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Underground Cable Fault Detection and Notification System

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Abstract: ***This paper provides fault location model for underground cable using Raspberry Pi module. The aim of the project is to determine the distance of the underground cable fault from base station in kilometres and provide a real time picture of fault itself in a web page when there is a fault such as insulation fault occurs, voltage drop varies upon the length of the fault in cable as current varies. A Prototype cable itself of about length 2 meters represents underground cable and fault is noticed by detecting the voltage changes using sensors which are controlled by Raspberry Pi module so that the fault information is displayed on LCD display.***

Keywords: Raspberry Pi, Prototype Cable, LCD display

1. Introduction

Previously there were overhead cables that were used to transmit power and nowadays there are underground cables which are in used and this method is superior to overhead installation method. The reason behind this is within underground cable as they are not affected by any weather condition such as storm, heavy rainfall as well as pollution .But problem in this method occurs when there is a fault in the cable so that it would be difficult to locate it. So we are going to find the exact location of the fault. Nowadays world is becoming digitalized so that the project is intended defect the fault location in a digital manner.

The underground cable system is a common practice in most of the urban areas.

The fault in a cable is represented as
- Defect
- Inconsistency
- Strength or Weakness that plays important role in cable performance
- Caused due to the breakage of conductor and failure of insulation

Coming to the type of faults, it can be classified into 3 groups
- Open circuit fault
- Short Circuit Fault
- Earth Fault

Open circuit fault
This type of fault occurs when there is a break in conducting path as current only will flow in a circuit around a continuous path around source of EMF.

Short Circuit Fault
This type of fault resulting in the flow of rapid high current through the equipment or transmission lines. It leads to extensive damage of equipment if allowed to persist even for a short period.

Earth Fault
This type of fault is an accident contact between charged conductor and ground.

Nowadays construction of underground pipe gallery has become Standards of Modernization. A perfect Monitoring system for underground pipe gallery can provide required information as to surrounding temperature, pressure, required control and also underground pipeline security which has a greater significance in economic growth. Nowadays people are majorly using two monitoring methods for underground pipe gallery one is manual monitoring method, where there is a regular maintenance is carried out to check each section of Pipe. This method requires man power, resources, cost estimation is comparatively higher and also it cannot guarantee the quality and also the management level. Some localities make use of chain cameras to check the status of the cable, where a camera is fixed at each point of the cable for fault checking. However there is a disadvantage as it requires more cameras, which costs more. At the same time capturing video and gathering information of underground pipe gallery cannot be done at the same time in this method as each camera will not be well linked. It also gives raise to information sharing issues. Therefore it is necessary to find a suitable system for monitoring underground pipe gallery where the cables are laid.

In order to overcome the limitations we are implementing a robot which travels inside the pipe gallery and determine the cable faults. It also provides information regarding the defects in the underground cable and sends the exact location of fault arising in the cable which makes it easier for the end user to make corrections. The fault location is sent to a Web page through Wi-Fi thereby forming a wireless communication.

Existing System
A wide variety of technologies and models are currently developed to evaluate underground cables but there is often little relation between the diagnostic results and the actual results. The underground power distribution failure represents a threat to power infrastructure .Since the cable

replacement is expensive the replacement must be done selectively.

Proposed System

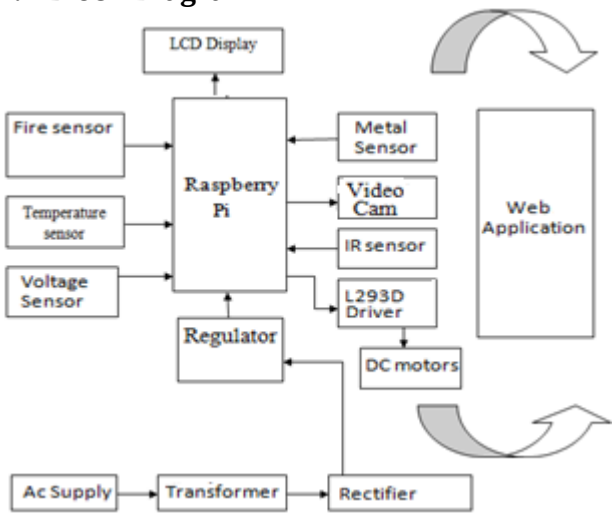
To overcome the situations stated above, we implement a robot that is built with Fire sensor, temperature sensor, and IR sensor to check the fault that is occurring in the cable. Here one thing is special thing is that the robot contains built in camera that captures the fault site image and sends it to the end users through Wi-Fi to a desktop web page developed using available web technologies. This system is less expensive compared to the previous system as it has all the features to detect temperature, pressure and cable fault in a system.

Hardware and Architecture with Block Diagram:

Block diagram shown below depicts the basic architectures of developed system. It contains certain module that is connected to the raspberry Pi module.

- The camera is used for capturing the image of faults.
- IR sensors are used so that if any obstacles or fault occurs it stops the robot.
- LCD is used for displaying the message or reading of sensor.
- Fire sensors are used to alert the robot if cable catches fire due to short circuit or from any other reason.
- Metal sensor is used for checking the insulation of cables.
- Alarm is used for making sound if fault is detected.

2. Block Diagram



3. Working Principle

The working of this system is very simple, it consists of a robot which is fixed with temperature sensor, fire sensor, voltage sensor, IR sensor to check the fault site. It is also provided with camera, Bluetooth connection, which is maintained through a webpage at user site. The end user will get the clear real time picture of the fault site.
This system is classified into 4 parts

DC power supply part

It consists of 230v ac supply which is stepped down using step down transformer. It also has bridge rectifier that converts ac signal to dc and regulator is used to provide constant dc signal.

