IoT Based Three Phase Transmission Line Fault Detection & Analysis

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DOI: 10.29322/IJSRP.13.07.2023.p13921
http://dx.doi.org/10.29322/IJSRP.13.07.2023.p13921

Paper Received Date: 02nd June 2023
Paper Acceptance Date: 07th July 2023
Paper Publication Date: 14th July 2023

Abstract

The Electric Power System is divided into many different sections. One of which is the transmission system, where power is transmitted from generating stations and substations via transmission lines into consumers. Both methods could encounter various types of malfunctions is usually referred to as a "Fault". Our project aims give an easy and smart way to detect faults in transmission system. A smart Internet based fault detection system was used to adequately and accurately indicate and locate the fault. Since maximum industries arerun on electric power and our day-to-day life is impossible to think without electricity, at least in cities. Any kind of problemin transmission system would be hindrance to our economic prosperity. So, we must make sure easy and fast detection as well as reinstalment of power supply after any fault, as faultis inevitable in the system. Our project will ensure a shorter response time for technical crew to rectify these faults and thushelp save transformers from damage and disasters. The system uses stepdown transformer, Arduino and a Wi-Fi Microchip. The system automatically detects faults, analyses and classifiesthese faults. Finally, the fault information is transmitted to the control room. In short, the time required to locate a fault is drastically reduced, as the system automatically and accuratelyprovides accurate fault location of three phase transmission lines and one can monitor the Voltage by means of Wi-Fi microchip that sends message to android device.[1]

Keywords: Three Phase Transmission, Voltage Regulation, ESP8266, sensors.

Introduction

In power system, fault is defined as the defect in power system due to which current is distracted from the intended path. Then, the fault creates the abnormal in power system which reduces the insulation strength between the conductor and this will cause excessive damage to the system. The faultsmay occur for a temporary or permanent in power systemand this can disturb the supply to users. Then, it is importantto detect the faults occurred so that it will prevent from any damage of equipment and continue supply the energy to consumers. From the studies, 70By using IoT system, user cantake immediate action to solve the fault problems in power system after getting notification. ESP8266 Node MCU is usedin this project to improve the protection system since user can detect the fault easily by getting notification from server to mobile phone. ESP8266 is a microcontroller and also a self- contained Wi-Fi networking solution offering as a bridge fromexisting microcontroller to Wi-Fi. This device is capable of running self-contained applica- tions. the ESP8266 Node MCU module also has built in USB connector and a rich assortment of pin-outs. The Node MCU can connect to the laptop and flash it without any trouble by using the micro-USB cable. One of the advantages of Node MCU is very user-friendly Detecting and locating fault in power line is very necessary for healthy operation of power system. In electrical power line fault often happen manytimes making the power system unreliable. In this idea using wireless sensor for detecting fault which includes phase to phase, short circuit and mainly line to ground fault in power line for better reliable and best operation of the system is presented. As simplify, this project can be applied at power system including in generation, transmission or distribution system because in this system, there are many apparatusesthat need to be protect and users can get the supply without having disturbance. Hence, from this project, we can knowand control fault occurred from the control room. The system consists of four main parts which is Microcontroller circuit or Arduino, Wi-Fi module circuit and cloud server. This project used Arduino Node MCU ESP8266 (V3) Wi-Fi modulo, Google firebase cloud server and using Arduino software for the programming. The purpose of this project is to advance to Three Phase Transmission Line Fault Detection Analysis. This project utilized Arduino software for programming. At the same time the IOT circuit will automatically interface to the firebase by mobile phone and send the Node MCU details which are available or not to the user. In line with these works, we developed a low-cost and simple approach to designing intelligent Three Phase Transmission

system using the concept of mobile- to-electronic circuit. First, we developed a general-purposeelectronic circuit design that can control Transmission Line.[2]

