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IoT Based 11kV Fault Detection

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Abstract : The fault location detection and real time monitoring has been a goal of power system engineers, since the creation of distribution and transmission systems. Quick fault detection can help protect the equipment by allowing the disconnection of faulted lines before any significant damage of the equipment. The accurate fault location can help utility personnel remove persistent of the faults and locate the areas where the faults regularly occur, thus reducing the occurrence of fault and minimize the time of power outages. In this Paper internet of thing based fault detection and location system was used to adequately and accurately indicate and locates the exact spot where fault had occurred. This will ensure a shorter response time for technical crew to rectify these faults. When a fault gets created in a cable line, this is sensed by the sensor and microcontroller and is updated to the user.

***Index Terms* - kV fault detection; IOT based fault detection; IOT; Fault detection;IoT;**

I. INTRODUCTION

For the past fifty years, electric power systems have rapidly grown. This has resulted in a large increase of the number of lines in operation and their total length. Transmission of electricity through overhead transmission lines is a widely used method for power transmission from one location to another. Failure is a critical issue in this essential service. The location of the fault must be identified for recovery from the failure. The restoration can be expedited if the location of the fault is either known or can be estimated with reasonable accuracy. Detecting and locating fault in power line is very necessary for healthy operation of power system. In electrical power line fault often occur many times making the power system unreliable. Speedy and precise fault location plays an important role in accelerating system restoration, reducing outage time and significantly improving system reliability. Though there is human effort involved in fault detection, technology assisted solutions can save time and resources.

A. Research Statement

Losses in distribution system are much higher than losses in transmission side and also fault are more frequent in distribution side. In distribution system most of the losses are caused by fault and theft. In this paper the focus is on single phase to ground fault in power line. When single phase to ground fault occurs, it becomes significant to detect fault quickly and with accuracy. It becomes challenging for the power company to detect and repair the fault as quickly as possible. Protection systems are designed to identify the location of faults and isolate only the faulted section in order not to damage the whole equipment in power system. For fault detection current existing solution is trial and error method. In which feed supply at the single end at a time by dividing that transmission line into two parts and check the fault up to that section. These processes go on until they find the fault area. After checking if they found anything, then it is ok to go forward otherwise it take more time and human efforts. Purposed solution for this research is to provide with a simple way to detect the fault and show the exact location of occurred fault which will ultimately lead to optimum operation of the whole system and to improve the reliability of distribution network. IoT Based Approach The aim is to detect the fault in the distribution line and intimate to the server about the fault location. To detect the accurate fault in the distribution lines, the sensor are used. The sensors sense the power characteristics of the transmission line. To design an efficient impedance-based and robust automatic fault detection [2] and location system for overhead 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. This Research work is limited to the design of an efficient system that will detect and locate line to line and line to ground faults in overhead lines which will automatically indicate to the control room or online at the exact spot of the cable line where a fault had occurred and also real time monitoring [1].

B. Research Methodology

The distance of fault from the primary distribution bus is estimated by impedance based method. Voltage and current values measured at one end or both ends of the line are required in this method. The method uses mathematical equations to estimate the fault location. Suggested a technique that used the fundamental frequency voltages and currents measured at a line terminal before

and during the fault[3]. The fault location technique was described by considering a single-phase-to-ground fault proposed a method that was based on measurements provided by Intelligent Electronic Devices (IEDs) with built-in oscillography function. This is installed only at the substation level and on a database that stores information about the network topology and its electrical parameters. In particular on 11kV networks using IoT based devices.

