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Under Ground Cable Fault Detection Using GSM and GPS by Using Arduino Board

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Abstract: This paper proposed to identify the blame area in underground link lines from the base station to correct area in km utilizing Arduino and GSM (Global framework for portable correspondence) module, GPS(Global Positioning System) module. The essential thought behind the working of this venture is ohms' law. In underground framework, event of blame is uncommon and is difficult to find the precise position of blame. To conquer this issue, we thought of the thought displayed in paper. This undertaking is masterminded with set of resistors appearing of link in kilometers and a lot of changes are utilized to make blame at each realized kilometer to decide the precise area and results in regards to blame readings, and showed on a LCD interfaced with the Arduino UNO board. Further Arduino programming is utilized to reproduce the blame. This task is beneficial in lessening the cost, creation misfortunes by sparing the time and endeavors for segment of shortcomings and improving the influence accessibility to customers through an upgrade of by and large efficiency of influence nets.

Keywords: : Fault ID, Global framework for versatile com-munication (GSM), GPS(Global Positioning System), Arduino UNO, Analog to advanced converter (ADC), Liquid Crystal Display(LCD).

I. INTRODUCTION

A heap of electrical channels utilized for conveying power is called as a link. An underground link by and large has at least one conductors secured with appropriate protection and a defensive spread. Ordinarily utilized materials for protection are varnished cambric or impregnated paper. Blame in a link can be any deformity or non-homogeneity that occupies the way of current or influences the execution of the link. So it is important to address the blame.Power Transmission should be possible in both overhead just as in underground links. Be that as it may, not at all like underground links the overhead links have the disadvantage of being effectively inclined with the impacts of precipitation, snow, thunder, lightning and so on. This requires links with dependability, expanded wellbeing, toughness and more noteworthy administration. So underground links are favored in numerous regions extraordinarily in urban spots. When it is anything but difficult to distinguish and address th flaws in over head line by negligible perception , it is beyond the realm of imagination to expect to do as such in an underground link. As they are covered somewhere down in the dirt it is difficult to distinguish the irregularities in them. Notwithstanding when a blame is observed to be available it is hard to distinguish the precise area of the blame. This prompts burrowing of the whole region to distinguish and address the blame which causes wastage of money and manpower. So it is necessary to know the exact location of faults in the underground cables.

Appropriate blame finding and recognizing approaches are required for an improvement in unwavering quality. Occurrences of underground link blames in the conveyance and power transmission framework is inescapable because of a few reasons hence a fast rectification and conclusion of the issues is a significant issue and is dependably the top need for the power wholesalers. HIF (High Impedance Fault)s identification on conveyance framework has been one of the current and troublesome issue confronting the electric utility industry. Ongoing headways in the advanced innovation through Arduino and GSM have empowered arrangements of recognition of these exceptionally happened shortcomings. A strategy dependent on major circuit examination standards to appraise blame flows, pre-blame and post blame stage voltages of different sorts is displayed through Thevenin grid [7], [13]. Impedance based calculations are typically utilized by utilities to find blames in conveyance`framework[11],[17],[18].

The link blame finding hardware as of now being utilized is similarly substantial. Also, by and large, one technique isn't sufficient and exact blame identification may require more than one strategy to assemble. In any case, sorting out different tests with confounded gear and to finally analyze the blame is a tedious undertaking. Recognizing the link blames and pinpointing the blame area makes task quicker and simpler for the field builds through structure and development of a light weight convenient machine [4]. Underground framework contributes potential points of interest through limited activities and upkeep costs, less tempest harm, diminished tree cutting expenses and decreased loss of standard power deals for utility clients. A suitable acknowledgment of a flawed fragment is required to lessen the intercession time blame. Quick and exact blame area assumes a significant job in accelerating framework redesign, lessening incredible financial misfortune and working cost along these lines limiting