Methodology

Node MCU ESP8266 Specifications Features

- Microcontroller: Tensilica 32-bit RISC CPU XtensaLX106
- Operating Voltage: 3.3V
- Input Voltage: 7-12V
- Digital I/O Pins (DIO): 16
- Analog Input Pins (ADC): 1
- UARTs: 1
- SPIs: 1
- I2Cs: 1
- Flash Memory: 4 MB
- Clock Speed: 80 MHz
- USB-TTL based on CP2102 is included onboard, EnablingPlug n Play
- PCB Antenna
- Small Sized module to fit smartly inside IoT project. [3]

Fig. 1. Node MCU Development Board Pinout Configuration

Pin Category	Name	Description
Power	Micro-USB	Micro-USB: Node MCU can be powered
Control	EN, RST	The pin and the button reset the
Analog pin	A0	Used to measure analog voltage in the range of
GPIO pins	GPIO1 to GPIO16	Node MCU has 16 general purpose input
SPI Pins	SD1, CMD, SD0, CLK	Node MCU has four pins available for SPI communication.
UART Pins	TXD0, RXD0, TXD2, RXD2	Node MCU has two URAT interface, UARTO (RXD0 & TXD0, URAT1(RDX1 & TXD1). UART1 is used to upload the firmware/program.
12C Pins		Node MCU has 12C functionality support. But due to the internal functionality of these pins, you have to find which pin is 12C.

Android Software

In this project we are using an android software named IOT Transmission. We build the software to know about Transmission line from anywhere connected with the server. We create the software from open-source MIT App Inventor from the internet. We named our software “IOT Transmission” based on our project name. we create this software MIT App Inventor .this software has a control panel by which we can detect the fault and we can see the condition of the transmission line. The step to run the software
At first, we need to check the internet connection. If the internet connection is okay then we will click on the software icon; shown in fig2 (a). By clicking the icon, we will enter in a page of developer’s and supervisor’s introduction and on the downward of the page we can see a heading “Control Panel”; shown in fig2.20(b). By clicking the control panel, we will enter the main function; shown in fig2.20(c).so we can detect and monitor any fault occurred in line transmission . [4]

System Description

There are three steps involved in this IOT base system project. These are described below—-
Flow chart of IOT base Three Phase Transmission Line Fault Detection Analysis

Figure 2 (a) Introductory panel and (b) Control panel

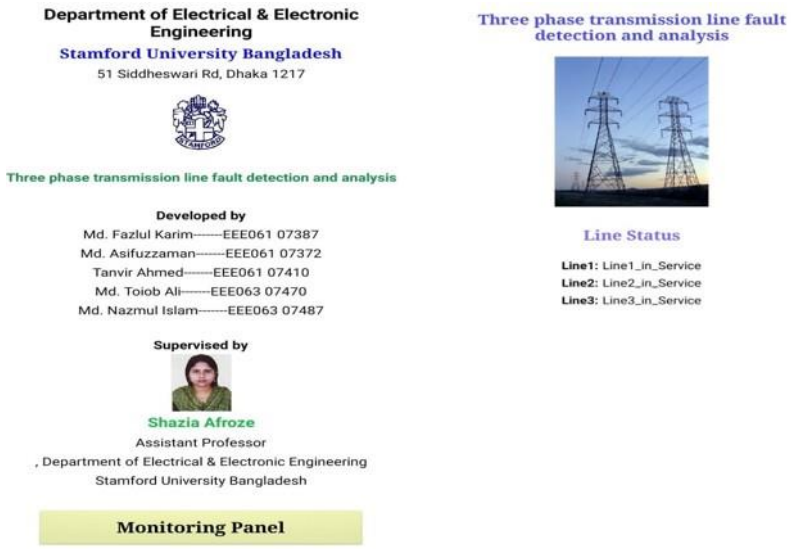
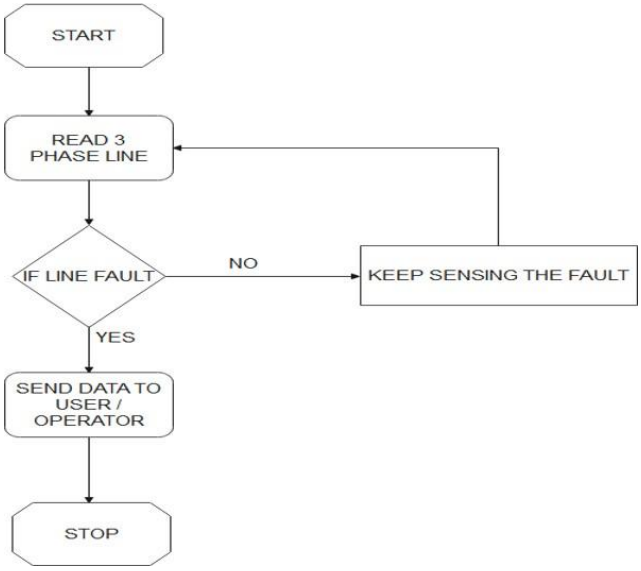


