Electrical Pole Climbing Robot for Fault Detection using Wi-Fi

Mayu S.Bankar, Vidya P. Kodgirwar

Abstract: ***This project is to create electrical pole climbing robot which can be used to reduce risk of electrician to connect the distribution lines for supplying purposes. Pole climbing robot, nowadays, is very common and interesting idea, which mainly works by connecting the distribution lines according to the directions given to it. In this modern era robots are being developed for various purposes to accomplish many tasks which seem to be complex and life endangering for humans. Benefits of using robots have been immense in terms of risk-free, speed and efficiency of doing required tasks compared to that of humans. The main objective of this work is to save human lives. Considering on that issue, a pole climbing robot has been designed. However, further modifications of this work might be able to perform the wiring and repairing tasks instead of an electrician. The developed robot works on the principle of linear motor, which is partially autonomous. With the installation of this project, risk of human injuries and death can be minimized while working in the distribution lines which is the main consideration of this project.***

Keywords**: *Wi-Fi, Microcontroller, Robot Arms, DC motors, Power supply, Gripper.***

I. INTRODUCTION

In this project it is proposed to implement Pole Climbing Robot. Here we are developing a Wi-Fi based pole climbing robot that will overcome the traditional method in which electricians are present on the electric poles thereby risking their lives. Electricity is the most desired energy source in this modern civilization which made people's life a lot simpler and easier. For supplying electricity from the power station transformers and poles are required. To give a new connection or may be to connect any loosen wire, workers climb the pole keeping their life at risk. The aim of this work is to make such a climbing robot that can climb the electrical pole which might be used to perform those worker's tasks. For many years working labors have been losing their lives or sustaining injuries performing risky jobs. Deaths and injuries from monotonous jobs in dangerous environments have been very common in developing countries. It has been observed that electrical injuries caused significant numbers of death in every year. The main causes for the numerous numbers of such accidents are due to lack of safety precautions, lack of proper training to the workers and dangerous working environments. Pole climbing robot, nowadays, is a very common and interesting idea to the people. Investigations over a pole climbing robot have been going on for the last 20 years due to different purposes such as inspections, cleaning and maintenance of high rises, nuclear experiment, pipes and so on Pole climbing robot is a multifunctional robot which can serve several purposes according to our demand. The main objective of pole climbing robot is to reduce the risk of the people who work in the distribution line [1-2].

II. SYSTEM ARCHITECTURE

Important devices to fulfill this project are AT mega 32 Microcontroller, Power Supply, Wi-Fi module (ESP8266), Relay drivers, Seven DC motors. Four DC motors for up down movements. One is for arm 1 movement and second is for Grip, Un-grip.

A. Robot Design

The basic concept behind the building of the project is to control the system with the help of microcontroller (AT mega 32). The system is powered up with the help of 5V power supply. The robot will do up and down with the help of DC motors & the command transmitted to it through the Wi-Fi. One arm is being used for gripping & one for holding the cable. The arms are connected through DC motor & it does to & fro motion with the help of commands transmitted through Wi-Fi. The Arm 2 of the robot is given a conductor with a bulb. The pole has a conductor with current provided in it. Whenever the Arm 2 is commanded up and touches the conductor on the pole, the bulb glows showing that the distribution lines have power and there is no fault. But if the bulb doesn't glows then it means that the lines are faulty and it needs repair. The AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers.

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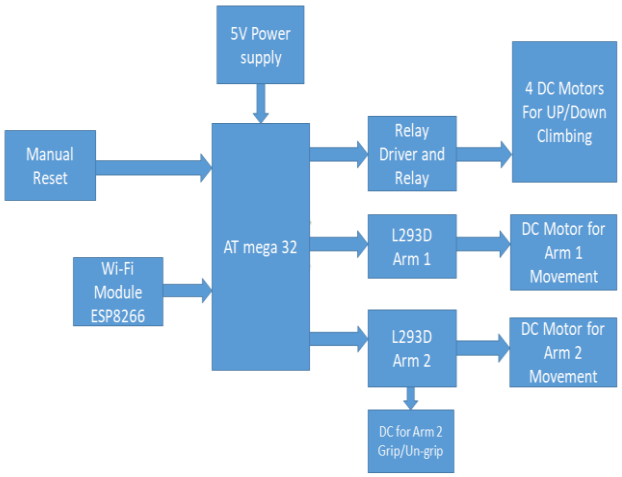

Fig. 1. Block diagram of the system

B. Description of the Block Diagram

The devices used in the project and how they are connected to the system, is described below:

Input section:

Wi-Fi Module: The Wi-Fi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The module is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor.

