Global Journal of Researches in Engineering: F
Electrical and Electronics Engineering
Volume 14 Issue 8 Version 1.0 Year 2014
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4596 & Print ISSN: 0975-5861

Transmission Line Fault Detection Using Android Application Via Bluetooth

By MD Asaduzzaman Nur, Jahidul Islam, Md. Golam Mostofa & Moshiul Alam Chowdhury

American International University, Bangladesh

Abstract- Technological advancement and its incorporation is playing significant in human life. In present days, the demand on the electric power for the household, commercial and industrial loads is increasing. Also, the management of electric power distribution system is becoming more complex. Bluetooth based fault detection is a newly developing concept in the power system fault detection. This is a part of smart grid. The system is designed to detect the transmission line fault for the user to easily recognize the current condition of the distribution line. The ultimate objective is to monitor the distribution line status continuously and hence to guard the fault of distribution line due to the constraints such as overvoltage, under voltage, SLG, DLG faults. If any of these does occurs then a user can easily detect the fault.

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GJRE-F Classification : FOR Code: 090609

Strictly as per the compliance and regulations of :

Transmission Line Fault Detection Using Android Application Via Bluetooth

MD Asaduzzaman Nur [α], Jahidul Islam [σ], Md.Golam Mostofa [ρ] & Moshiul Alam Chowdhury [ω]

Abstract- Technological advancement and its incorporation is playing significant in human life. In present days, the demand on the electric power for the household, commercial and industrial loads is increasing. Also, the management of electric power distribution system is becoming more complex. Bluetooth based fault detection is a newly developing concept in the power system fault detection. This is a part of smart grid. The system is designed to detect the transmission line fault for the user to easily recognize the current condition of the distribution line. The ultimate objective is to monitor the distribution line status continuously and hence to guard the fault of distribution line due to the constraints such as overvoltage, under voltage, SLG, DLG faults. If any of these does occurs then a user can easily detect the fault.

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I. Introduction

Protection system's main function is to clear faults from the power system at high speed to ensure safety, minimize equipment damage and maintain power system stability[2]. Protection of power systems requires an understanding of system faults, their detection, and safe isolation of the faulted device. By taking an inventory of all the essential electrical loads and doing a basic electrical load evaluation [2], an idea regarding how much power our system needs to produce has been obtained. We are also aware about the power fluctuation situations also that means what voltage minimum / maximum we are getting from the A.C supply mains. In doing this project we would be using concepts of microcontrollers, Bluetooth Module and Android Application.

II. Fault Types and Protection

a) Single-Line-to-Ground Fault

A short circuit between one line and ground, very often caused by physical contact, for example due to lightning or other commomeans. The single line to ground fault can occur in any of the three phases[1]. However, it is sufficient to analyze only one of the cases.

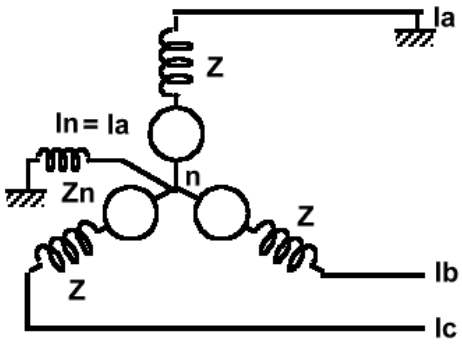

Figure 1 : Single Line to Ground fault

b) Line-to-Line Fault

A short circuit between lines, caused by ionization of air, or when lines come into physical contact[1], for example due to a broken insulator. For a Line-to-line fault, the currents will be high, because the fault current is only limited by the inherent (natural) series impedance of the power system up to the point of faulty (refer Ohms law).

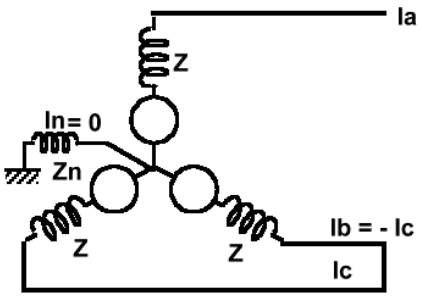

Figure 2 : Line to line fault

c) Double- Line -to Ground Fault

Two lines come into contact with the ground (and each other), also commonly due to stormy weather or some other means [1].