Figure 3: Flow Chart of IOT Based Three Phase Transmission Line Fault Detection Analysis



At first, we power up or start the project and it is going to read the three-phase line .if our program detects the fault in line then it sends the data to user and if not occurred any fault, then keep sensing the fault. Every time it checks the condition and continuously run in a cycle or loop.

Block Diagram of IOT Based Three Phase Transmission Line Fault Detection Analysis Power Supply: The power supply block covert the voltage from 220v to 5v. Here we used a rectifier circuit and ASM1117 IC to convert the voltage to 3.3v.

Node MCU: Node MCU is an Arduino microcontroller. It sends the controlling signal to the all equipment used in the circuit and receive the signal from the equipment's.

Wi-Fi: A Wi-Fi chip is situated on the Node MCU with which we connect the internet to the circuit. Voltage Regulation: we use an IC which name is ASM1117 and its output is 3.3v for voltage regulation we used diode and we connected it in a series connection.

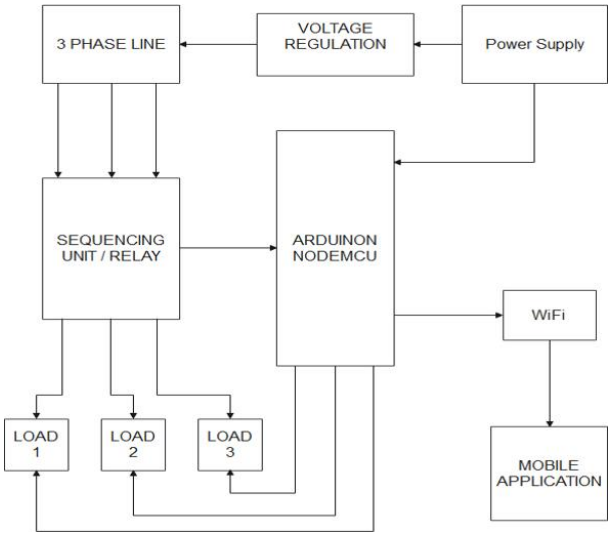
Three Phase Line: from voltage regulator we gather three types of voltage.

Sequencing Unit/Relay: we use the relay for three phase line to connect with NODEMCU.

Load: we use the prototype load by the Dc LED light and if any fault detects in Transmission Line, then turn off the Load.

Mobile Application: we built a software named “IOT Transmission” to monitor our circuit from anywhere through the Internet.

Figure 4: . Block Diagram of IOT Based Three Phase Transmission Line Fault Detection Analysis



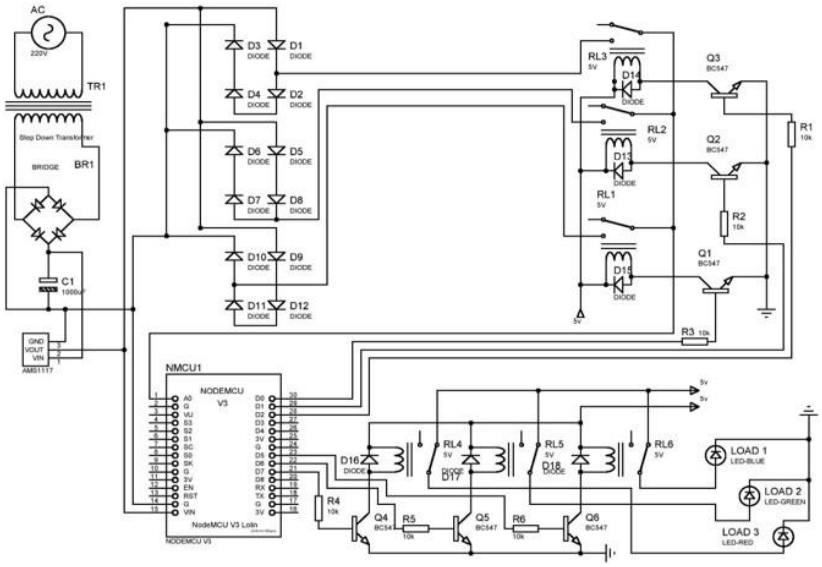
Circuit Diagram of IOT based Three Phase Transmission Line Fault Detection Analysis System The required equipment’s used in the circuit are-

