DESIGN AND FABRICATION OF POWER LINE INSPECTION ROBOT

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Abstract : **This paper presents an alternative approach for the automated inspection of Power Lines. In this paper we are briefly looking into the inspection of Transmission Lines using sensor technology. The sensors mounted on the setup are basically ultrasonic and Hall Effect sensors to detect the anomalies in the continuity of wire. The inspection robot plans it response to the flaw detection from a real-time dynamic background while crawling over Power Transmission Lines optimally. Though the implementation of a high precision robotic inspection is a complex multi parameter based job were considering only some study parameters. In this robot we are planning to have a multiple power sources one is from the solar energy and the secondary conventional backup of continuous DC supply from the 9V battery.**

IndexTerms **– Power lines,Transmission lines, Sensors, Robotics.**

I. INTRODUCTION

In this age of high end electronics and automation, financially effective quality power transmission becomes a major issue. For this purpose we need to continuously monitor the transmission systems [1]. As most of the times and even if the job is repetitive the precision of human decision through manual inspection fades away. Even if done effectively in manual inspection the worker will be living on the edge of his life by having fair chances of either falling from a height or even getting an electric shock. If the inspection is continuous and effective the losses occurring due to halt of industries due to breaking in Power Line can be reduced to very minimum percentages [2]. This can even help in preventive and early detection of the damage in the power lines. However the damage due to some of the nature's forces such as lightning and thunderstorms are unavoidable.

Sometimes the aerial inspection using a helicopter is done but it is proved to be an expensive option. Because of all the basic reasons stated above it is better to have a permanent robust inspection robot to avoid human involvement and to be financially effective. The robot can even function without suspending the transmission through the power lines [3]. The control must be highly efficient and stable because even a small error in the movement and performance can damage the whole system at minimum and to make the matter even worse this can suspend the transmission through the power line [4].

This has been ever growing research field from the 1980's and there has been a great deal of developments since then. In the early years there have been some difficulties in the ability to detect obstacles effectively. So finally the redundancies in the implementation of tech dream have been overcome by the usage of the advanced sensor systems. Being a model and just a prototype the system excludes many of the major heavy-duty equipments such as counterweights, pulleys and wheels etc.The sensors are used for detection and to give a feedback regarding the bends and flaws in the lines.

II. MODULES USED

The components required for the above mentioned module are:

2.1MICROCONTROLLER

Microcontroller is Minicomputer made using semiconductor materials on an integrated circuit with a processor core, memory elements (RAM and ROM) and I/O ports. Here we use the ATMega328a microcontroller. Computer based microcontroller has a flash memory of 32 KB and has read while write capabilities. It works in the range of 1.8 to 5.5 V. The microcontroller has a good throughput. The Arduino Microcontroller shown in fig 1 and 2 is used to dump the program.

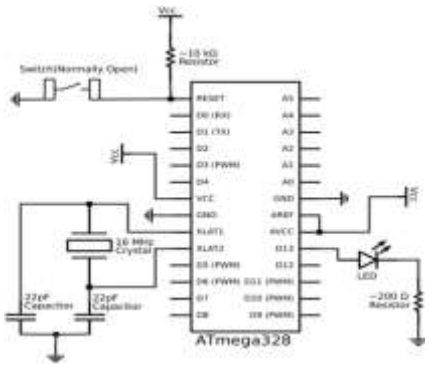

FIG 1 PIN DIAGRAM OF ATMEGA328A

FIG 2 ARDUINO MICROCONTROLLER

2.2 GEARED DC MOTOR

Basically in DC motor the electrical pulses are converted into mechanical rotations. The direction of rotation of the motor is dependent on the polarity of the voltage source. Geared DC Motor shown in fig 3 and 4 is widely used for various applications such as construction of position servo mechanisms at each joint of a robotic manipulator and it should have high gains.

These become inefficient in the Torque Controlled joints because of backlash and friction. To compensate this error and to improve functionality we can use a joint torque feedback using torque sensor such as strain gauges. But the torque sensor decreases the structural strength and stability of the robot and has low response.

Some defects that can be observed in DC Geared motors are:

1. Mechanical binds due to bearing misalignment.
2. Mechanical defects of the gear trains.
3. Winding defects such as improper number of turns, incorrect wire size or shorted turns.

