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IoT based Underground Cable Fault Detection and Monitoring System

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Abstract : With the development and advancement in technology, many thing changes. As technology laid us to understand its importance like in urban areas, the electrical cable runs underground instead of overhead lines, which occupies less space and is considered as the effective and efficient way of transmission. But the problem arises when any fault occurs in the underground cable and it's also difficult to detect the exact location of the fault during the process of repairing that particular cable and the methods existed till now follows some algorithm in order to identify the location of the fault. The proposed system which comprises of current sensors, microcontroller (Arduino NANO) and Wi-Fi modem which creates a pathway between the assembled hardware and internet so that the real time data can be serially communicated towards server its being serially communicated towards server and along with this everything becomes smart and interconnected with the help of IoT (internet of things) those real time data can be retrieved in laptops or smartphones from the server. [1] Meanwhile by using effective platform provided by IoT any one can retrieve information whenever they required. By implementing the proposed system life of the cable will also get by increased because after implementing the system the supply transmission of the power can be stopped till the fault gets repaired and through this the unnecessary losses which are developed though the leakage of current can be avoided.

Keywords : Electrical cable, current sensors, of Wi-Fi modem, of IoT (internet of things).

1. INTRODUCTION

In the urban areas, the electrical cable runs underground instead of overhead lines. Whenever the fault occurs in underground cable it is difficult to detect the exact location of the fault for process of repairing that particular cable. The proposed system detects the exact location of the fault and by the means of Wi-Fi modem it's serially communicated towards server. Since problem that occurs in underground cable is a big problem till now. As it is very difficult to find the exact location or faulty location manually, which suddenly affects the efficiency of the cable wire due to losses occurred. Till now many techniques had already been implemented in order to detect fault in cable wire .But the problem came up is how to detect fault in cable wire when it is under grounded, and how to access or retrieve those data related to faulty location whenever it is required .In order to fill those gaps, we proposed the system which detects the exact location of the fault and through the means of Wi-Fi modem its serially communicated towards server. Through previous researches many techniques came up which were useful

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to overcome the problem upto some extent. In one of the paper by K.Hasan, A et.al. says that-failure and degrading of air craft wiring is a big concern which could further lead to fire and smoke because of arcing .But the proposed technique based on TDR ,in which train of pulses are generated in order to detect the fault[2].Till now electrosurgical being a one of the major problem for the researchers in one of the paper proposed Robert.d.Gross,a et.al.says that a problem of an electrosurgical grounding which lead to a severe burn was reduced at some extent through a technique proposed of electrosurgical grounding pad which consist of a temperature sensor and alarm .With the help of temperature sensor faulty location is being caught before it started producing burn,on the other hand alarm detect the faulty location with problem and alerts the operator in a control room about the burn[3].The problems and the techniques we discussed above were the best way of dealing with the problem only when we consider in order to alert the personnel, what if along with the alerting about the faulty location if we maintain proper data about that location and the fault and serially communicating the data towards the server from where the information can be retrieved through IOT (Internet of things).When we talk about the term IoT it is the best way of mitigating any problem as through this all object become interconnected and smart[4].Through previous researches we made a conclusion that when we are talking about underground fault it really becomes a tough job so in our proposed system we are using current sensor that has to be placed along with the underground cable which after detecting fault will serially communicate the data towards the server with the help of Wi-Fi modem from where information can be retrieved through IoT.