influence misfortune time and in particular improving framework accessibility and execution. Different blame finding techniques like the sectionalizing strategies, Murray circle strategies and acoustic location strategies [9-15] are not favored much since they suffer from numerous weaknesses. The sectionalizing strategy can't be utilized in light of the fact that looking at of underground link is absurd. The acoustic strategy may end up cataclysmic and impeding at stormy time. The Murray circle strategy is reliant upon the idea of Wheatstone and is exceptionally unseemly brought about by unmistakable lead-protections [12], [6]. Emblematic technique for discovery of open circuit conductor and short out blame in mechanized appropriation framework is utilized which precisely identifies the area in which blame happens [13]. A solitary finished blame area plot is likewise conceivable utilizing only the transient blame flows on an EHV (Extra High Voltage) framework and it is this plan which is shown on an appropriation framework utilizing one collector as blame transient signs are high recurrence signals superimposed on the enduring state voltage and flows. The transient signs would then be able to be extricated by applying a reasonable high pass filter. It has been found, in any case, that the twofold finished technique likewise gives an exact blame area if the blame is found legitimately hanging in the balance of intrigue or it ought to show the area of the feeder circuit if the blame is on a feeder [8]. Electric utilities frequently experience the issue of identifying the exact area of blame in underground links. These deficiencies happen even from a pessimistic standpoint time and cause the extraordinary measure of impediment to utility buyers. The disappointments of the underground power links speak to a genuine risk to the dependability of intensity foundation causing disastrous separate of the link. A dc voltage is connected to a course of action of arrangement resistors speaking to a link relies on the area of blame as the current differs, the potential drop likewise changes over the arrangement resistors in like manner and this drop in potential decides the area of blame. Current would change depending on the link blame area and voltage drop crosswise over resistors fluctuates as needs be the point at which a low DC voltage is given at the feeder end through link lines (arrangement resistors) in the matter of short out which is then sustained to ADC to create precise advanced information which the modified Arduino families would show in kilometers [5]. In this work, we have determined precisely the area of a link blame, wiped out the commotion brought about by arcing voltage, upgrade the exactness by contributing pre-blame heartbeat flags infrequently into the link, find the open circuit and short out blame in underground links utilizing Global framework for portable correspondence (GSM) module and Arduino programming and reproduce the system and blame utilizing programming named IDE (Integrated Development Environment) Arduino 1.6.11.

II. Methodology Implementation of Arduino uno board and GSM technology Arduino/genuine

The proposed framework actualizes Arduino to give quick information handling framework and results on LCD. The framework ends up minimal and cost efficient as the parts, for example, transfers, controller IC, hand-off driver IC, GSM module and LCD and so on are coordinated with Arduino. This empowers transfers to separate between stages by flickering the related leds. It empowers GSM module to send sms to administrators for speedier blame discovery and showcases blame related data on LCD so the blame could be settled as quickly as time permits. GSM Implementation of GSM module in proposed framework decreases correspondence hole by transvering speedier blame outcomes and is otherwise called Arduino shield since it causes Arduino board to interface with web and send or get messages. Messages are sent naturally to administrators henceforth they don't should be accessible every minute of every day where the blame happens and creation misfortunes are likewise diminished thus making framework increasingly confirmed, efficient, basic and definitely has an edge against our rivals. Then again, it could be reached out to blame tolerant framework in light of the fact that each part has its own instrument and if any part quits working, it will confine just that specific segment so as to work consistently