II. PROPOSED BLOCK DIAGRAM

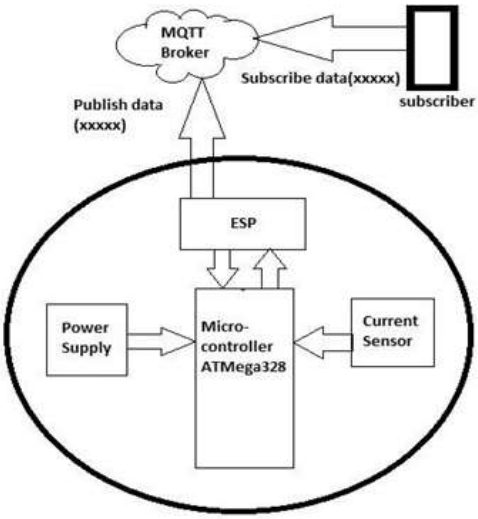

Fig.1 Proposed system

A. Tmega328p Microcontroller

The Atmega328 is a very popular microcontroller chip produced by Atmel. It is an 8-bit microcontroller that has 32K of flash memory, 1K of EEPROM, and 2K of internal SRAM. The Atmega328 has 28 pins. It has 14 digital I/O pins, of which 6 can be used as PWM outputs and 6 analog input pins.

B. Current Transformers (Sensors)

The Current Transformer (C.T.), is a type of "instrument transformer" that is designed to produce an alternating current in its secondary winding which is proportional to the current being measured in its primary. Current transformers reduce high voltage currents to a much lower value and provide a convenient way of safely monitoring the actual electrical current. Flowing in an AC transmission line using a standard ammeter. The principal of operation of a basic current transformer is slightly different from that of an ordinary voltage transformer[4]. Most current transformers have the standard secondary rating of 5 amps with the primary and secondary currents being expressed as a ratio such as 100/5. This means that the primary current is 20 times greater than the secondary current so when 100 amps is flowing in the primary conductor it will result in 5 amps flowing in the secondary winding. A current transformer of say 500/5, will produce 5 amps in the secondary for 500 amps in the primary conductor, 100 times greater.By increasing the number of secondary windings, Ns, the secondary current can be made much smaller than the current in the primary circuit being measured because as Ns increases, is goes down by a proportional amount. In other words, the number of turns and the current in the primary and secondary windings are related by an inverse proportion.A current transformer, like any other transformer, must satisfy the amp-turn equation and we know from our tutorial on double wound voltage transformers that this turns ratio is equal to:

$$secondary\ current\ , I_S = I_P \left(\frac{N_P}{N_S}\right) \qquad (2.1)$$

C. ESP8266 Module

The current ratio will set the turns ratio and as the primary usually consists of one or two turns whilst the secondary can have several hundred turns, the ratio between the primary and secondary can be quite large. For example, assume that the current rating of the primary winding is 100A. The secondary winding has the standard rating of 5A. Then the ratio between the primary and the secondary currents is 100A-to-5A, or 20:1. In other words, the primary current is 20 times greater than the secondary current. But relatively large changes in a current transformer turns ratio can be achieved by modifying the primary turns through the CT's window where one primary turn is equal to one pass and more than one pass through the window results in the electrical ratio being modified[5].

The ESP8266 series, or family, of Wi-Fi chips is produced by Espressif Systems, a fabless semiconductor company operating out of Shanghai, China. **ESP8266EX** (simply referred to as ESP8266) is a system-on-chip (SoC) which integrates a 32-bit T microcontroller, standard digital peripheral interfaces, antenna switches, RF, power amplifier, low noise receive amplifier, filters and power management modules into a small package. It provides capabilities for 2.4 GHz Esp8266 MODEM is a class of wireless MODEM devices that are designed for communication of a computer with cloud network. It has a 64 KB boot ROM, 32 KB instruction RAM, and 80 KB user data RAM. Also they have IMEI (International Mobile Equipment Identity) number similar to mobile phones for their identification. An esp8266 can perform the following operations: Receive, send or delete SMS messages in a cloud.

D. Communication Protocol

MQTT stands for Message Queue Telemetry Transport. As its name suggests, it's a protocol for transporting messages between two points. This protocol is so lightweight that it can be supported by some of the smallest measuring and monitoring devices, and it can transmit data over far reaching, sometimes intermittent networks[6]. MQTT is designed to overcome the challenges of connecting the rapidly expanding physical world of sensors, actuators, phones, and tablets with established software processing technologies. These principles also turn out to make this protocol ideal for the emerging M2M or IoT world of connected devices where bandwidth and battery power are at a premium. The MQTT high-level architecture is primarily divided into two parts – a broker and a client. A broker acts as the heart of the architecture with capabilities of both subscriber and publisher.

