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Electrical Inspection and Autometed Robot for Electrical Transmission Line Inspection

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Abstract: ***The paper presents sharing several of experiences and practices on smart robotic application for overhead transmission line maintenance and inspection. The robotic puller passes over barriers below the power line, such as the road with traffic, power distribution lines, river, or vegetation making tasks achieved conveniently, safely, and rapidly without impact on nearby communities.The target of the research is to create a mobile robot prototype for inspection of overhead power lines. The inspection robot shall crawl along the ground wire and transpose autonomously across installed equipment on the ground wire, such as vibration dampers, suspension clamps, compression dead ends, etc. In addition, the inspection robot is able to take photos and videos during a transmission line inspection . Using the robot, transmission line inspection's labor cost can be reduced, and the new method helps improve patrol and inspection efficiency, comparing to the conventional manpower method. Trough utilization of the new maintenance and inspection robots, utilities can minimiz transmission line operation & maintenance budget.***

Keywords: Mobile robot, Inspection,Visual Inspection,Service Robot.

I. INTRODUCTION

The procedure used for inspection and verification of wires or cables of energy transmission lines is subject to the experience of one technician who, through binoculars, covers the lines of transmission in a helicopter and is able of visualize points where seems to exist damages . New approaches, developed to automated this process, take advantage of global positioning system (GPS) technology, sophisticated cameras and related data-recording equipment, aerial access to remote areas, and robotics. It was known that there is great interest among the energy distribution companies of purchasing a system that allows remote inspection of power lines, particularly in remote areas, by a robotic vehicle. In is reported a development of a mobile robot for inspection in a guard cables. This paper describes the project of a mobile robot able of carrying out visual inspection of transmission lines, reporting to the operator possible imperfections. This work is presented divided in mechanical system, mechanism base – robot operations development of the control system and development of the visual inspection system.

A. Transmission Line Maintenance Robot

According to the corporate social responsibility policy, transmission system division desires to improve a better approach for stringing additional power lines while communities suffer no public impacts. Thus, the team of inventors decides to evolve a research project on an advanced approach of pilot-line pulling for the power line installation that conventionally requires manpower and land/water vehicles to pull out a pilot line dragged over the field beneath the power line above, The consequence is that it damages farmlands beneath the power line and causes an effect on communities,

Constraints and challenges for pulling the pilot line with the existing working approach are concluded as the following:

1) Interrupted traffic and vegetation damages to landowner (damage compensation to be paid)
2) A great amount of workers needed co-working on different places
3) Risks of injury by incidents during line pulling operations over the roads, railways, communication lines, power distribution lines, and etc.
4) Scaffolds needed above the street and electric distribution line
5) Electricity de-energization required when crossing over high voltage switchya

Therefore, the researchers utilize the robotic technology to diagnose and evolve the new creative approach for better pilotline pulling operation above all obstructions with the robot developed as a tool to pull out a pilot line through a number of cradle blocks.

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B. Mechanical Model

During the development of the mechanical architecture for the inspection robot, beyond all the requirements related to the wind effect , the requirements to allow the robot transposition of tower cable connections were considered. An evolutive methodology was adopted to design the robot mechanical prototype . The design cycle was incremental and consists of develop a mechanical configuration, develop detailled mechanical project, build a test prototype and develop improvements. Several configurations for the transmission lines inspection robot were proposed and tested. Figure (1) shows all these configurations.

Configuration of Figure (5 a) corresponds to an initial model, without capability of towers transposition , but already able to inspect the cable. This configuration had a set of two wheels, to move the inspection vehicle along the cable and one actuator for traction.