Power Supply**:** Here we are using 5V power supply to power up the microcontroller and hence run the DC motors. Fig. 2.2 shows the block diagram of a typical power supply. The AC mains are given to the transformer primary to get the required voltage at the secondary.

Fig. 2. Block Diagram of power supply

Then it is applied to the bridge rectifier, which converts the sinusoidal input into full wave rectified output. The output of the rectifier contains some ripple voltage. To remove this voltage filter circuit is used. A ripple voltage is nothing but a small value of AC over DC signal.

Then a pure DC is given to the regulator. The function of the regulator is to give the constant or stable output DC in spite of changes in the load current [3].

The reasons for choosing IC regulator is that they are versatile in operation and relatively inexpensive with features like programmable output, current/voltage boosting, internal short circuit current limiting, thermal shutdown.

The 78XX are popularly known for regulation has been used. The 78XX series is a 3-terminal positive voltage regulator and 79XX series is a 3-terminal negative voltage regulator As name suggests it transforms the voltage level from one level to another. Transformer used is the step down transformer to step 230 V to +15 V.

It provides isolation from the mains.

Output Section:

DC motor: A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronics, to periodically change the direction of current flow in part of the motor.

Gripper**:** It is used to grip and un-grip.

PC/Mobile: Used for transmitting commands and view the actions of the robot being performed.

TCP/IP: TCP/IP specifies how data is exchanged over the internet by providing end to end communication that identify how it should be broken into packets addressed, transmitted, routed and received at the destination. It is designed to make network reliable, with the ability to recover automatically from the failure of any device from the network.

Robotic Arm: Computer controlled mechanical arm is a robotic arm. It is a machine that mimics the action of a human arm. One end of arm is attached to a firm base while the other has a tool. They can be controlled by humans either directly or over a distance [4].

III. SIMULATION RESULTS

OrCAD Capture: OrCAD is a proprietary software tool suite used primarily for electronic design automation (EDA). The software is used mainly by electronic design engineers and electronic technicians to create electronic schematics and electronic prints for manufacturing printed circuit boards [5].

Multisim: NI Multisim is an electronic schematic capture and simulation program which is part of a suite of circuit design programs. Multisim is an industry-standard, best-in-class SPICE simulation environment. The Multisim design approach helps you save prototype iterations and optimize printed circuit board (PCB) designs earlier in the process.

Proteus: The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards

MikroC Pro for AVR: Use included mikroC PRO for AVR libraries to dramatically speed up the development: data acquisition, memory, displays, conversions, communication etc.

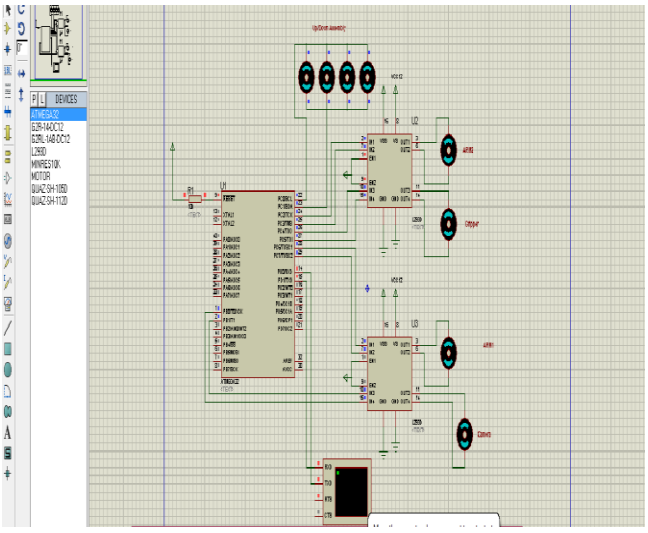

Fig. 3. Simulation of Pole Climbing Robot in Proteus

Table- I: Commands and Results

Commands	Motor that Moves	Result
U/U	M1, M2 M3, M4	In Clockwise direction Robot Moves Up.
D/D	M1, M2 M3, M4	In Anti-clockwise direction Robot Moves Down.
1	M5	In Clockwise direction ARM 1 Moves Forward.
2	M5	In Clockwise direction ARM 1 Moves Backward.
3	M6	In Clockwise direction ARM 2 Moves Forward
4	M6	In Clockwise direction ARM 2 Moves Backward
5	M7	Grip
6	M7	Un-grip

Monitor your program structure, variables, and functions in the Code Explorer. Generate commented, human-readable assembly, and standard HEX compatible with all programmers. Inspect program flow and debug executable logic with the integrated Software Simulator. Generate COFF (Common Object File Format) file for software and hardware debugging under AVR Studio [6].