Cable part

The cable part is denoted by cable itself of length of about 2 meters in approximation where fault creation is made at every known point of the cable to cross check the accuracy of the same.

Controlling part

It consists of analog to digital converter which receives input from current sensing circuit, converts this voltage into digital signal and feeds the raspberry pi module that controls the 4 wheeled robot.

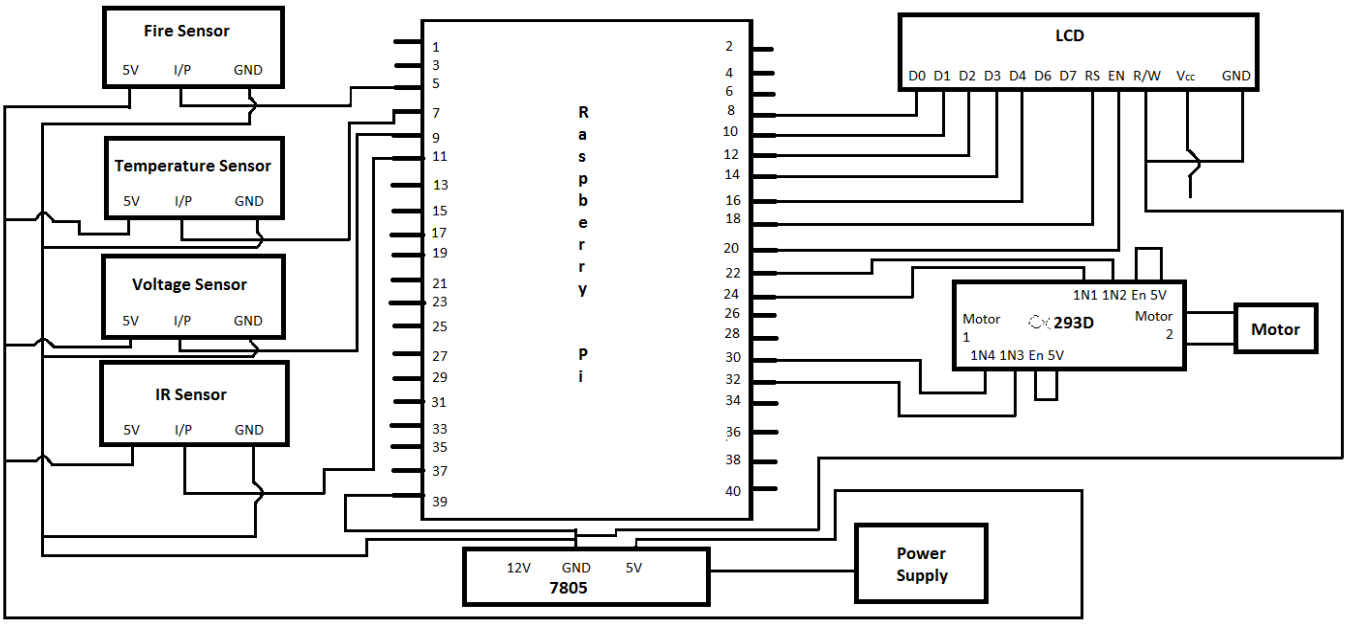
Display part

It consists of LCD display interfaced to raspberry pi module which shows the status of the cable. It display part also consists of webpage which provides the real time picture of the fault site on the cable.

The robot is made to move in underground pipe gallery in which all the other cables are laid. Here the robot is controlled by Raspberry pi module. Here the Programming language used for the operation of raspberry pi module is **Python**. The robot moves on the pipe and collects the information of the cable as the command of the end user .The robot checks the status of the cable. If it detects any fault then it captures the image and sends it to the end user through web page that is created using web technologies. It also displays the message on LCD screen regarding the type of fault.

Similarly whatever the fault that occurs in the transmission line will be sent to the website through Wi-Fi. Thus, we can access that by opening the website in our smart phones/ personal computers, for which the end user need to log into the website.

4. Circuit Diagram



5. Result

The result of this project is obtained in 3 cases

- Case 1: If there is no fault in the underground cables then LCD will display "NO FAULT".
- Case 2:If there is a insulation fault then it will be detected by metal sensor and on LCD it will Print as "INSULATION FAULT"
- Case 3: If there is a short circuit fault then it will be detected by temperature sensor, as temperature goes high and on LCD it will be printed as "SHORT CIRCUIR FAULT".

After display the type of fault the image of the fault site will be available on the web-page.

6. Advantages

- The main advantages are cheaper to install and maintain than any other system.
- They are quick to fix whenever fault develop however they are move suspect to damage and many people to don't like the way they look.
- Fault and damage to lines are given are easier to locate. So they are quicker to repair their so money and reduce the amount of time that business is without power.
- Less maintenances
- Higher efficiency
- Fewer faults occur in underground cable.
- It can detect of other types of cables faults such as short circuit; cable has cuts, Resistive fault sheath fault water trees.
- This method is applicable to all types of cable ranging from 1KV to 500KV.
- Less storm restoration cost.
- Increased reliability during severe weather
- Less damage during severe maintenances.
- Far fewer monetary interruptions improved utility relation regarding improved the public safety.
- Reduce live wire contact injuries
- Improved aesthetics (removal of using high poles of wires).

7. Future Scope

In this paper we detect the exact location on short circuit fault in the underground cable from feed end in Kilometres by using Raspberry Pi in future. This project can be implemented in calculating impedances by using capacitor in an AC circuit fault phase, so thus the open circuit fault.

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