UNDER GROUND CABLE FAULT DETECTION & MAINTENANCE
ROBOT BASED ON ATMEGA 328P MICRO-CONTROLLER

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ABSTRACT - As use of underground cables is increasing for both power transmission and data transmission smooth and uninterrupted connectivity and power transfer is required. The major drawback with underground cable is that their maintenance, detecting faults & repairing is very difficult, costly and time consuming for long cables. As well as cables may be present in some areas which are not suitable for humans to work in such hazardous conditions, hence robots are preferred. The proposed design of robot gives it ability to crawl on curved round surfaces with turns hanging over the ground laying cables. The robot is equipped with wireless live camera feed, High Voltage Shielding, Humidity Sensors, Temperature Sensors, also the robot is fitted with remote controlled polymer based resin spray mechanism which is capable of repairing minor faults and cracks. For the long term sustainability perspective, many major cities around the globe using underground system for power cable distribution. The conventional method is environmentally damaging and significantly more expensive. Human workers face many difficulties in maintaining and repairing the cables in underground system.

KEY WORDS - Motor driver, Micro-controller, H-Bridge, Servo motor, Lead-acid battery.

1. INTRODUCTION

With the continuous progress of science and technology, the construction of major cities has been accelerated, and the available space resources on the ground have become more and more intense. Thus, the use of underground space has gradually attracted people’s attention. The underground pipe gallery is a modern, scientific and intensive urban infrastructure. The construction of underground pipe gallery has become one of the standards of modernization of our country. There are two traditional monitoring methods for underground cables and ducts, one is manual work monitoring mode, that is regularly arrange maintenance personnel to patrol each section of the pipe corridor. This kind of inspection plan consumes manpower, material resources, the cost is higher, and also cannot guarantee the safety of the maintenance personnel. The quality and management level cannot be guaranteed. In addition, some areas take use of chain camera to monitor, which is to put a camera at each key point of interval distance to monitor the underground pipe and cables to check for faults.

However, this monitoring method requires too many cameras, which are costly. At the same time, video and monitoring data of the underground cables and pipes cannot be combined, each camera cannot be well linked. It is easier to cause the issue that information cannot be shared. Hence the related decision-making is highly affected. Therefore, it is necessary to find a suitable monitoring scheme for underground cables and pipes where the cables are laid. In order to overcome this disadvantage, we are implementing a robot which can travel through the pipe gallery and determine faults in the cables and also other defects in the underground system which makes it easy for correction.

Existing system contain a variety of technologies and tests are currently available to evaluate underground cables but there is often little relation between the diagnostic results and the actual detraction. The failures of underground power distribution cables represent a serious threat to the reliability of power infrastructure. Replacement must be done selectively since cable replacement is expensive. ATMEGA 328P is latest micro-controller and actually it fulfill our requirements, it is easy to program and cheaply available. Also, we have battery backup, lead acid battery depending upon the ratings, the robot is design for operating at 66 KV of voltage. Also it is semi-autonomous because repairing and maintenance can be done by robot itself, but in case of certain conditions, where human efforts are require in that case human can take manual control. Also we are using high torque motors for better traction control. We are using flashlights for emergency situations, and high capacity batteries for long occurrence. As well as cables may present in some areas which are not suitable for humans to work in such hazardous conditions hence robots are preferred.

Proposed system is to overcome the above situation, the designed robot has wireless camera, temperature sensors, humidity sensors etc. which is used to detect faults & cracks in underground cables. The pipes and ducts where the cables are laid contains free space, the robot can be adjusted according to shape and size of pipe then the robot can crawl inside which is out of human reach. The robot can be controlled via Bluetooth using android app as well as by dedicated radio transmitter up to 2 km range. This technique will help us to determine exact location of fault as well as due to board polymer resin spray system it can repair minor faults and cracks which can be costly to repair if done manually. Hence the proposed system is cost efficient, reliable, and fast.

2. LITERATURE SURVEY

The use of underground system for power cables is implemented due to many advantages. Underground cables are not exposed to many dangerous situations, and it also makes some space on the ground for the development of the infrastructure. Underground transmission of electricity is associated with reliability. There are many disturbances involved in the transmission of electricity through overhead cables such as storms, hurricanes, cyclones. The only way to make electric power cables safe and economical to repair is to use underground system. Hence many cities around the globe such as Manhattan, Downtown San Francisco, Toronto, Chicago, Mumbai, are opting for this technique. The disadvantage of underground cables is that it is practically difficult to detect faults and hence maintenance is costly. It is challenging to upgrade underground cables. Because
upgrading the cables means installing whole new supply lines. Hence these costs get added up in the actual cost incurred for maintenance of the cables. The second main disadvantage is that workers are exposed to an unsafe environment for the detection and inspection of the power cables. Damage to the live power cables can cause injuries that are related to dangerous effects of arcing current and by associated fire or flames. If the insulation sheathing of the wire is damaged, workers are exposed to direct electric shock. The underground cables fault analysis is done by using a micro-controller. That is why we are implementing a robot to find the exact fault location of cable.

