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Arduino based Underground Cable Fault Detection

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Abstract- **The objective of this project is to determine the distance of the failure of the underground cable in the base station using one kilometer of Arduino board. Underground cable system is a common practice in many urban areas. Even if a failure occurs for some reason, at that time the repair process related to this particular cable is difficult because of not knowing the exact location of cable failure. The project uses the classic concept of the Ohms law, when a low voltage at the end of the power supply device is applied across a series resistor the current varies depending on the location of the Fault the cable. In the case of a short circuit (grounded line), the voltage across the series resistors changes accordingly, then input to the ADC constructs the Arduino board to develop accurate digital data for the in kilometer. The project is mounted with a resistance representing the length of the cable in KM and creating defects is executed by a set of switches in each known KM to check the accuracy of it. Failure occurs at a given distance and the respective phase is displayed on an LCD screen connected to the Arduino board.**

Keywords- Arduino Board, Ohms Low, LCD (liquid Cristal display), cable Fault, ADC (Analogue to digital converter), Digital Data.

I. INTRODUCTION

In this paper we proposed a fault localization model for the underground cable lines with Arduino.

The purpose of this paper is to determine the distance from the base station's underground cable fault in kilometers. In this project we used a simple concept of ohm's low .When a fault occurs in the system the distance located on liquid crystal display (LCD).. Until the last decade, cables were designed to be placed above the head and, at present, there is no underground cable that is higher than the previous method. adverse weather conditions such as storms, snow, torrential rains and pollution does not affect on underground lines But when a fault occurs in underground lines it is difficult to locate the fault in underground cable. We will find the exact location of the fault. Now the world has become digitized so, the project is to detect exact location of the fault in digital form. Underground cabling system is a more common practice in many urban areas. Although the fault occurs for some reason, at that time, the repair process for this particular cable is difficult because of not knowing the exact location of the cable breakdown. Fault in cable can be classified in two groups:

Open circuit fault :-In open circuit fault there is no current because there no conducting complete loop for current flowing that is I=0.in this fault supply voltage is equal to the output voltage. open circuit fault is better than short circuit fault..

Short circuit fault:- In this fault output voltage is zero but current is same

Further short circuit fault can be categorized in two types:
Symmetrical fault:- In this fault :equal lead current and equal phase shift.

Unsymmetrical fault:- In this fault magnitude of current is not equal & phase shifting is not equal by 120 degree.

Terminal method:- in this method used to detect the fault location in underground lines without any effort This method used to locate the type of circuit occurs; the voltage drop varies with the default length on the cable, as the current varies. A plurality of resistors is used to represent the cable and a DC voltage is supplied at one end and the defect is detected by detecting the voltage variation the defect area To accelerate the tracking of the buried cable.

II. LITERATURE SURVEY

A. Introduction

A literature review was conducted to determine the technological and / or industrial techniques available or used to meet this need for power companies as described in the previous chapter. The investigation is limited to the United States. Patents listed in the last five years; Technical journals (IEEE Transactions on instrumentation and measurements, IEEE Transactions on Circuits and Systems

and transactions); The indices of the publication of the energy industry; The periodic disclosure of products during the last seven years; And the manufacturer's documentation.

B. Patents

Of the 25 related patents found, 5,210,498 number is the most applicable to this project. Known as the "detector for detecting underground cables and errors therein using the high-power electromagnet", a method is described for locating ground-induced faults by transmitting a signal on the wire and viewing the signal Of surface.

C. Technical Journals

Pantaloons proposes that a Gaussian estimator, of maximum frequency, of maximum likelihood can determine the transfer function of a linear system, of continuous time, of two ports with time delay. The estimator can be used to locate a discontinuity in a cable. The location of the fault was based on the principle of Time Domain Reflectometry (TDR). The cable was stimulated with a pulse of short duration. The stimulus and the first reflection were sampled and the first spectral line F determined by the fast Fourier transform (FFT) was sent to the estimation algorithm. The propagation velocity of the cable was necessary to determine the final location of the fault. A simplified analytical model described by A bullma'atti implies the modeling of a resistive or capacitive charged line (RC) based on finding the approximate poles of the transfer function. This transfer model aims to make it easier to implement a computer-aided analysis; However, it is not as accurate as other published techniques.

Schutt-Aine reported a transient propagation analysis through non-uniform structures and uniform lines. The analysis uses a formulation of dispersion parameters in the time domain to establish closed form algorithms for current and voltage variables in the line. The technique was applied to micro-terminal, uniforms and tapered lines. A digital signal processing algorithm (DSP) was developed to estimate the location of a fault using a line parameter estimation technique. Van Biesen, This process was applied to TDR data sampled from a known non-defective cable for line parameter calibration and compared to a faulted line to locate the discontinuity. The technique requires knowledge of propagation velocity for accuracy. It is reported that the process solves the precision of 30 cm using a 20 MHz-8-bit sampler.