• Power Supply ASM1117 3.3v
• NODEMCU
• Relay
• Voltage Regulator (Diode)
• Resistor
• Capacitor
• LED light

Working Procedure

At first by the converter circuit, we are converting the voltage from 220v AC to 5v. Then we have to connect the internet to the system through the Wi-Fi module. Here we can monitor the system by using mobile application. Voltage source in a circuit may have fluctuations is not providing fixed voltage output so we use voltage regulation for IC “AMS1117” to maintain our output voltage 3.3v. Although operating voltage of NODEMCU is 3.3v. We work on a system that need three different type of voltage and that’s why we use voltage regulator and we make the voltage regulator by using a series connected four quantities of diode.

Figure 5: Circuit Diagram of IOT Based Three Phase Transmission Line Fault Dictation Analysis



From the diode there is different value we can make. We know that silicon diode saturated value is 0.7v. and our output voltage is 3.3v. when we connected diode to our output voltage then we get value from diode D4: 3.3v-(0.7v-0.7v-0.7v-0.7v) =0.5v

D3: 3.3v-0.7v=2.6v;

D2: 3.3v-(0.v7-0.7v) =1.9v;

D1: 3.3v-(0.7v-0.7v-0.7) =1.2v;

Now we get four different voltage and we take three of them D3=2.6v, D2=1.9v and D1=1.2v.

Here is a NODEMCU that we use contains only one analog input pin, but our three-phase transmission line system has three input that's why we used three Relay and it takes reading from three of the transmission lines for 1 second pulse and it continue the previous loop.

We know that NODEMCU analog pin (A0) input value is 3.3v but it happens in a different way, when NODEMCU get 0 to 3.3v then its value is 0 to 1024. We define that when we input D3 voltage 2.6v then Arduino catch the value is 850- 1000 D2 voltage 1.9v then Arduino catch value is 550-650 D1 voltage 1.2 v then Arduino catch value is 400-500 If there is no voltage then its value is 0-100

Through the relay D1, D2 D3 value is go to the NODEMCU Analog pin. Then we measure the all of value and we understand that what line is short circuit or what line is grounded and we see the load variation and we also see the fault by our mobile application using internet. [5]

Application

Smart Cities

The IOT can be used to monitor the vibrations of buildings, bridges, and monuments in case the building material is threatened or overloaded. Noise pollution can be controlled around hospitals and schools. It can be used to manage traffic especially during traffic jams, peak hours, accidents, and rains. It can be used to manage street lights—automatically switch them off in the presence of sunlight and switch them on at the onset of darkness. Home Automation the IOT can be used to remotely control and program the appliances in your home. It can be useful in detecting and avoiding thefts. Industrial Automation

By using this technology, we can automate manufacturing processes remotely. It can also prove useful in optimizing the production processes. We can manage the inventory and the supply chain. We can also diagnose if the machines require repair and maintenance. We can monitor the emission of toxic gases to avoid damage to workers' health and the environment.

Smart Environment

A very important application of IOT is detecting pollution and natural calamities. We can monitor the emissions from factories and vehicles to minimize air pollution. We can track the release of harmful chemicals and waste in rivers and the sea, thereby arresting water pollution. We can also keep tabs on the quality of water being supplied for drinking. Agriculture Automation We can use this in agriculture automation. Such as irrigation automation.