III. Algorithm to detect the fault using GSM and Arduino uno board

This undertaking is made out of a plan of arrangement resistors speaking to a link, a stage down transformer (230/12 volts), a scaffold rectifier to change over 12 volts AC (exchanging current) into 12 volts DC (direct current), controller, LCD, Arduino UNO board and GSM module to remotely advance the information. The total model/venture is empowered through power circuit which is made out of step down transformer, connect rectifier and controller ICs , this undertaking utilizes 2 distinctive voltage level 12V (for Relays and hand-off driver IC) and 5V (for GSM, Arduino and different parts). Arduino is arranged with C language, when circuit is turned on Arduino begin its programming cycle and sends flag to transfer driver IC to work hand-off. At the point when Arduino executes its program cycle then each of the three links are examined with a deferral of 500ms. Amid this sweep if any switch is closed(fault is made), Current gets way to ground through transfer contact. This flow of current causes into the 16*2 LCD along with its phase and location of fault. The same data which is displayed on screen is remotely forwarded to the responsible person through GSM module and can be monitored on laptop or pc using serial monitoring techniques. In this model three relays are used to differentiate between the phases and relay driver IC is used to control relay through Arduino programming (Clanguage). Fig.1 indicates the block diagram of underground cable fault detection and displays over mobile system through messaging. This project circuit block diagram comprises of various blocks such as a power supply block, Arduino UNO block, multiplexed relays, fault switches, LCD display and GSM module. Hence, this proposed project can be used to detect the accurate location of the fault and also for sending the data to a mobile system in text messaging format along with displaying over an LCD display using GSM module.

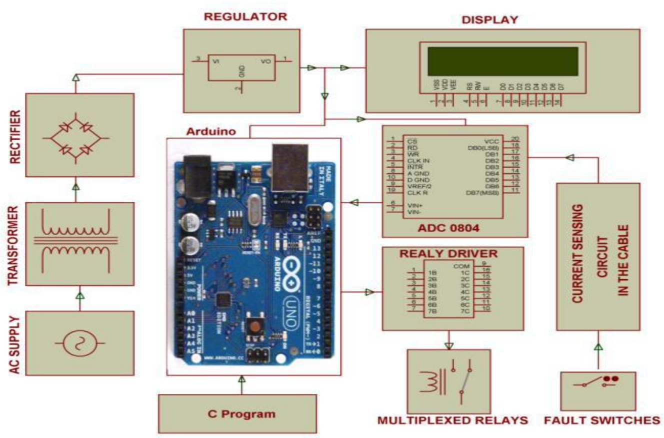

Fig. 1. Underground cable fault distance locator block diagram

IV. Simulation:

In this simulation, sets of resistors connected in series i.e. R1 to R17 and twelve switches indicating faults are simulated using NI Multisim software as shown in Fig.2.

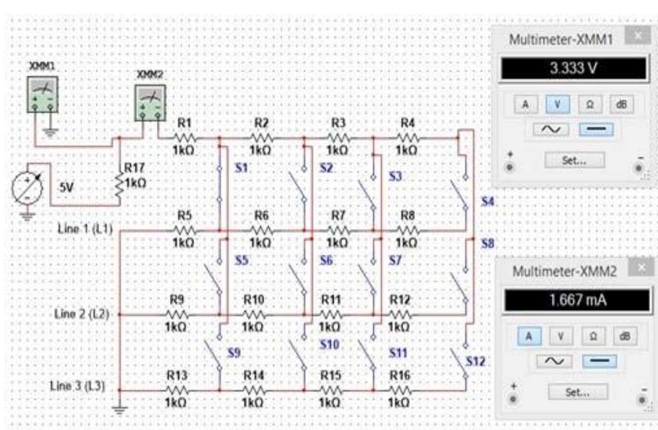

Fig. 2. Simulation model of resistors and switches using NI Multisim

TABLE I : MEASURED VOLTAGES, MEASURED CURRENTS, AND FAULT LOCATIONS

Switch : No	ADC Read	Voltage (V)	Current (mA)	Fault Loc:
L1-S1	651	3.182	1.818	2KM
L1-S3	876	4.285	0.714	6KM
L2-S6	818	4	1	4KM
L2-S8	908	4.44	0.556	8KM
L3-S9	654	3.2	1.7	2KM

The readings are taken with the help of operation of different switches. The voltage drops and current across series resistors when distinct switches are closed as shown in the Table 1. The distance (km) where the fault is located can be calculated as:

$$D = (M \times R)/V \qquad \text{(a)}$$

Where, M is the measured value or ADC reading, V is the reference voltage in volts and R is the resistance offered and can be calculated as:

$$R = V/I + 1 \qquad \text{(b)}$$

Where, I is the current in mA and V is the measured voltage where the fault is located. Both, equation (a) and (b) are used for short circuit fault location. We have used the following steps to detect the fault.