III. MATLAB SIMULATION

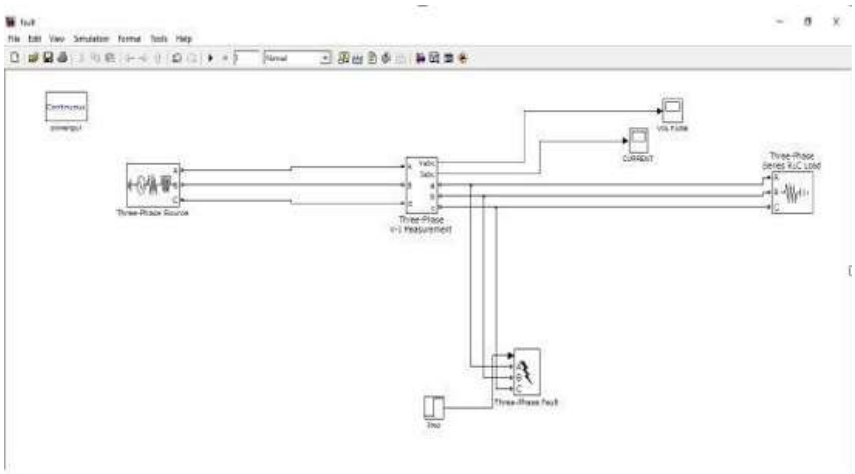

Fig. 2. 11kv line simulation in MATLAB

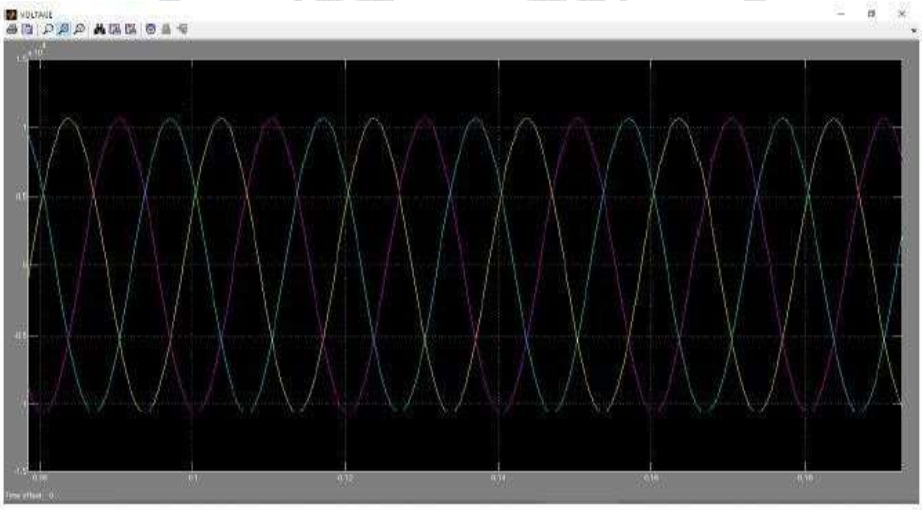

Fig.3. 11kv voltage waveform in MATLAB

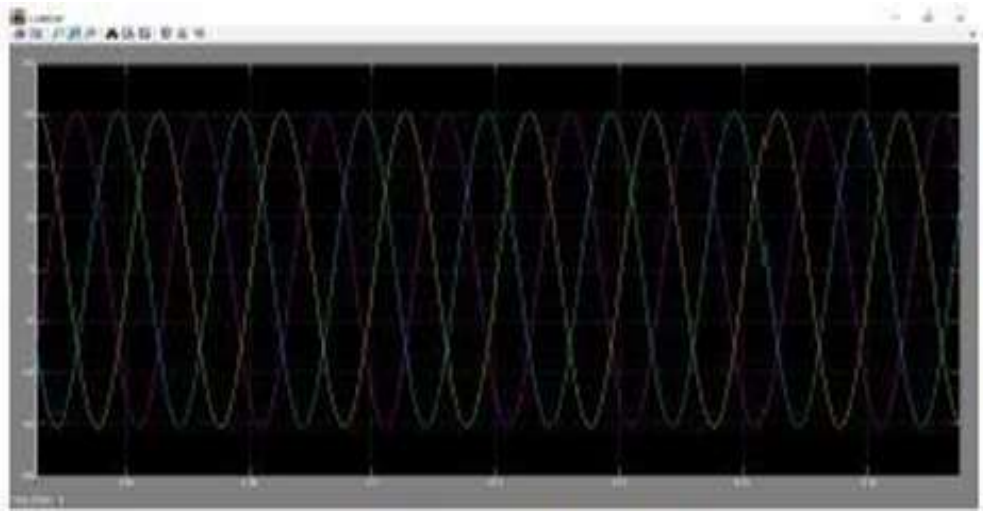

Fig.4 11kv current before fault