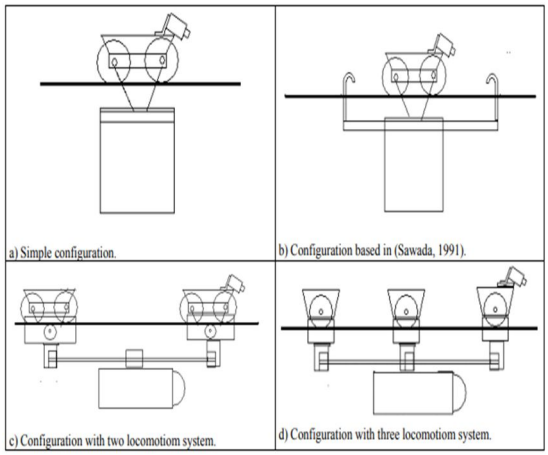


Figure 1 Mechanical configuration of the robots.

C. Control Portion

Control Portion Divided In to three parts

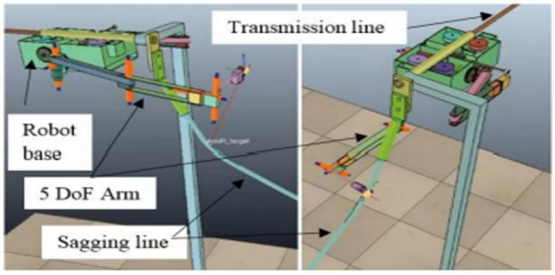


Fig.2. V-rep simulation for grasping the transmission line

1) *Robot motion-control Part:* Robot movement is controlled by a microprocessor inside, which is the core duty for moving towards a desired location precisely. The inner subsystem includes a system of battery power supply which will energize power to all parts and a feedback-control part that can work with a communicationcontrol part closely for sensing the state of the robot such that the microprocessor can make a judgement to receiving information to command motion of each movement.

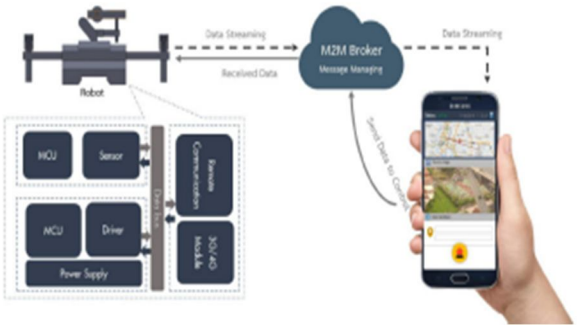


Figure 4: The conceptual design of the transmission line inspection robot

2) *Communication Control Part:* This part includes an embedded microprocessor which has a role about communicating to each equipment, e.g. sensors which transmit feedback information to the movement part that identify the movement state or a camera that record images during the robot roll along each path.
3) *Tele-Monitoring Control Part:* The robot has a communication unit with a network for transmitting states back to the cloud system via a mobile cellular system for a tele-monitoring control part. M2M (machine to machine), which is a protocol commonly for the IoT world, is used as a format of Data streaming. It can work with reliability although the restriction of system bandwidth, i.e. sending data in the field to the cloud system via the App for observing.

II. CONCLUSIONS

In this work, a tool to automate the inspection of transmission lines was developed, decreasing the time interval of line disconnection and increasing the safety of the maintenance procedures . This mobile robot can be used as basis for future developments, generating a more complete system for energy transmission lines services. Among future developments the implementation of a tool to place and remove aircraft warning spheres is foreseen ,as well as tools to carry out repair in damaged cables; and, finally, a system to execute autonomous inspection through the recognition of damages in the ground cables.

III. RESULT

Nowadays the robot can move only between single spans of towers because it can't overcome a tower, but new studies will modification and improvements. be done so that the next version of the robot will be able to overcome a tower, which will result in much higher productivity in the inspections. We believe that this first project will encourage other developments that will help the company to reach the top of the quality in the subject of the automation. We also believe that this is a great alternative to make our processes more agile, economical and safe. Government is supporting the idea and providing everything the technicians and engineers need to develop this research. Besides that, there is a very well equipped research center and there are many specialists working on this subject. We believe that in few time the investment will have its return.