2. RELATED WORK

Various methods came in existence in order to detect underground fault or fault in cable wire. Some of them are as follows: Aurthur C .Westrom et .al stated a method in which just after the fault established in a wire a chirped pulse stream are being injected .With respect to delay time between sending and reflected pulses a certain calculations are being made by some correlation process which is designed specially in order to eliminate the effect of noise caused by voltage arcing which thus provide an accurate calculation of the faulty location [5]. Wei-Jen Lee et.al stated that in some circumstances arcing fault on underground cable can generate large amount of heat and gases. The decomposed gases settled to the end of the duct of the cable lead to fire and explode. By collecting certain information and developing few algorithms he tried to solve the calculation in order to examine and get the data of the faulty location [6]. IoT (Internet of Things) makes the world exciting. Now days everything is converged towards wireless technologies from where IoT has evolved. Y. J. Fan et.al says that the term IoT it is the best way of mitigating any problem as through this all object become interconnected and smart[4].In recent year IoT based application have come up with its wide importance as it summarizes present state of art IoT systematically in industry. Collectively the previous researches or the method mentioned above have made its vast application in recent days but those were not enough in order to gather data or to solve the problem regarding underground fault .But in this paper we proposed the system which laid us to get accurate position of the fault in underground cable and also as the fault detected the related data will be communicated to the server through Wi-Fi modem and from the server the information can be retrieved any time using IoT . IoT based techniques are widely used these days in industries.

3. SYSTEM DESCRIPTION

Various components used in the system are basically a current sensor , arduino Uno , Wi-Fi modem , LCD display and there interfacing diagram is also shown (figure 2). Measuring the amount of current is one of the important task and earlier it was achieved by placing a resistor in the current paths but due to that the heat dissipation was more so now various technologies came up which measures current without any heat loss, one of such current sensor is MEMs silicon based Piezoelectric AC current sensor, which operates at resonant frequency and gives an improved response when placed near to current carrying conductor [7]. Here we have used Arduino NANO as a microcontroller which works similar like Arduino Uno. Due its miniature size it can be placed over breadboard and reads the sensed values and as per the coding done by the user it performs the specific tasks. Like in this, microcontroller (Arduino) will receive the input from the sensor and according to it, the controller circuit will

perform some set operations like displaying of data in LCD display which is interfaced with it or serially communicating the real time data through Tx-pin of microcontroller [8].Wi-Fi module acts as a medium which connects any of the physically assembled system with internet and transmits the data in the server. Wi-Fi module.

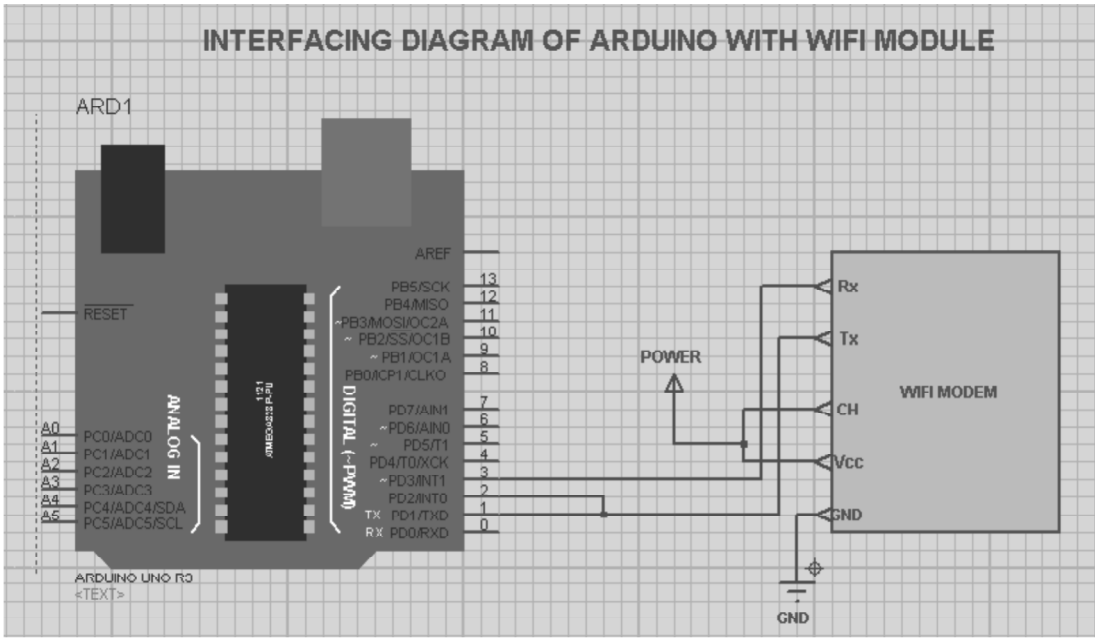

Fig. 1. Interfacing diagram of Arduino and Wi-Fi module.

