Transmission Line Inspection Robot

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Abstract - *The mobile robots equipped with inspection sensors, instruments and communication devices are able to automatically perform on-line detection or inspection of mechanical or electrical failures without suspending power supply. The robot gathers the data of these transmission lines using various sensors which is sent to the control room by using the transceiver provided in the robot. The communication between the robot and control room takes place without wires using existing infrastructures utilizing RF technology or any other communication protocols. A short GSM based fault detection and location system was used to accurately indicate and locate the exact spot where fault has occurred.*

***Key Words*: Sensors, ARM, GSM, GPS**

1.INTRODUCTION

Power line inspection and maintenance are fields of application where robotics has yet to be introduced. However, as in many other hostile environments, substantial benefits in terms of workers safety and quality of inspection results could arise. The transmission line inspection robot presents one of the latest initiatives toward that goal. A smart GSM based fault detection and location system was used to adequately and accurately indicate and locate the exact spot where fault had occurred. This will ensure a shorter response time for the technical crew to rectify these faults and thus help save transformers from damage and disasters. The system implements automatic fault detection by including a clamp-meter for current measurement, ultrasonic sensors for sag and obstacle detection, GSM and GPS module and IR sensor for crack detection. The heart of the robot prototype is the ARM microcontroller that coordinates all the sensors to the final working of the robot. It has both to and fro movement that helps in continuous monitoring of the transmission line. Hence, ultrasonic sensors are provided for both forward and backward obstacle detection along with the sag detection sensor provided beneath the body of the microcontroller. A clamp-meter is provided for the accurate current measurement. An IR sensor is provided for crack detection. GSM and GPS module helps in providing the user with accurate fault location at the time of fault detection. Finally the fault information is transmitted to the control room. In conclusion, the time required to locate a fault is drastically reduced, as the system automatically provides accurate fault location information.

2. BLOCK DIAGRAM REPRESENTATION

The block diagram mainly consists of

- ARM Micro-controller
- Crack detection equipment
- Obstacle detection
- Sag detection
- Clamp on meter
- Movement mechanism

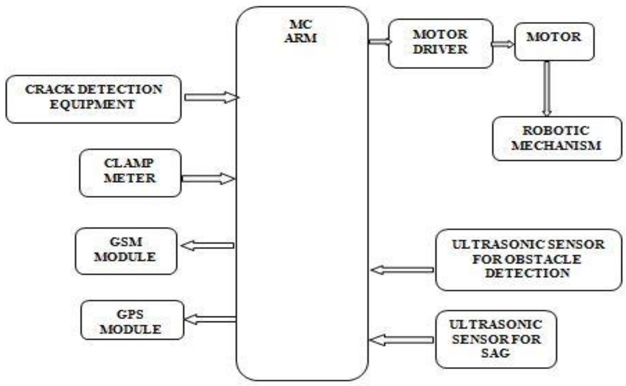

Fig -1: Block Diagram

According to the block diagram, 230V supply is given to the ARM microcontroller, through an adapter. It is the heart of the system and is chosen so as to aid the robot movements. All the sensors are interfaced with the micro-controller which coordinates all the functions. An IR sensor is used for the same and it detects the cracks on the pathway and sends the information to the micro-controller for further action. Two ultrasonic sensors are used for both forward and backward obstacle detection and are located at the front and back portion of the system. An ultrasonic sensor is used for the Sag detection and is located beneath the body of the system for the accurate sag detection. The meter helps to measure the current and display the value of current at the meter display. The current hikes initially and finally rests at a value of 1A. The forward and backward movement of the motor is facilitated by the gear mechanism along with the dc motor. The robot prototype is programmed to follow forward path for at least 1m and then returns its path after the limit.

3. OPERATION

The circuit diagram implements the ARM microcontroller (LPC2148) for the controlling action. All the sensors are connected to the corresponding Vcc and ground. The Txd and Rxd pins of GPS and GSM module are connected to the ARM via, port pins. The sensors sense the various faults like sag, obstacle etc and send the information to the ARM microcontroller. The robotic mechanism is also controlled by the same controller. It is facilitated by the gear mechanism with the aid of a dc motor.

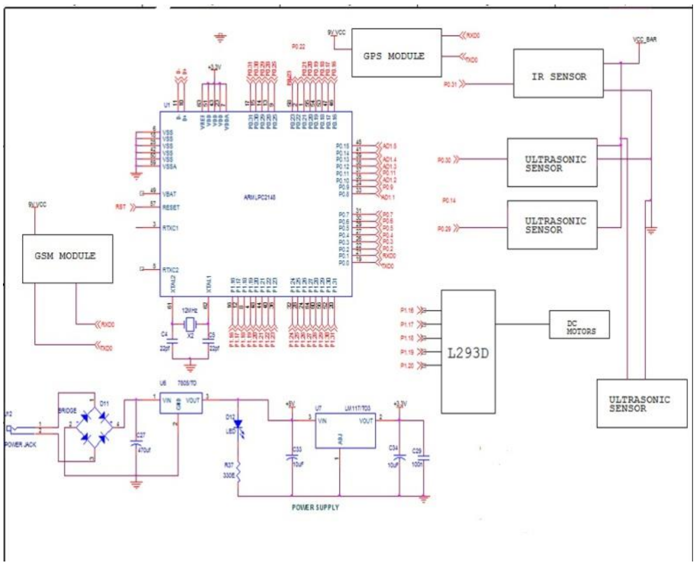

Fig -2: Circuit diagram of the proposed prototype.

A single phase induction motor is used as the load to the line. The power supply circuit to the ARM is also shown in the figure and it helps to step down the voltage to 3.3V which is acceptable to the ARM.

4. EXPERIMENTAL SETUPS AND RESULT

The figure shows the experimental setup of the Transmission line inspection robot. It consists of ARM microcontroller, ultrasonic sensors, GSM module, GPS module, Infrared sensor, clamp meter, DC motor, single phase induction motor.

As the robot prototype runs along the line, it can detect the obstacles, current fluctuations, abnormal sag and convey the information about the fault to the control room, i.e. user mobile phone. This is achieved with the help of a GSM-SIM900 module that sends the message regarding the fault location and the type of fault. After a predetermined distance (i.e. 1m), the robot prototype stops and reverses it's motion to continuous inspection along the same line. The setup includes two wooden poles that support a straight 1m Al rod of 6mm diameter which acts as the sample transmission. The robot moves along the rod using gear mechanism which is actuated by a dc motor.

The rod is supplied by a single phase induction motor, which is clamped on both sides of the rod as shown in figure. The current through the rod is measured and displayed on a clamp on meter attached to the body of the robot. Current hikes through a series of value and finally settles at a reading of one ampere. This steady state current and their by the load can be varied by using a motor of higher rating. As the prototype moves along the line, the current fluctuations from the rated 1A is detected by a clamp on meter and displayed on its screen. Any obstacle along the line will be detected by the ultrasonic sensor and the robot prototype stops, reverses its motion away from the obstacle and corresponding message send to control room.

Fig -3: Experimental Setup of Proposed prototype

5. CONCLUSIONS

The modal was completed with the following features including obstacle detection both forward and backward, Sag detection, Current fluctuation detection, Crack detection and corresponding messages were sending to the control room. The prototype can be developed to include more features by using another microcontroller but the weight constraints should not be ignored. Thus control stations use this information for the real time monitoring and control of faults.

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