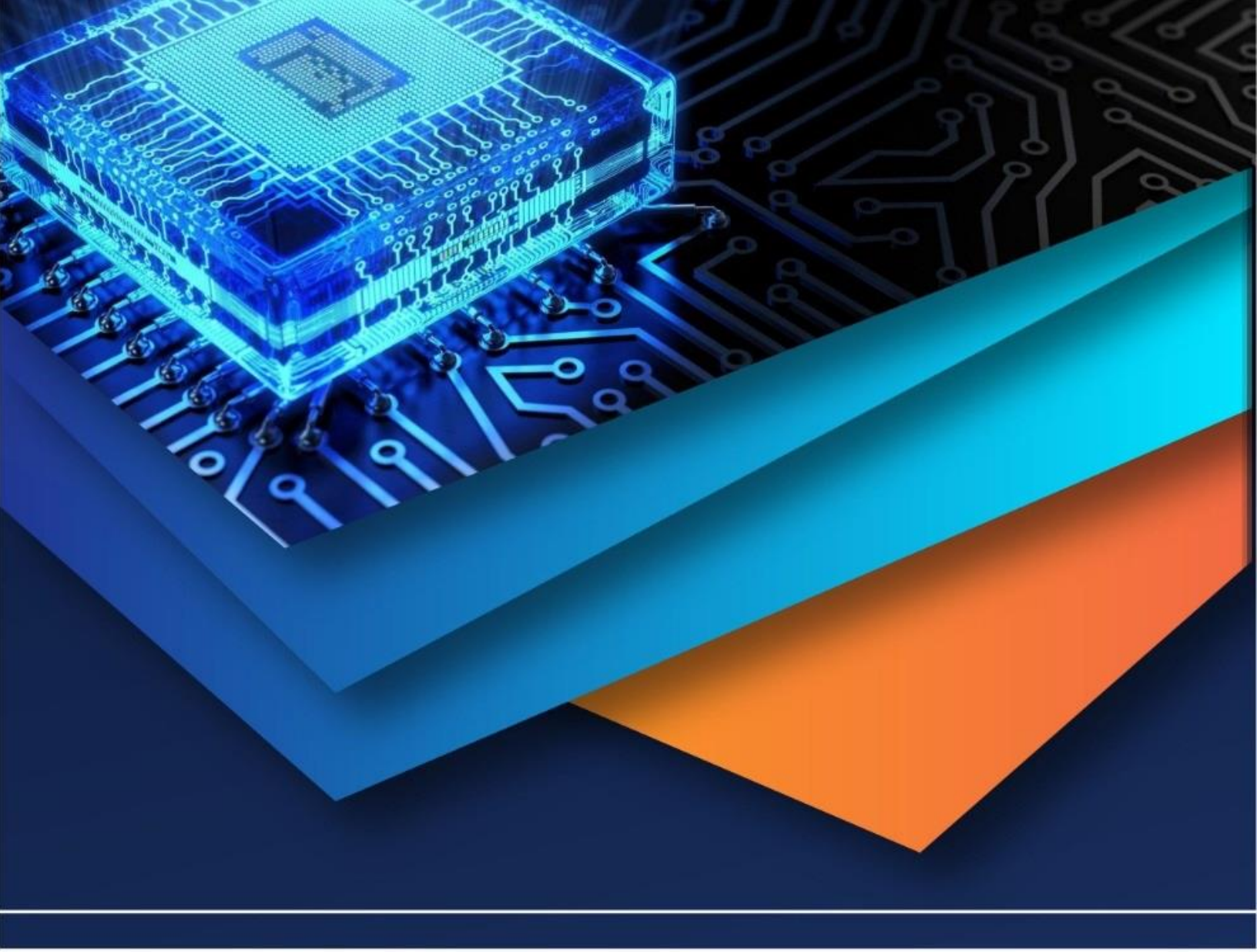
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