3. BLOCK DIAGRAM

![Fig 1 - Block Diagram of the Proposed System](image)

Power supply unit is required to give different power voltages, to each and every module. Micro-controller will require 5V, the motor will require 12V. Hence power modules are required. Power control circuit is required now up to the power control circuit there is a video transmitter system, which is taking data from the camera and telecasting it using video receiver which is going to receive by video transmitter via OTG in a mobile. So, this is the complete system which we are opting for a video transmission. After this we have motor control system in which the data from the user is being received with radio frequency receiver module, data is transported from radio frequency transmitter from user to the micro-controller, then which is processed with the help of written program inside the micro-controller and the command will be compared with the algorithm and command will be initiated to the actuators such as forward direction, backward direction then we also have a maintenance system in which we have a spray controlled by servomotor. If we say signal through a servomotor through the RF transmitter which is received by micro-controller, then processed by the micro-controller and given to the servomotor. Hence we can also activate the action of spraying using RF transmitter.

4. COMPONENTS USED

Temperature sensor monitors the ambient temperature of the cable. It records the temperature in the cable. It can detect the surrounding environment condition. Humidity sensor is a critical parameter under consideration for underground cable as it detects the presence of water in the air. Humidity in excess amount indicates moisture, which increases the short circuit fault probability.

**A. Lead-Acid Battery**

There is one battery for complete supply which is lead acid battery. It is a storage battery, it has large current capability. The ratings are 12V, 8Amp Hr, this battery is also called as industrial battery. The batteries are maintenance free batteries. The charging current is 1.5 Amp means the current flows into capacitor when voltage is first applied, and discharge current is 8 Amp means the current that throws out.

**B. Geared Motor**

The motors are long duration working motors. It is from the company Johnson's geared motor. The rating of the motor is 100 rpm dc, 12V, 350mA. The stall torque is 26 kg/cm means when maximum torque applied to the shaft the motor stop rotating and steady torque is 8 kg/cm means net force is zero.

**C. Main Board**

Central link is showing the maintenance part of robot. This is the main board with all the circuit components. It shows the camera, flashlights, L298 module motor driver, ATMEGA 328P micro-controller, lead acid battery, geared motor, resin spray mechanism, relay module, video transmitter, radio receiver, servomotor, buck converter.

**D. Camera**
The camera is 1500 TVL means camera is able to render images of that capacity, 5MP and 10mm wide lens, the camera also has noise reduction audio feedback system means noise cancellation , OSD support is available means the ON screen display is available.

5. METHODOLOGY

we designed our special kind of frame we carried that X-frame from copper or aluminium plate and then we shielded it with proper shielding for providing proper protection to our robot. Then we fabricated our main circuit board which is cad software by Auto-cad. We fabricate our frame and we attached the shielding to it, it means whole assembly of X-frame and proper shielding. Then we developed a board using all our modules on it. After this we balanced the robot with equal distribution of weight for better operation of robot. After that we tested our robot in other conditions and try to simulate in original. We rectified errors and the areas of improvement.

6. TESTS AND RESULTS

Robot was successfully run. The bend of frame is tested. Spraying mechanism is working and is tested successfully. All motors are working in front and back direction using video frequency control. Camera is successfully tested. The temperature along the cable is the same, but there is a peak permit to verify the cables and pipes state can contribute significantly to reduce supply fails, leading to more gain and a better service quality. Tests related with sensors, localization and navigation were presented. The visual localization system was tested in a robotic platform, showing good performance associated with robot localization.

7. CONCLUSION

This work is based on study and development of robotic system that has sensors to verify the cables and pipes presented in the network. A set of experiments validates the robot mechanical structure, providing its capacity to adapt in different situations that can occur during inspection. The visual localization system was tested in the robotic platform, showing good performance associated with robot localization. We intend to show the user interface for remote control of the robot. The interface will allow the automatic online inspection of the obtained data from the robot. The current system of detecting faults involves the digging of roads, which is not only a waste of human resources and money but also cause inconvenience to the general public. Hence the proposed model solves this problem to get extend and is also coefficient. As the proposed system is autonomous, it reduce the human interference involved in manual underground cable fault detection making the system more efficient and less time-consuming.

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