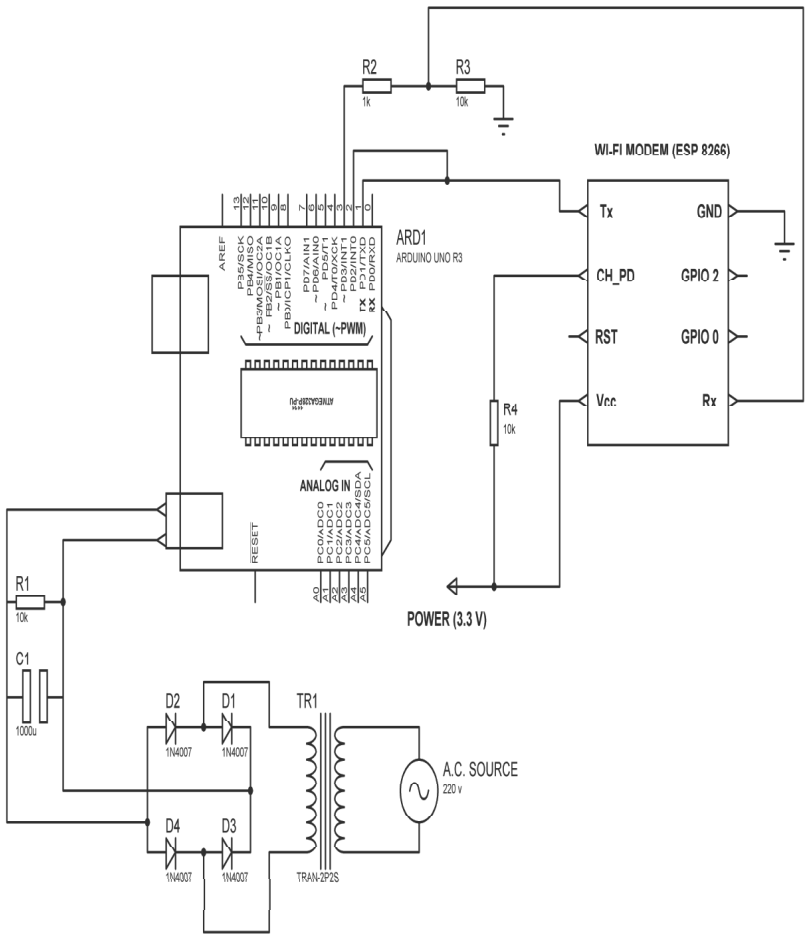

Fig. 2. Circuit diagram of Arduino and Wi-Fi module.