IV. PROTOTYPE DESIGN

The main system consist of climbing Module. In this module four wheels are connected to four DC across the pole and whole system enclosed with wooden material. DC motor Five gives forward and backward movement and also there is conductor connected to this motor, also having power line and Bulb it will check there is power available or not if power is available bulb will glow.

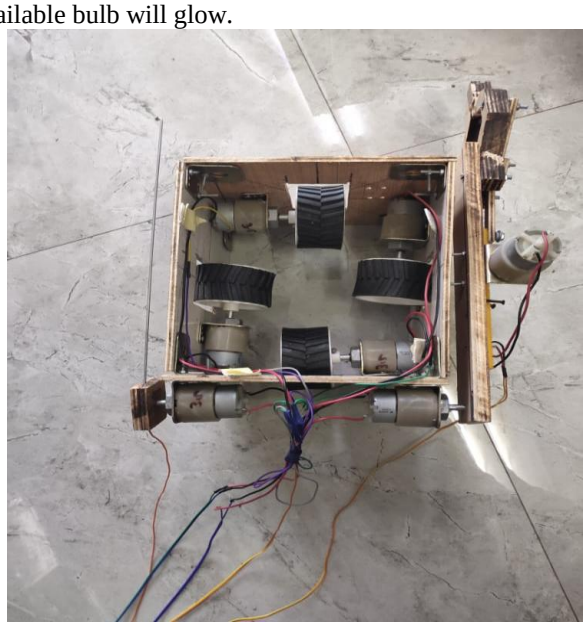

Fig. 4. Climbing Module

If all motors moving in clockwise direction then the entire assembly goes up similarly in anticlockwise direction, entire assembly come to its original position. DC motor six it will helps to hold gripper and gives forward and backward movement also having DC motor seven holds piece of wire and used for griping and un-griping of wire.

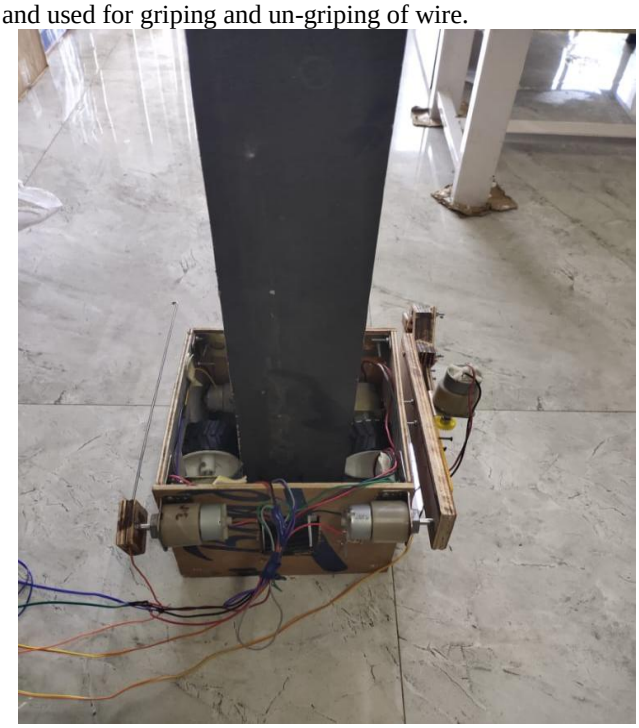

Fig. 5. Module at its Original Position

In entire system DC motor five is ARM 1 it will gives forward and backward direction and also checks there is any phase or not as well as DC motor Six and Seven is ARM 2 it will gives forward and bakward movement and also used for grip and ungrip.This entire stytem controlled by wi-fi through mobile device.