Practical Work

• At first, we collected the required equipment with the desired rating for our project. And we write the code with C++ and then load it in the Node MCU. In coding at first, we coded for the Wi-Fi chip. We set a code for mobile hotspot name and password. Then we coded for the other equipment's step by step. we included the whole code in the appendix part. • Our main power supply is 3.3V as this is the operating voltage of node MCU. Then to get three different voltages we used three different voltage regulators, that are made using diode connected in series, which provide voltages of 1.67v, 1.95v and 2.96v. • The three different voltages are sent to A0 pin (Analog pin) of Node MCU. Now Node MCU has only one Analog pin (A0 pin) so we had to use 3 relays. Each relay takes data for each line for one second, this mechanism is also operated by Node MCU, and send to A0 pin and it continues.

• Three loads, here made with LEDs, each connected with a relay and the three relays are connected with D5, D6, and D7 pins of the Node MCU respectively. Android app is installed in an android device which is connected to the project through wi-fi network.

• After setting up all equipment and installing program we checked the project by manually creating faults and every time it detected faults properly and showed the notification on the android app.

Discussion:

Combination of the hardware and installment of program gives the final design of IOT based three phase transmission line fault detection and analysis. We had to face few problems while making this project, some of them are included below:

- At first collection of desired rating equipment was a cumbersome job. we had to go to many places to get the ideal hardware some of them are collected through online shops and some from physical markets.
- Secondly, writing program was really tough, and a time- consuming task, and took majority of the time needed to make this project. We had to learn many rules and tricks to make the code error free and, on this matter, internet was a real handy thing. Finally, with help of our supervisor we solved it and got desired result.
- Then combing hardware together took little while, though we had our circuit diagram ready but we only understood some of its faults at the time of connecting equipment, so we have changed the circuit diagram accordingly.
- One of the main concerns was providing three different voltages to Node MCU since it has only one analog pin. So, we had to come up with new idea. Eventually we used relays and made some changes in the Node MCU code, and finally it worked smoothly.
- we had faced some trouble connecting the project to android app through wi-fi. And when it got connected the connection remained only for few seconds. Then we changed the app and installed latest version one thus is performed properly.

Prototype Design and Result

Figure 6: Prototype Design of IOT Based Three Phase Transmission Line Fault Dictation Analysis

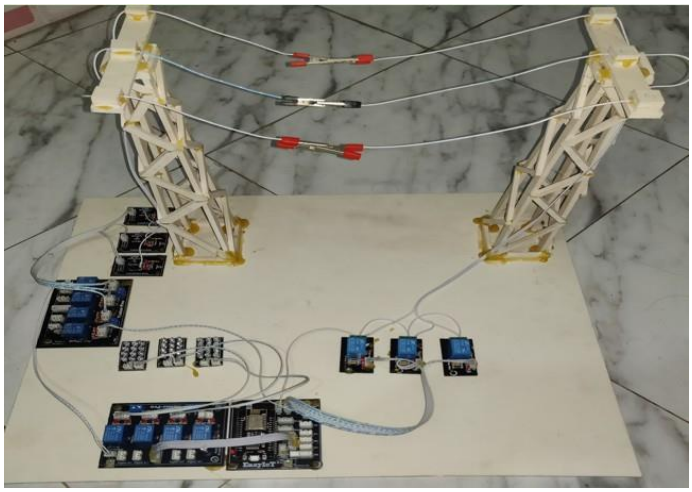
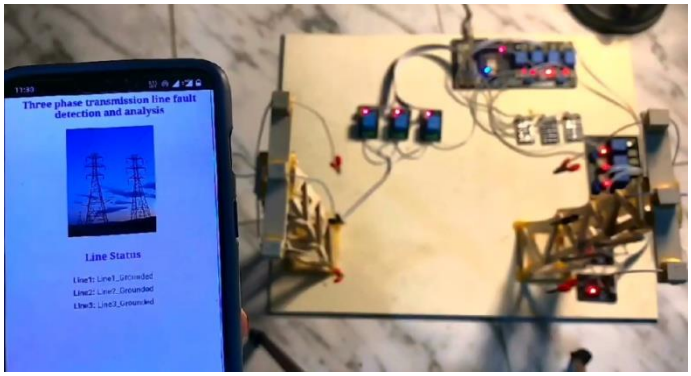