Which is usually interfaced with Arduino is ESP8266. It's cheap and an easy way to get interfaced with any microcontroller platform wirelessly through internet. Now coming to its pin configurations, it consists of 8 pins but the pins which are actually used are Tx pin, Rx pin, CH_PD pin, Vcc, Gnd. CH_PD is the enable pin which is active high pin and by giving input HIGH it enables Wi-Fi and connects the system with internet and any of the sensed values can be serially transmitted to the server. For example, an ARM based power meter works on similar principle [9]. An interfacing diagram of Arduino with Wi-Fi module is shown in the proteus simulation software in figure 1. And the same is seen in assembling both the components whose circuit diagram is shown in figure 2 where we are placing some resistors in order to avoid the burning effect of over all circuitry. LCD display used here is 20 X 4 which is a flat panel display which uses a group of LEDs and writes the sensed value in its display screen and in the circuitry itself there is a facility through which we can control the LCD brightness and intensity [10].Now, figure shown below is the block diagram of the system (figure 3) where current sensors are placed across the underground cable and the sensor is interfaced with arduino and further arduino is interfaced with 20 x 4 LCD display and Wi-Fi modem. Sensed values from the current sensors goes to microcontroller and from there the values gets displayed in the LCD display and further serially communicated towards server and from server the real time data can be retrieved in smart phones or laptops through IoT. For example, for an underground cable the correct value is 5 amperes, then the value is sensed by the sensor and the similar value is shown in the display and transmitted in the server and supposes any fault occurs then the faulty value assures that the fault has been detected and then the further more actions can be taken. The system is simulated in proteus simulation software in order to check its accuracy and it's shown in the figure 4. The circuit diagram shows the interconnection of the components in which the current sensor output pin is connected to the analog input pin of arduino which is A0, and a DC rectified power supply is given to the arduino. After that 20 X 4 LCD display is interfaced with arduino, where we have connected pin number 4, 5 of LCD display to 13, 12 pins of Arduino which are PB5/ SCK and PB4/MISO respectively and we kept the R/W pin of display at ground which will write in the LCD display and the data pins of lcd display (D4, D5, D6, D7) are connected to 7, 6, 5, 4 pins of arduino which are PD7/AIN1, ~ PD6/AIN0, ~PD5/T1, PD4/T0/XCK respectively. After that we interfaced Wi-Fi module (ESP8266) with arduino in which we connected pin 1, 2 of arduino to the Tx pin of Wi-Fi module and then pin 3 of arduino is connected to Rx pin of Wi-Fi module and we gave power of 3.3 V to Vcc and CH_PD pin of Wi-Fi module which is an active HIGH pin, by giving logic “1” enables Wi-Fi module and connects the assembled system with internet and provided with ground in GND pin of Wi-Fi module. At last when the code was implemented in arduino then the real time data was serially communicated in the server and the information from the server can be retrieved in mobile or laptop through IoT.

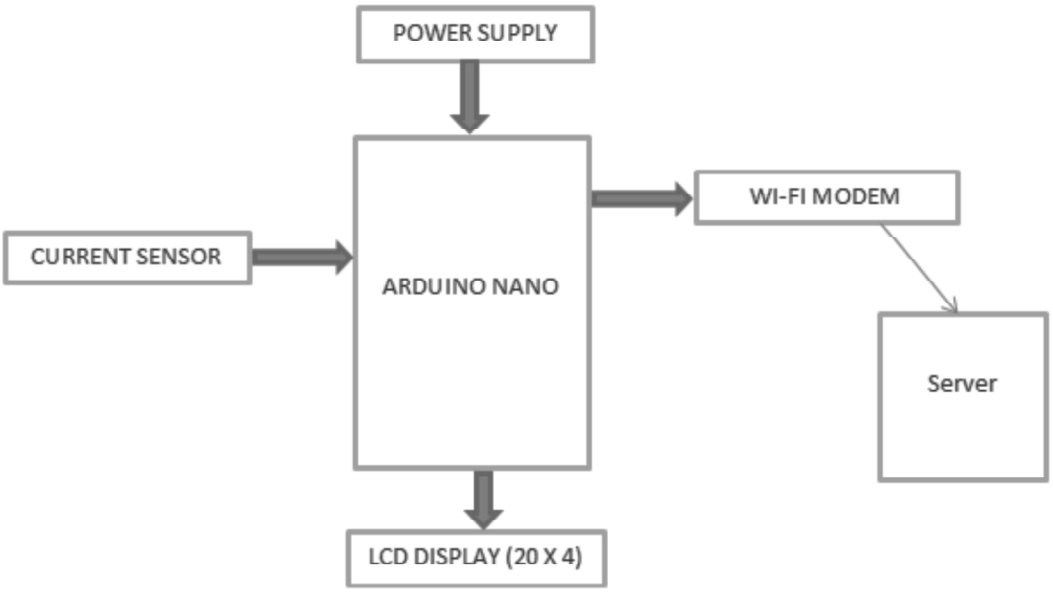

Fig. 3. Block Diagram of IoT based Underground cable fault detection and monitoring system.