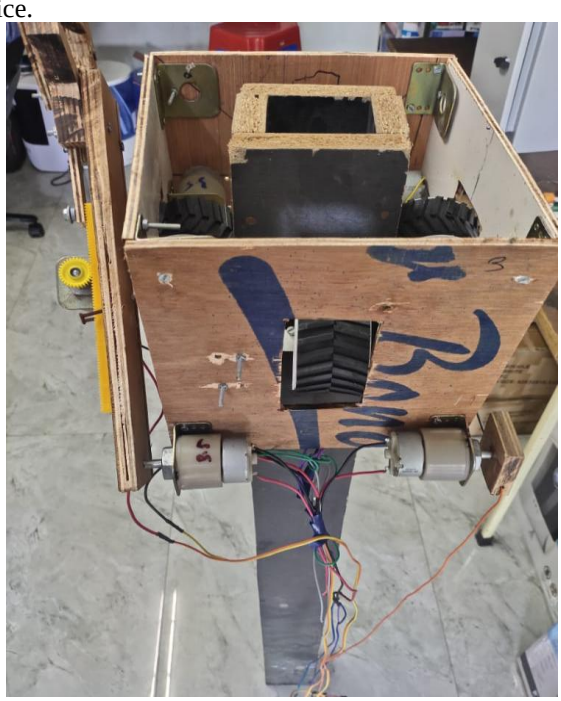

Fig. 6. Module at Top of the Pole

V. HARDWARE RESULTS

Designed the Circuit of main assembly and have performed its Simulation on Proteus. We have used voltage regulator LM7805 for voltage regulation in case of fluctuations.

We have also build the PCB for main assembly. The Microcontroller, L293D as DC Motor Driver, Wi-Fi to give Instructions to Robot.

According to the commands given the arm will move and also the arms will grip and un-grip.

Table-II: Interfacing Commands

Commands	Microcontroller Pin	Voltage	Current
U	RC0	5V	25mA
D	RC1	5V	25mA
1	RC2	5V	25mA
2	RC3	5V	25mA
3	RC4	5V	25mA
4	RC5	5V	25mA
5	RC6	5V	25mA
6	RC7	5V	25mA

Table-III: Interfacing Commands for Motors

Driver Pin	Voltage	Current	Results
OUT 1	12V	600mA	Robot Moves Up
OUT 2	12V	600mA	Robot Comes Down
OUT 3	12V	600mA	ARM 1 Moves Clockwise
OUT 4	12V	600mA	ARM 1 Moves Anti-Clockwise
OUT 1	12V	600mA	ARM 2 Moves Clockwise
OUT 2	12V	600mA	ARM 2 Moves Anti-Clockwise
OUT 3	12V	600mA	Grip
OUT 4	12V	600mA	Un-grip

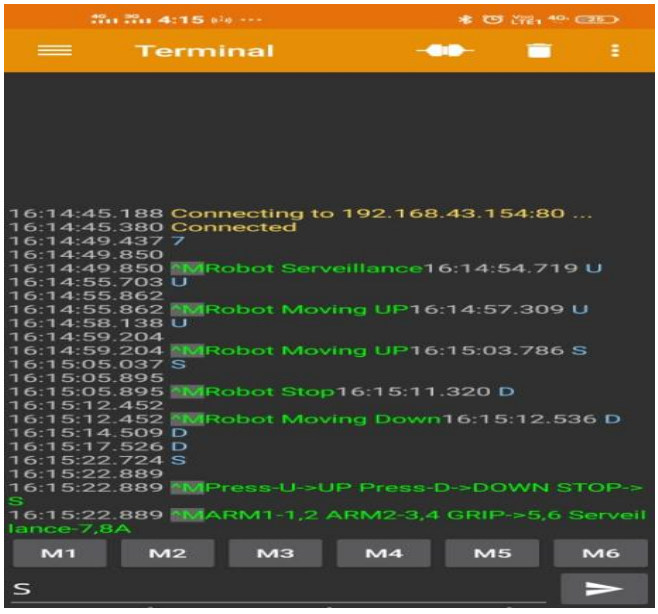

Fig. 7. Instructions given from Mobile Device

VI. CONCLUSION

This robot is very helpful to the society in terms of reducing the number and risk of accidents that usually happen to electricians while connecting wires.

Robot will climb on the pole and do the work of phase and fault detection with the help of arms connected to the DC motors. Also it is to be controlled by PC/Mobile using Wi-Fi. Long control range due to usage of Wi-Fi devices: Can be controlled up to distance of 400m in open area.

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