D. Murray Bridge loop

Murray Bridge loop is a bridge circuit used for localization of underground or submarine cable faults. it has been used for over 100 years.

One end of the defective wire is connected by a pair of resistors to the voltage source. Also, a zero detector is connected. The other end of the cable is short-circuited. The bridge is balanced by modifying the RB1 and RB2 values.

$$\frac{Rz}{Rg+Ry} = \frac{RB1}{RB2}$$

This is equivalent to:

$$Rz = (Rg + Ry).\frac{RB1}{RB2}$$

The value of Rx resistance is proportional to Lx length, so that the fault point can be calculated:

$$Lz = 2.L.\frac{RB1}{RB1} + RB2$$

Where L is the total length of the test cable - a proportional Rg value.

The method assumes that there is only one error, low resistance to the insulation resistance of the cable without damage and cable conductors have a resistance for uniform length units.

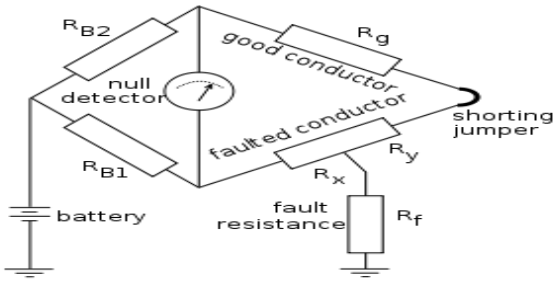

Fig. 1 Murray Bridge Loop

III. SYSTEM DEVELOPMENT

A. Block Diagram of the system

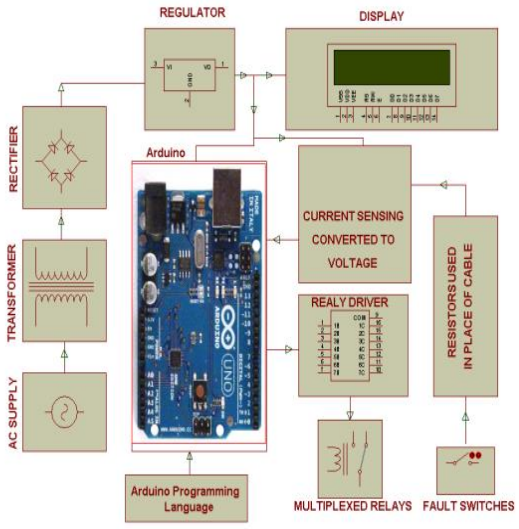

Fig. 2 Block Diagram of the system

B. Block diagram description

1) RESISTOR

Resistor is a passive component used to control the current in a circuit. Its resistor is given by the ratio of the voltage applied through its terminals to the current passing through it. Therefore, a particular resistor value, for a fixed voltage, limits the current there through. They are ubiquitous in electronic circuits.

The different value of the resistors is used to limit the current or the desired voltage drop depending on the nominal voltage of the device to be connected in the circuit.

For example, if a 2.3 V and 6 mA LED must be connected to a 5V power supply, a voltage drop of 2.7V (5V-2.3V) and a limiting 6 mA current is required. This can be achieved by providing a 450 connected in series with the LED resistor.

Resistors can be fixed or variable. Low power resistors are comparatively smaller than high power resistors. The resistor of a resistor can be estimated by its color codes or can be measured by a millimeter. There are nonlinear resistors whose resistor changes with temperature or light. The negative temperature coefficient (NTC), the positive temperature coefficient (PTC) and the light dependent resistor (LDR) are some of these resistors. These special resistors are commonly used as sensors. Read and know the internal structure and performance of the resistor.

2) LED

Light emitting diodes (LEDs) are sources of semiconductor light. The light emitted by the LED varies visibly to the infrared and ultraviolet regions. They operate at low voltage and power..

On the basis of the semiconductor diode, the LEDs emit photons when the electrons recombine with the holes of direct polarization. Both terminals of the LED are the anode (+) and the cathode (-) and can be identified by their size. The longest leg is the positive terminal or anode and a shorter terminal is negative.

The voltage before the LED (1.7V-2.2V) is less than the supplied voltage (5V) for conduction in a circuit. Using an LED like burns such as a high current would destroy your door pn. Therefore, a current limiting resistor is used in series with the LEDs. Without this resistor, a low input voltage (equal to the forward voltage) is a pulse width modulation (PWM) used to drive the LED. Get details on the internal structure of an LED.