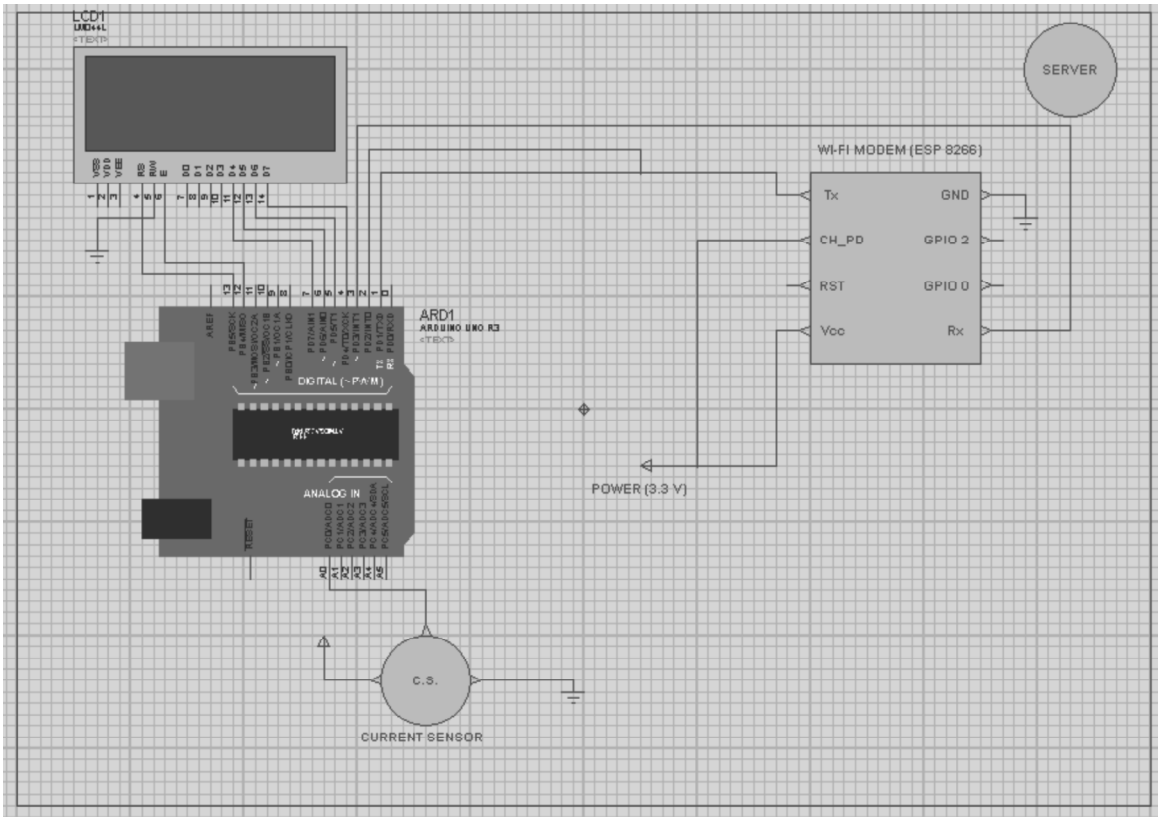

Fig. 4. Proteus simulation model of the system.