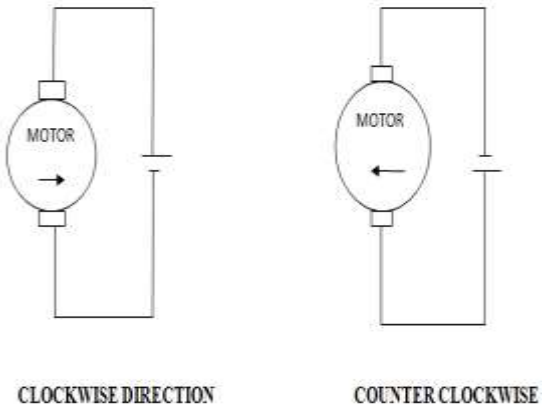

FIG 3 BI-DIRECTIONAL DC MOTOR

FIG 4 GEARED DC MOTOR

2.3ULTRASONIC SENSOR

In Physics, velocity of any wave is defined as the product of the wavelength times the frequency. The velocity of an electromagnetic wave is 3×10^8m/s whereas the velocity of sound wave propagates in air at 344m/s (at 20°C).The velocity of the sound is dependent on temperature and density. At slower velocities, wavelengths are short, therefore higher resolution of distance and direction are obtained.

The ultrasonic wave Intensity propagated into the air attenuate directly proportional to distance which is caused by diffusion loss on spherical surface due to diffraction and absorption loss, that energy is absorbed by medium. The ultrasonic sensors shown in fig 5 functions on the principle of Doppler Effect. The transmitter transmits the sonic signal it hits the target surface and then gets reflected with a shift in the amount of energy. By this variation we can calculate the distance of the target.

FIG 5 ULTRASONIC SENSOR

2.4 HALLEFFECT SENSOR

Electrically charged particles moving through a magnetic field experience a deflecting force perpendicular to both the direction of their motion and the direction of the magnetic field. There are various applications of this sensor and they work on the principle of Hall Effectwhich is shown in fig 6. The applications are as follows:

Automatic Transmission (placed near the Gear Rod)

Ranging and Distance Measurement

Level Measurement

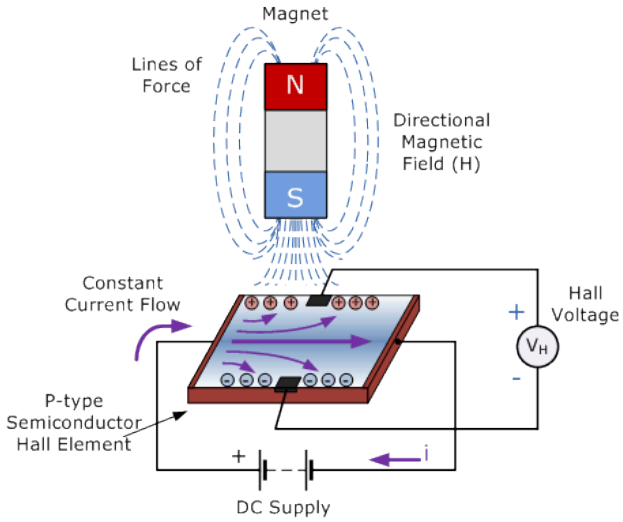

FIG 6 HALL EFFECT SENSOR

III. FUNCTIONALITY OF THE SYSTEMS

The robot is placed near the Power Transmission Line to measure the perpendicular distance between the sensor and the transmission line. There will be a change in the sensing values (i.e. distance) as soon as the defect or any crack is observed by the sensor mechanism. Here in the ultrasonic sensor the emitter of the sensor emits the sonic waves at a particular frequency but due to the passing in the air there will be an absorption loss dependent on the various localized physical parameters of the air. This is a continuous bias error but when a bend or any damage in the wire is detected it will change the frequency in a very abrupt spike. So observing this we can get distance at which this damage had taken place by display on the LCD. Here there is also a Hall Effect sensor which continuously senses magnetic field about the transmission line and there would be an instantaneous variation in the magnetic field and even flux orientation if the wire is having some damage. So using this phenomenon we can detect the flaws in the Power Line. These variations in the fields are analyzed and compared by the constant intervening of the microcontroller setup. Thereby we can find the distance and possibly the location of occurrence of the damage to the wire. The whole system is primarily powered by a Solar Based System supported by a backup of 9V battery.

IV. CONCLUSION

This paper has made an attempt to innovate and make possible the prototype of autonomous Power Line Inspection Robot. By further enhancement of the various mechanisms, stability criterions both control based and even mechanical and usage of other important equipment make this simple idea to be industry ready to be used. By this construction of the model there would be reduction in the loss of human lives, will be economical, almost theoretically infinitely repeatable and qualitatively sound.

V. ACKNOWLEDGMENT

The authors S.Chandra Sekhar and S.Neeraja are thank full to B.S.S.Tejesh for his constant support in this project

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