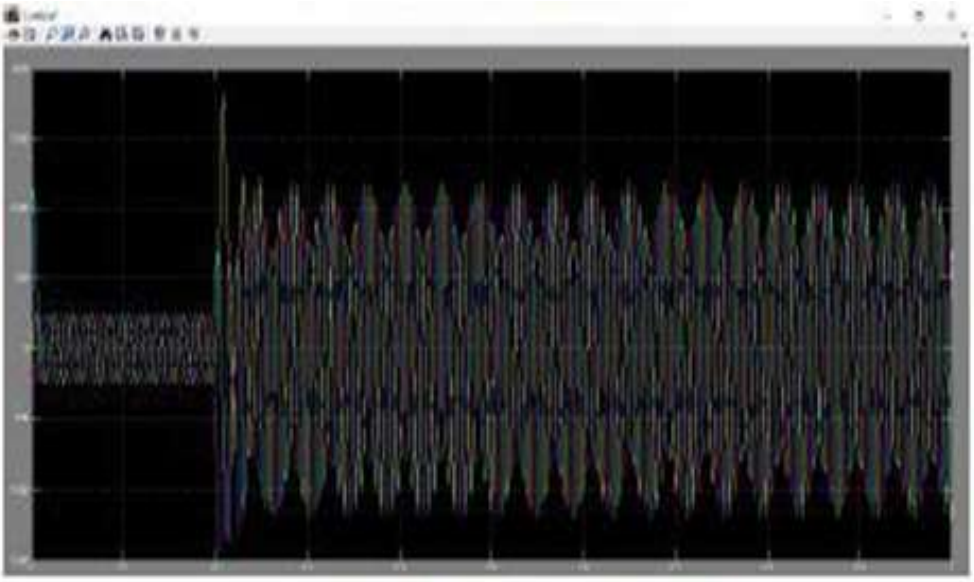

Fig.5 11kvline current waveform after fault

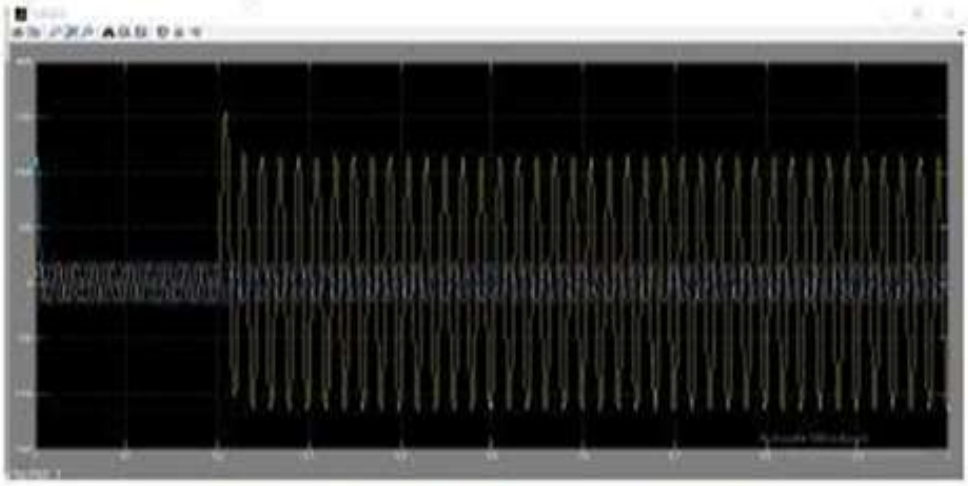

Fig. 6. 11kv line fault current waveform in one phase

Simple calculation is made for line to ground current fault if KVA value is assumed as per standard data:

11KV LINE CURRENT:
KW = KVA*PF
POWER [KW]= 2900*0.9
POWER = 2610 KW
POWER [KW]=root(3)*KV*I*PF
root(3) = 1.732
2610= 1.732*11*I*0.9
2610/1.732*11*0.9 = I

A. *Writing Sketches*

Programs written using Arduino Software(IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .ino. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom right hand corner of the window displays the configured board and serial port. Sketches contains main two parts in void setup parts it describes total component setup in circuit and directives that components in second part void loop it makes all set component being active continuously during running program e.g. 11 kV fault detector continuously results shows on interfaced LCD which is result of sensing of current by current sensor. So we can say that LCD will print whatever GSM AT is command Additional libraries can be added at the top of programming when begins[7].

B. *Libraries*

Libraries provide extra functionality for use in sketches, e.g. working with hardware or manipulating data. To use a library in a sketch, select it from the Sketch >Import Library menu. This will insert one or more #include statements at the top of the sketch and compile the library with your sketch. Because libraries are uploaded to the board with your sketch.

C. *Uploading*

Before uploading your sketch, you need to select the correct items from the Tools > Boar and Tools > Port menus. Ports name will varied by varying operating systems. Once you've selected the correct serial port and board, press the upload button in the toolbar or select the Upload item from the Sketch menu. Current Arduino boards will reset automatically and begin the upload[8].

the RX and TX LEDs blink as the sketch is uploaded. The Arduino Software (IDE) will display a message when the upload is complete, or show an error[9].

IV. Conclusion

In conclusion proposed system will provide a reduction in the time required to locate a fault by automatically providing accurate fault location information specially in the 11 kV line system. Simulation of the 11 kV line shows the current after and before the fault.

References

[1] S.Suresh, R.Nagarajan, L.Sakthivel, V.Logesh, C.Mohandass, G.Tamilselvan "Transmission Line Fault Monitoring and Identification System by Using Internet of Things" International Journal of Advanced Engineering Research and Science(IJAERS),Vol- 4, Issue-4, Apr- 2017

[2] G.S.Nandakumar, V.Sudha, D.Aswini "Fault Detection in Overhead Power Transmission" International Journal of Pure and Applied Mathematics, Volume 118 No.8 2018, 377-381

[3] P. Chandra shekar., "Transmission Line Fault Detection & Indication through GSM, "International Journal of Recent Advancs in Engineering & Technology , vol. 2, issue 5, pp 28-30, 2014.

[4] S.Chavhan, V.Barsagade, A.Dutta, S.Thakre., " Fault Detection in Power Line using Wireless Sensor Networks," IPASJ Internaional Journal of Electrical Engineering , vol.3, issue 3, pp 8-13, March 2015.

[5] Ing. Komi Agbesi, Felix Attuquaye Okai., "Automatic Fault Detection and Location in Power Transmission Lines using GSM Technology," International Journal of Advance Research in Science and Engineering, vol. 5, issue 1, pp 193-207, January 2016.

[6] Ivana Podnar Žarko*, Krešimir Pripužić , Martin Serrano, Manfred Hauswirth IoT Data Management Methods and Optimisation Algorithms for Mobile Publish/Subscribe Services in Cloud Environments

[7] Prof. M. S. Sujatha, Dr. M Vijay Kumar Dept of EEE. "On-line monitoring and analysis of faults in transmission and distribution lines using GSM technique", E- ISSN: 1817-3195. Vol. 33 No.2, 30th Nov, 2011.

[8] H. K. Wong, Shihe Chen, S. K. Lau, Joe Tang, K. P. Liu "Detection of Open-circuit Fault in 11kV Ring Circuits by Unbalanced Current Measurement"

[9] Kehinde Olusuyi, Ayodele Sunday Oluwole, Temitope Adefarati, Adedayo Kayode Babarinde "A fault analysis of 11kv distribution system (a case study of ado Ekiti electrical power distribution district)" American Journal of Electrical Power and Energy Systems.