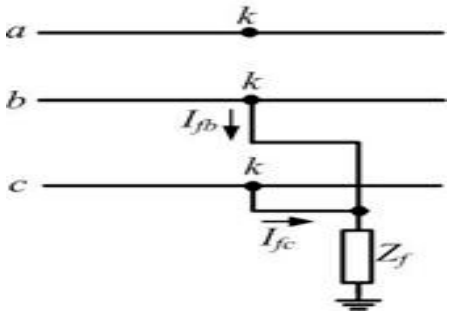

Figure 3 : Double line to Ground Fault

Author α σ ρ ω: Student, Electrical and Electronic engineering department, AIUB, Dhaka, Bangladesh.
e-mails: snur.aiub@yahoo.com, jahid_2912@yahoo.com, mostofa44444@gmail.com, moshiul16@rocketmail.com

d) Lower Voltage

Low voltage is a relative term, the definition varying by context. Different definitions are used in transmission and distribution line, and in the electronics industry. Electrical safety codes define "low voltage" circuits that are exempt from the protection required at higher voltages. These definitions vary by country and specific code. Lower voltage is defined as incoming line voltage at the point of use which is smaller than the Public Service Commission's mandated legal limits; and/or smaller than the voltage ratings of the connected equipment. Lower voltage is considered a safety hazard by all industry standards and can cause premature failure of connected equipment. Devices could be damaged by lower line voltage.

e) Over Voltage

Overvoltage is defined as incoming line voltage at the point of use which is greater than the Public Service Commission's mandated legal limits; and/or greater than the voltage ratings of the connected equipment. Overvoltage is considered a safety hazard by all industry standards, and can cause premature failure of connected equipment. Overvoltage has been a widely known industry problem for many years, but it is not generally understood by many who have to deal with it. Power companies have been unable to control it adequately. Overvoltage occurs most often during severe cold winter weather for the following reasons: (1) Inadequate size of power distribution systems; (2) slow reaction time for power company's distribution systems to regulate voltage during extreme load variations; and (3) abrupt reductions of loads.

III. Block Diagram Arrangement

In figure 4, the basic arrangement of the implemented project can be found.

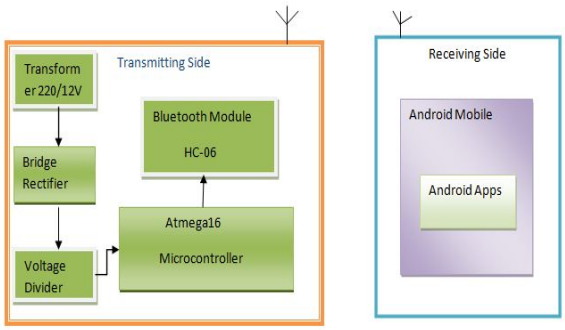

Figure 4 : Block diagram arrangement of the project

Among the major components required to establish the project, few of them are the power transformers (step down), microcontroller ATMEGA 16 and Bluetooth module ,Bridge rectifier.

a) Transformer

Transformer is an electrical device used to step up and down the AC voltages. There are two types of transformers: Step up and step down transformer. Step up transformer increases the magnitude of voltage while step down transformer decreasethe magnitude of voltage. Depending on the ratio of the number ofturns in the primary & secondary winding a transformer is characterized as step up or step down. For this project purpose, considering 1Φ voltage to be around 220 V, 3 step down power transformer of rating 220/12 has been used to represent a realistic representation of the 3Φ system.

Figure 5 : 220v/12v transformer

b) Microcontroller ATMEGA 16

Brain of this project is Atmega16 micro-controller. It is a 8 bit Micro controller with RISC architecture. Its speed is up to 16MIPS throughput at 16MHz. It has 16K bytes of flash and 512bytes EEPROM. Operating voltage 2.7v -5.5v, in active mode it consumes only 1.1mA & in sleep mode it consumes less than 1uA current which made it a perfect choice for his project [3].

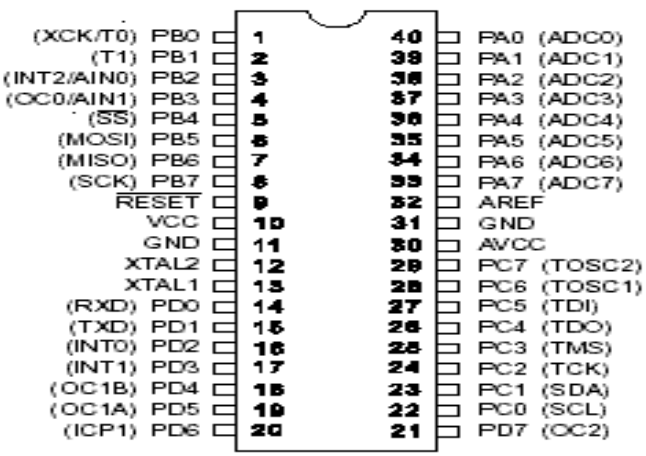

Figure 6 : Atmega16 microcontroller

c) Bluetooth module

HC-06 has been used as Bluetooth module. The Baud rate is 9600. Master and slave mode can't be switched in this Module. HC-06 module have paired memory to remember last slave device. The working voltage is 3.3V, but it can work at 3.00-4.2v.The Current pairing 20~30mA, connected 8mA[5].