3) POWER SUPPLY

Pure dc output is essential for system operations with no ripple electronic circuit.

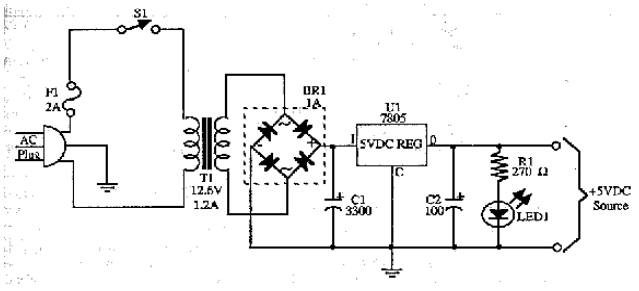

Fig. 3 Power Circuit

A device to convert the available power of a set of functions to meet specified requirements. The typical power source application comprises converting raw input power into a voltage and / or controlled or stabilized for the operation of current electronic equipment .Power supplies belong to the field of power electronics, the use of electronics for the control and conversion of electric power. A diet is sometimes called a power converter and the process is called energy conversion. It is sometimes called a power conditioner and the process is called power conditioning. There are many types of power supply. Most are designed to convert the high voltage power supply to a voltage suitable for low power electronic circuits and other devices. A power supply can be decomposed into a series of blocks, each of which performs a specific function.

The power supplies used in our project, digital control three-phase induction motor are+5V and + 12V.

These power supplies can be designed by a simple circuit, composed of a bridge rectifier (diodes Here we used connected in a bridge assembly called Diode bridge), an inductive or capacitive filter, a controller (7812 to + 12V and 7805 to + 5V), a resistor and a light emitting diode (LED) and transformer. The purpose of each component in the power supply design circuit shown in the diagram (taken using SCH express) is described below: Power is the first and most important part of our project. For our project, we need a regulated +5 V with a maximum rating of 500 mA

4) STEP DOWN TRANSFORMER

the transformer below is the first part of the regulated power supply. To lower the sector 230V AC, we need a transformer down. Here is the main feature of the electronic transformer.

1. Power transformers are generally designed to operate from a low impedance source at a single frequency.
2. It is necessary to build with sufficient insulation of the necessary dielectric.
3. Notice transformers are in, volts. The volt amplifier of each of the winding or secondary windings is added to the secondary VA total. To this are added losses.
4. Raising the temperature of a transformer is decided on two well-known factors, namely unit losses provided by transformer dissipation and heat or cooling.

5) RECTIFIER UNIT

The supply unit is a CKT. It converts the alternating current into DC by pulses. Generally, the semiconductor diode is used as the grinding member because of its property to conduct current in one direction. In general, there are two types of rectifiers.

- Half wave rectifier
- Full-wave rectifier.

In the half-wave rectifier, only the half-cycle AC of A. is corrected so that its efficiency is very low. We use a complete bridge type rectifier, in which four diodes are used. In each half cycle, two LEDs have both and they achieve the maximum efficiency in O / P.

6) FILTER CIRCUIT

Generally, a rectifier is required to produce a D.C. Pure for use in various places of the electronic circuit. However, the o / p rectifier has a pulsating character, ie if for example a DC is applied to the electronic circuit, a buzzing will occur,

ie it will contain AC components DC components are undesirable DC and must be kept away from the load. To do this, use a filter circuit that removes (or filters) AC components that comply with the load. Obviously, a filter circuit is installed between the rectifier and the voltage regulator. In our project, the filter capacitor is used because of its low cost, small size and low weight and good feature. The capacitors are connected in parallel to the rectifier o / w, as it passes AC, but does not pass all DC Three terminal voltage regulators A voltage regulator is a CKT. It provides a constant voltage regardless of the change in load current. IC voltage regulators are versatile and relatively inexpensive. The 7800 Series consists of three positive terminal voltage regulators. These integrated circuits are designed as a fixed voltage regulator and with an appropriate heat sink can provide an O / P current greater than 1 A. These devices do not require any external components. This IC also has an internal thermal overload protection and an internal protection in the short circuit current limitation. For our project, the voltage regulator 7805 is used.