Figure 7: All lines are grounded and the mobile app shows the information



These are the screenshots of our project video. We have named three lines as line1, line2, and line3. When all three lines get a connection then it shows all are in service. If I disconnect line 3 the app shows that line 3 is grounded. Now if I connect line 2 with line 3 app shows that line 3 is cut and short with line 2. Here I open both lines 2 and 3 and it shows that both are grounded. opening line 1, all three lines are now grounded. Now line 3 is connected and 1 and 2 are grounded. It delays a bit, around 4 seconds, as we send all the analog signals to one pin of Node MCU. So, these were how our project functions.

Figure 8: line 3 is grounded and the mobile app shows the information

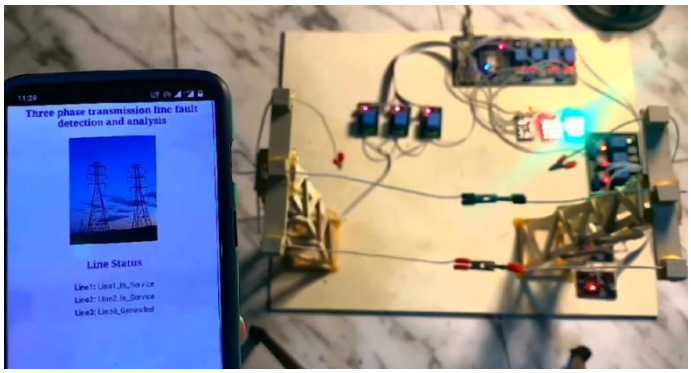
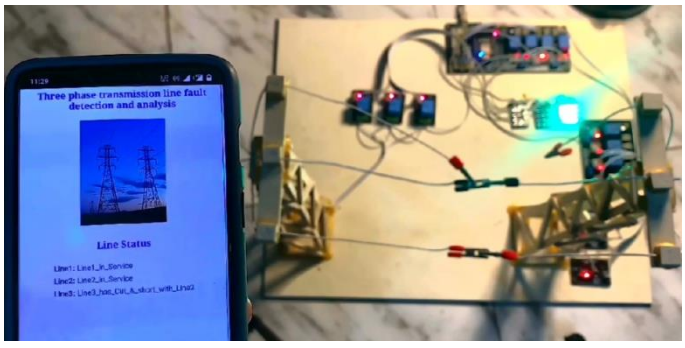


Figure 9: line 3 is cut and short with line 2, and the mobile app shows the information



Shortcomings

- With all of this IOT data being transmitted, the risk of losing privacy increases.
- As we are using internet to our system a hacker can hack our system.
- Any failure or bugs in the software or hardware will have serious consequences. Even power failure can cause a lot of inconvenience.

- The unskilled workers and helpers may end up losing their jobs in the effect of automation of daily activities. This can lead to unemployment issues in the society.

Future Scope & Conclusion

The project aims at controlling power distribution appliances via smartphone using Wi-Fi as communication protocol and NODE MCU, Firebase as a server system. Power Distributor company will move directly with the system through a web-based interface over the web. For future development we can use an LCD display in local distribution office. We can use automatic alarm system in this project with digital display. We can monitor the transmission line all over the country by the system.

IOT is growing very fast, generating huge volumes of data, pushing the Cloud to its limits, whether in bandwidth, number of requests, response times or even processing capacity. Edge Computing is the solution when you need to ensure critical actions and processes, bringing intelligence close to where things are and actions take place. Easy edge is an IOT Edge platform that deeply reduces the complexity and cost of using and managing devices in applications, enabling developers to deploy their IOT solutions extremely easy and fast, facilitating IT/OT convergence. Easy edge enables the implementation of highly scalable IOT solutions, especially in the professional and industrial segments, with high flexibility and simplicity, saving time and resources, improving services and increasing productivity logo easy png.

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