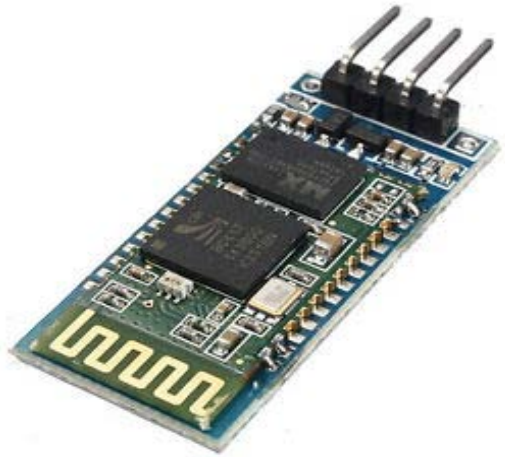

Figure 7 : Bluetooth module HC-06

d) Bridge rectifier

An AC power source is required for powering major appliances but almost all electronic circuits require a steady DC supply. A simple rectifier circuit described in this project converts the input from AC source to DC voltage. Firstly, the AC input from mains is stepped down to a lower value of voltage. This AC supply is then passed through a rectifier circuit to remove the negative cycle of AC waveform. The resulting signal is then filtered to get the DC output. The major part of the circuit is connected to the secondary coil of the transformer which is comprised by diodes and capacitor. While the diodes act as a rectifiers, capacitor filters out the DC component from the circuit.

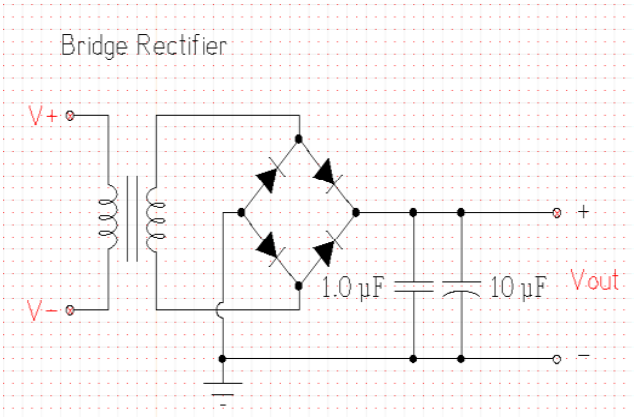

Figure 8 : Bridge rectifier

IV. Simulation

The initial stage, the circuits have been designed and simulated in PROTEUS. The circuit have been utilized to analyze the line to line, single line to ground, double line to ground, open conductor, over voltage and under voltage in the sides of the transformer. The circuit diagram can be found in figure 9.

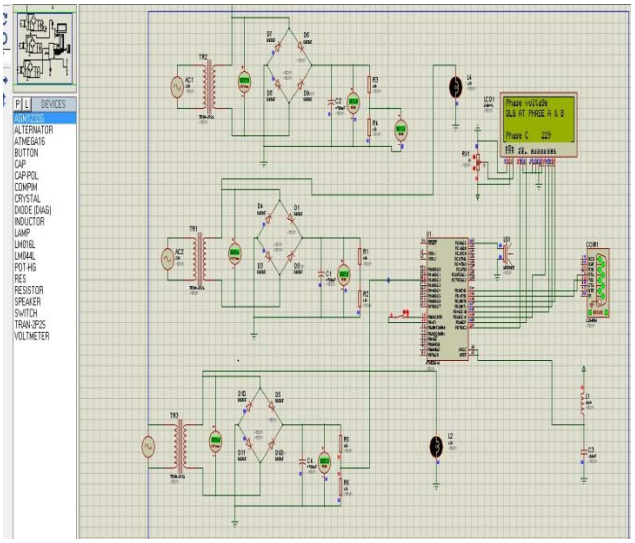

Figure 9 : Circuit Simulation

V. Hardware Implementation

In reference to figure 4, the transmitting and receiving side can be described as follows:

a) Transmitting side

Heart of the project is the microcontroller ATMEGA 16. In general the normal distribution phase voltage is 220 V, in this project we used a step down transformer 220/12 V for converting the phase voltage from 220 V to 12 V. Then, a bridge rectifier has been used for converting the 12 V ac to 12 V dc; after that, applied voltage divider converts the 12 V to 5 V because the microcontroller works at maximum 5 V. By this process the three distribution phase is connected into three microcontroller pins. At cases, when the distribution side is in load shedding protection of transformer must be ensured, which is why the microcontroller power is given from an external power source (5 V battery) backup and also the Bluetooth module power is given from external power source(4V battery). Bluetooth module communicates with atmeg16 through UART. RXD of Bluetooth module is connected with TXD of atmega16 and TXD of Bluetooth module is connected to RXD of atmega16.

b) Receiving side

In receiver Side an Android Phone is connected with Transmitting side via Bluetooth Module CI Android Apps[6]. At first we connect the android phone with HC-

06 and the password of the HC-06 is 1234 then android apps shows the data which is send by transmitting side. The communication protocol is UART and baud rate is 9600[4].

In view of the descriptions above, the implemented hardware can be found in figure 10.

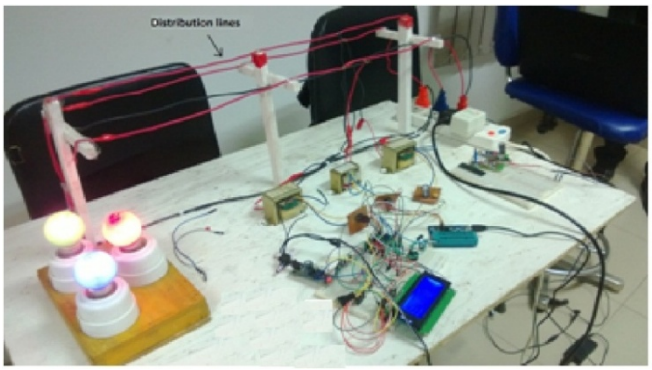

Figure 10 : Implemented Hardware model

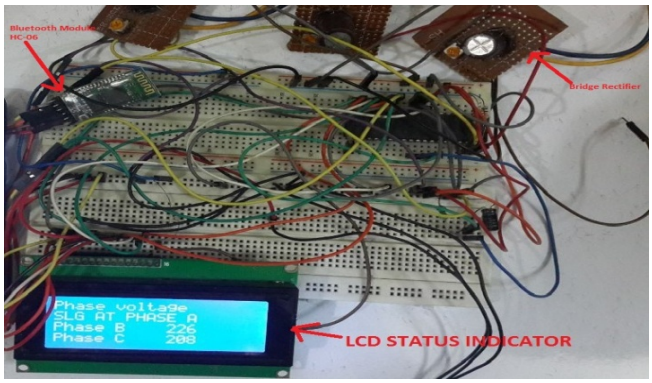

Figure 11 : LCD status indicator

As viewed from figure 10, the system was found to be balanced three phase system. In figure 11, the corresponding representation appears in the LCD display with the phase voltages in all the phases to be around 219 V. The view from Android Phone is also shown in figure 12.

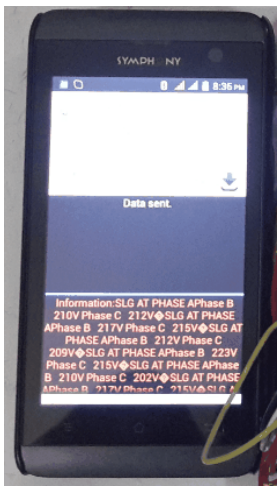

Figure 12 : Android Phone output

VI. Future Prospects

In view of a wide and Short range of possibilities on the basis of Bluetooth based fault Detection system, a few has been depicted below:

1. Fault detection of a Generator and motor.
2. Improvements to human-machine interface.
3. Improvements in computer-based protection of Industry automation.

VII. Conclusion

Microcontroller and Bluetooth based fault detection system is a reliable technique for monitoring and controlling the electric distribution system, the microcontroller works up to 100 ºC temperature. For Short distance data transmission Bluetooth technology is a reliable and robust one. Any kind of fault occurring in the distribution system results the Bluetooth modules to send instant messages automatically to the nearest user. Bluetooth based microcontroller Fault detection system will serve as a reliable, easy and cost effective solution for monitoring and controlling the electric distribution system.

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