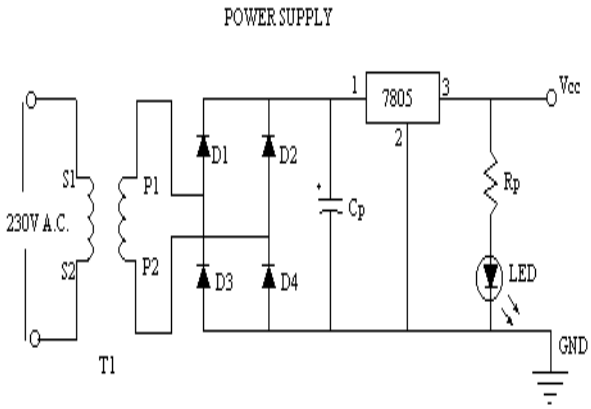

Fig. 4 Power Supply Circuit

7) THE VOLTAGE REGULATOR

A voltage regulator is an electrical controller designed to automatically maintain a constant voltage level. In this project, a 5V and 12V power supply is required. To achieve these voltage levels, voltage regulators 7805 and 7812 must be used. The first number 78 represents a positive supply and the numbers 05, 12 represent the required output voltage levels. The L78xx series of three terminal positive regulators is available IC 7805 (Voltage Regulator IC.

1 2 3

Specifications:

- Available o/p D.C. Voltage = + 5V.
- Line Regulation = 0.03
- Load Regulation = 0.5
- Vin maximum = 35 V
- Ripple Rejection = 66-80 (db)

RELAY

The relay detects the device that detects the fault and sends a trip signal to the circuit breaker to isolate the faulty section. A relay is an automatic device by means of which an electric circuit is indirectly controlled and regulated by a change in the same or another circuit. There are different

a) TRANSFORMER

Features

- Output Current up to 1A
- Output Voltages of 5, 6, 8, 9, 10, 12, 15, 18, 24V
- Thermal Overload Protection
- Short Circuit Protection
- Output Transistor Safe Operating Area Protection

Description

• The KA78XX / KA78XXA three-pin positive regulator series is available in the TO-220 / D-PAK housing and several fixed output voltages, making them useful in a wide range of applications. Each type uses an internal current limitation, thermal shutdown and safe protection of the operating area, making it essentially indestructible. If adequate heat release is provided, they can deliver the output current 1A. Although primarily designed as fixed voltage regulators, these devices can be used with external components to provide adjustable voltages and currents.

b) ARDUINO

Fig.6 Arduino

Arduino is an open source company, hardware and software, projects and users that designs and manufactures microcontrollers and microcontroller kits to create digital cameras and interactive objects that can detect and control objects in the physical world. Project products are distributed in the form of open source hardware and software under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL) [1] for the manufacture of Arduino boards and software distribution for any person .Arduino boards are available commercially in pre-assembled form, or as do-it-yourself kits. Arduino table designs use a variety of microprocessors and controllers. The panels are equipped with input / digital pin assemblies and analog (I / O) outputs that can be

coupled with various expansion cards (Shields) and other circuits. Maps include serial communication interfaces, including Universal Serial Bus (USB) on some models, which are also used to load personal computer programs. Microcontrollers are usually programmed using a series of dialect characteristics of C and C ++ programming languages. In addition to using traditional channels of compilation tools, the Arduino project provides an integrated development environment (IDE) based on the language processing project.

c) WORKING

In our project we can detect the fault in three phases. In each phase of the system required large wire 3km,4km,5km.so this can't fit in this system.so used for this its internal resistance of cable. Because, as the length of the copper wire increase the resistance in the cable also increases.so we connect 1kΩ resistance for each 1 km distance 1km indicate 1km distance .In this project we connect 4 resistance of 1km in series so we cover 4km distance in each phage.

In this project just connect switch to disconnect the wire in each km segment .with the three phage cable one reference cable are also present to compare with it .The arduino board required the reference resistance of cable with the fault cable resistance .consider, a single cable in which 4 resistance are connected with 4 switches and when fault occur the system at 2 km distance. The 2 kΩ resistance are given to the arduino .The arduino compare it with reference resistance .The arduino is program such that it contain the ohm lows V=IR as the resistance value decreases the voltage in the cable increases and it calculate the fault location.

The arduino has only 1input port.so for 3 phages three relay are connected which gives data to the arduino one by one.

IV. ADVANTAGES AND LIMITATIONS

A. ADVANTAGES

1. Low Maintains of project
2. Improved public safety.
3. Less consumption of power
4. Easy to handle.

B. LIMITATIONS

1. The Arduino and other component require 5V DC Supply.
2. Relay requires 12V dc.
3. Sometimes network Problems for rural areas may happen
4. Angular value required time to read so some delay occur.

V. CONCLUSION

Finally ,we have done this project for location of fault in underground cable In the rural areas where underground transmission system is used. it is difficult to find the fault in the cable . So this project is beneficial to use to detect the fault location. So the fault can easily locate and extinguish. The Arduino has several advantages over the microcontroller so use of arduino is more useful arduino based underground fault detection is more advantageous than microcontroller based underground fault detection.

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