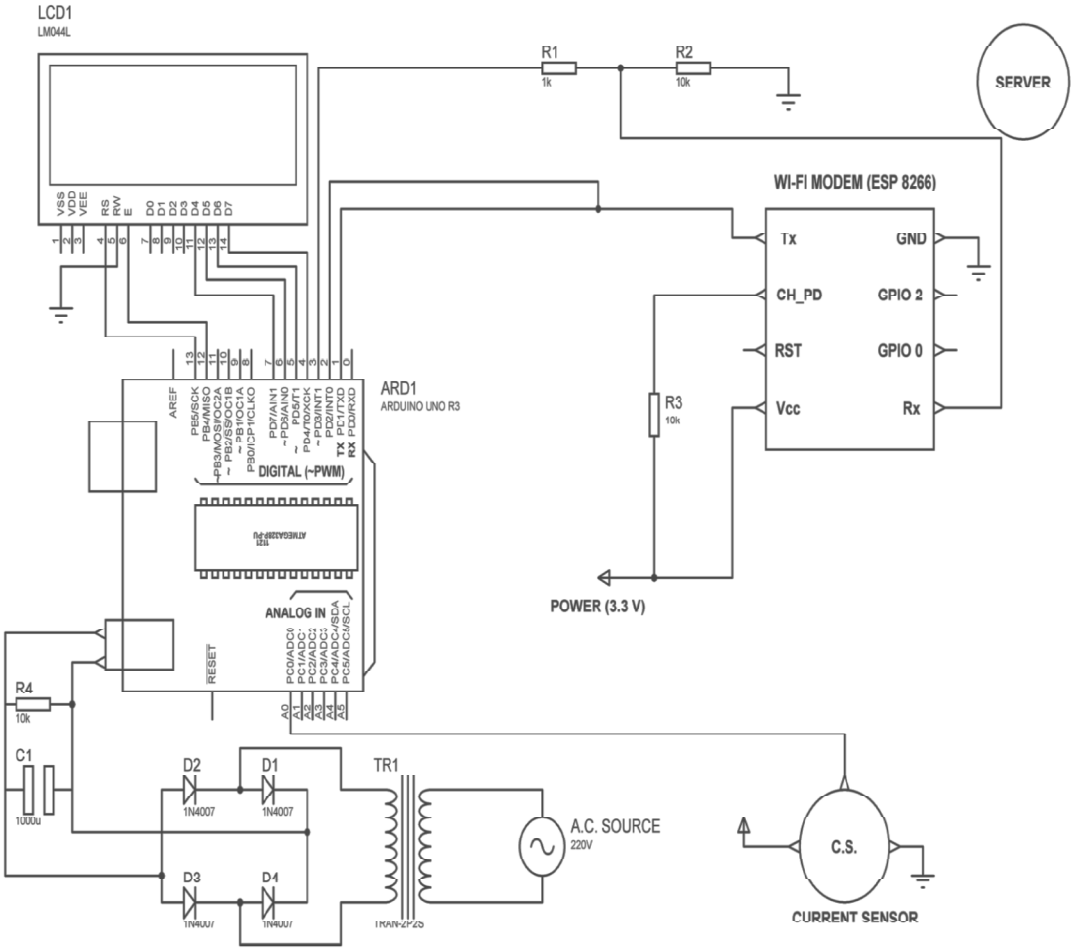

Fig. 5. Circuit diagram of the system.

4. RESULT

Though researchers came up with there methods for the detection of fault for underground fault detection system but somewhere we were not able to know that when actually the fault occurred and also its location and also in one of the existing methods in order to get the location of the fault some certain algorithm has to be performed and some calculations which could be a bit time consuming and till then there might be a chance that major loss could occur but here it's not so, by the implementation of the proposed method , real time data will be easily known and if any faulty case occurs then there will be decrement or increment in the actual value and its fault, location will be easily known to the authorities as the real time data can be retrieved from the server in mobile phones or in the laptop. Not only this, life of the cable will also get by increased because after implementing the system the supply transmission of the power can be stopped till the fault gets repaired and through this the unnecessary losses which are developed though the leakage of current can be avoided.

5. REFERENCES

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