V. Algorithm:

The initialization of Arduino and GSM is shown through algorithm and flow chart, see Fig.3

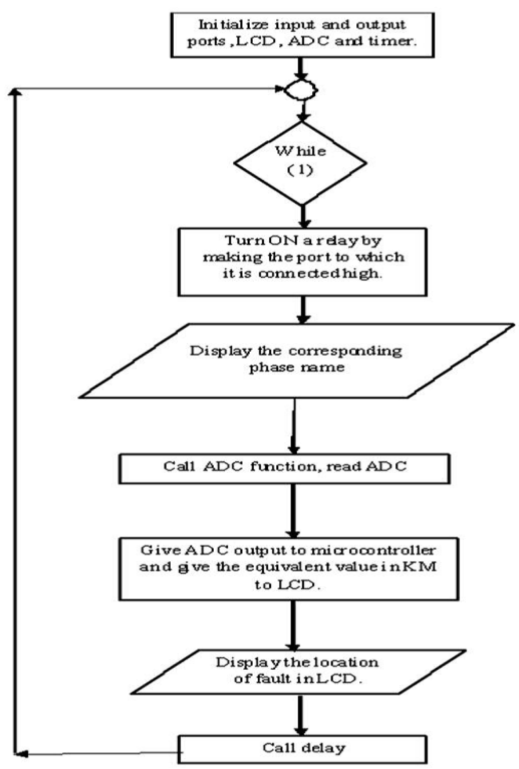

Fig. 3. Flow Chart

The steps of algorithm are as under:

1) Initialize all input, output; declare timer, communication ports, LCD Function, ADC and GSM shield.
2) Initiate an infinite loop; turn on relay 1 by causing pin 5 high (to start scanning line 1 or phase R).
3) After declared time turn on relay 2 by causing pin 6 high (after delay of 500ms start scanning line 2 or phase Y).
4) After declared time turn on relay 3 by causing pin 7 high (start scanning line 3 or phase B after 500ms)
5) Read analog data at pin Ao(Analog voltage drop signalfrom the arrangement of resistors representing cables).
6) Convert analog data into digital data (Analog voltage data into digital voltage data using built in ADC con- verter of Arduino).
7) Process all converted digital data (Calculate the fault point if any, using predefined formula which is discussed in paper eq(a and b).
8) Display result on LCD (Display calculated result for each Phase/Line on LCD).
9) Send data to GSM (Arduino forward the calculated data same which is displayed on LCD to GSM).
10) Transfer data to programmed number (Forward the obtained data from Arduino to the predefined Cellular number).
11) Repeat whole cycle from step 2-10 (Start scanning again to check for the fault).

VI. Advantages

- Less maintenance
- It has higher efficiency
- Less fault occur in underground cable
- This method is applicable to all types of cable ranging from 1kv to 500kv
- It can detect other types of cable fault such as Short circuit fault, cable cuts, Resistive fault, Sheath faults, Water trees, Partial discharges.

VII. Result and Analysis:

Arduino UNO board with no Fault All three lines in working condition represent no fault which is created through switches in circuit and then Arduino displays the result on LCD and same result forwarded to cellular mobile network through GSM Module

VIII. Conclusion:

Thus the project on Underground cable fault detection using Arduino was done and the distance of the fault from the base station in kilometers was displayed for the three individual phases R,Y and B. Circuit can be tested with different resistor values to simulate various fault conditions In this project faults upto a distance of 4km can be detected.When the fault switches are operated to fault condition then the phase corresponding to that particular switch is considered as the faulty phase. So the faulty section can easily be located.

IX. Future Scope:

In this paper we detect the exact location of short circuit fault in the underground cable from feeder end in km by using arduino. In future, this project can be implemented to calculate the impedance by using a capacitor in an AC circuit and thus measure the open circuit fault

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