectifier is made up of four diodes. By providing a 12V AC input to the bridge rectifier; the rectifier gives a 12V pulsating DC output. The bridge rectifier's output is fed to a 1000μF capacitor, which converts pulsating DC to pure DC. The voltage regulator is used after the capacitor The voltage regulator gives a fixed 5V DC power supply as the microcontroller and display are powered by a 5V DC supply,. The regulator converts 12V DC to 5V DC. The Wi-Fi module operates on a 3.3V DC supply, to obtain 3.3V supply, 3 diodes are connected in series.

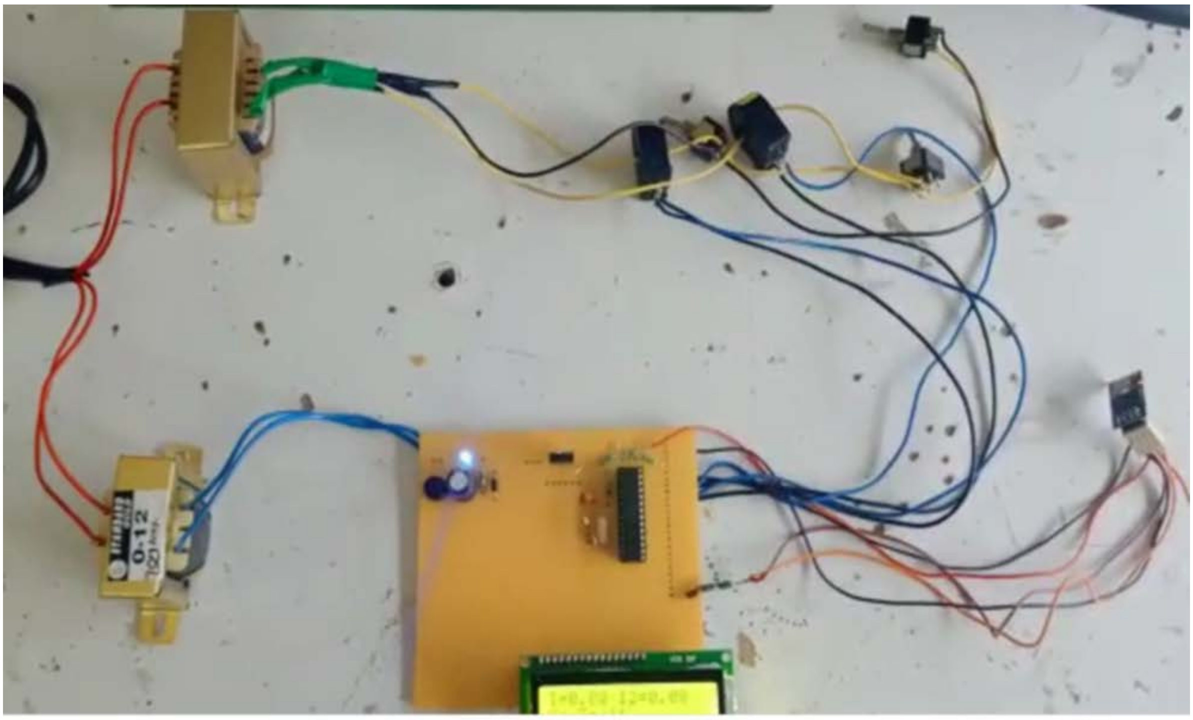

Figure 2: Proposed implementation

The microcontroller is an Atmega328p with 28 bits. The microcontroller is made up of two circuits. One is a reset circuit, and the other is a circuit reset circuit with a 10kΩ resistor connected to Pin 1 of the microcontroller circuit, a 16 MHz crystal, and 22pF. A clock circuit is built from these three components. Two current transformers (CT) are connected to 1φ and 2φ of the center tapped transformer respectively, which is an interface with the microcontroller. Across two terminals of the current transformer, one resistor is connected, that resistor is known as a burden register. The resistor voltage is measured across this burden. When the ON switch is set to 1, the phase current is increases. Also the primary current of the current transformer is increases, causing the voltage across the resistor to rise. The current supplied to the microcontroller is in the form of analog energy, which the microcontroller converts into digital form. In the microcontroller, the Amega328p ADC is inbuilt. Both CT pins are connected to the microcontroller's ADC pin. For serial communication, the Wi-Fi module is connected to the microcontroller's Transmit (Tx) and Receive (Rx) pins. For manually doing short circuit, 3 switches are employed. Switch 1 is joined to phase A & phase B and Switch 2 is attached to phase A to ground and Switch 3 is fastened to phase B to ground. After switching on the main supply, the center tapped step down transformer gives 2 phases of output and manually create an L-L fault by using the Switch 1 ON. When the Switch 1 is turned on, phases A and B are getting short-circuited, causing overcurrent to flow. When overcurrent flows from the CT, the current transformer gives signals to the microcontroller, and the microcontroller converts the signal from analog to digital in order to display a Wi-Fi module. The display shows the current values of I_1 and I_2 as well as the type of fault that occurred, such as L-L or L-G. The ESP826601 Wi-Fi module receives a signal from the microcontroller. The ESP826601 Wi-Fi module allows a microcontroller to connect to a wireless network. There are up to 9 GPIOs that can be used. When the microcontroller sends a signal to the Wi-Fi module, the data is stored on the server and a signal is sent to the receiver, can observe the fault by using a URL.

2.2. Implementation

Depending on the magnitude of the DC required, AC can be stepped down or up when supplied to the primary winding of the power transformer. The 230V/12V transformer is utilized in this circuit to execute the step down operation, converting 230V AC to 12V AC across the secondary winding. Rectification is usually accomplished in the power supply unit using a solid-state diode.A diode allowsflowingof electrons in one direction during a proper biasing condition. When an AC is applied to the diode, the electrons are flowingonly when the anode is positive and cathode is negative. Diode does not allow to flow of electrons after reversing the polarity of the voltage. The bridge rectifier is very commonly used circuitry for a large amount of DC power. A bridge rectifier comprises four diodes of INN4007 to get full wave rectification. Power supply is achieved by using voltage regulator. Without regulators have an inherent effect.

2.3. Operation

L-G Fault: For fault creation switches in this demo project and CT connected to each phase. When switch on switch between phase A and ground, line to ground fault is created CT1 measures the value I1=2.55 as shown in fig. 3.

Figure 3:LCD displaying L-G Fault

L-L Fault: When switch on the switch between phase A and phase B line to line fault is created CT1 and CT2 measures the current and send to microcontroller, display shows the value as I1=2.03 and I2=2.07.

3. Advantages

I. Respond to others in real time.
II. In comparison to the existing system, the coverage area is much larger.
III. Cost-effective
IV. It can communicate wirelessly
V. Economically sound and low-cost

4. Future scope

This can be used for Underground Line Fault Detection.

5. Conclusion

The model is designed to solve the problems faced by power system. By using such a method, we can easily detect the fault and resolve it. It is highly reliable and locates the fault in three phase transmission line and also supposed to data storage. It allows to record all of the real time data sheets up to date and avoiding future transmission line problems.

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