Advance Line Following Robot

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***Abstract*— It is fascinating yet quite challenging to build proper LINE FOLLOWING ROBOT. This paper presents the development of a line follower wheeled mobile robot. In this project At89s52 which is 8051 family based microcontroller is chosen as the main controller to react towards the data received IR sensors to give fast, smooth, accurate and safe movement in partially structured environment. The designed robot is an economical pilotless transportation in industries for detecting obstacles and for monitoring to prevent damages of robot. The whole system can be made functional and deployed. The system monitored through Group Special Mobile (GSM). It stops the robot when there is an obstacle and passes the information to the client about the barrier. Embedded system helps to minimize human power, decreases power consumption and provides greater performance.**

***Index Terms*— Line following robot, IR sensor, GSM, Microcontroller, DC motor.**

I. INTRODUCTION

Robotics is an interdisciplinary area involving diverse disciplines such as physics, mechanical design, control theory, electronics, signal processing, computer programming, statics and dynamics, artificial intelligence and manufacturing.

Mobile robots have capability to move around in their environment with a certain degree of autonomy. Autonomous navigation is associated to the availability of external sensors that acquire information of the environment through visual images or distance or proximity measurements. There are great deal of focus was granted to line following for mobile robot, the most interested literature is given by Gini G. and Marchi A. in 2002 how developed an idea of a simple autonomous agent relying only on vision information using single camera for integrated mobile robot navigation. The result indicated that use of simple reactive strategies reduces risk of failures [3].

Line follower Robot is a system which traces black line on a white surface, or a magnetic field with the help of embedded magnets. In this paper a line tracer is presented which will trace a black line on a white surface. We have made use of sensor to achieve this objective. Sensors work with the analog signals. They are converted to digital signals by the microcontroller and the digital input is used to drive the motors. The motor have been interfaced using a motor driver. The microcontroller has been programmed accordingly to make a perfect coordination between the sensor input and the motor output.

II. PROPOSED WORKING MODEL

The proposed robotic system consists of two separated parts: Hardware and Software as shown in figure 1. The hardware parts represent the designed robot which is a set of robot content that includes robot body and other devices related to the control equipment and signal transmission or receiving. The software part is the control system, which is the controller, is the line following routine. The line following routine is responsible on routing the robot according to the detected path, and then making the suitable decisions that issued to the robot. It is important to mention that both the controller and robot are operated according to closed loop control system technique. The input data of line following routine in the controller are received from the visual sensor carried in the robot are operated according to closed loop control system technique. The input data of line following routine in the controller are received from the IR sensor pairs carried in the robot. Such data help the controller to detect the intended path of robot motion and determine the decisions needed for correct and safe navigation through the environment.

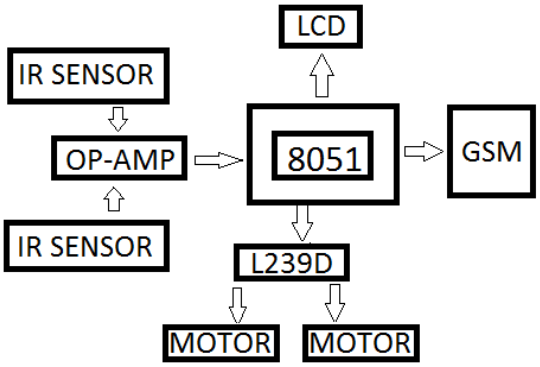

Figure 1. Block Diagram of Proposed Model.

III. HARDWARE PART

The hardware part is stand for mobile robot. The robot is responsible for sensing its current situation and obeys to the controllers orders. Robot sensing help the controller to predict the desired movement of the mobile robot towards the destination point. In addition to the robot body, the robot consists of some important parts; each of which is used to perform a specific function. These parts are discussed and explained in the following section.

(i). Robot Body

It is useful to make the robot autonomous in nature and could be monitored wirelessly. The body was designed such that it can hold the IR pairs at the right position, and can accommodate a liquid crystal display (LCD), GSM/GPRS module microcontroller unit and battery which is source of the power for running the robot.

(ii). MICROCONTROLLER

It belongs to the 8051 family of microcontrollers. Some advantages of using AT89s52 are:

- It has a vast 64 KB programmable flash memory and 1024 bytes of RAM.
- Its most important feature is it has got x2 mode which means the user can use 12 clocks per machine cycle or 6, so by that we can access instruction quickly.
- Easily available.
- Cheap compared to other microcontroller.
- Easy process of burning the program.
- It can withstand temperature between the ranges 0°C to 70°C.
- It also has built in Analog to Digital converter.
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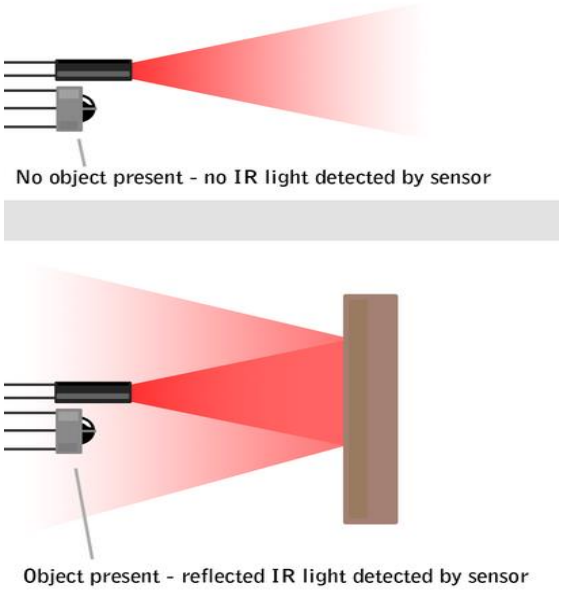
(iii). GSM/GPRS Module

GSM/GPRS module is used to establish communication between microcontroller and a GSM-GPRS system. Global System for Mobile communication (GSM) is an architecture used for mobile communication in most of the countries. Global Packet Radio Service (GPRS) is an extension of GSM that enables higher data transmission rate. GSM/GPRS module consists of a GSM/GPRS modem assembled together with power supply circuit and communication interfaces (like RS-232, USB, etc) for computer. The MODEM is the soul of such modules.

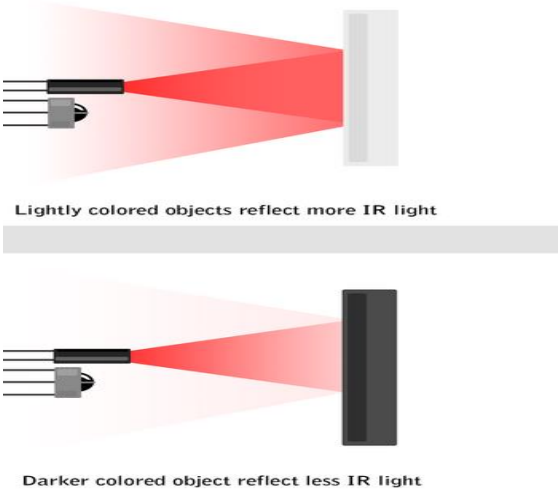
Here it is used send the information to the client. So the client could monitor the robot remotely.

(iv). IR SENSOR

The basic concept of IR(infrared) obstacle detection is to transmit the IR signal(radiation) in a direction and a signal is received at the IR receiver when the IR radiation bounces back from a surface of the object as shown in figure 2(a). Since the sensor works by looking for reflected light, it is possible to have a sensor that can return the value of the reflected light. This type of sensor can then be used to measure how "bright" the object is. This is useful for tasks like line tracking as shown in figure 2(b).



(a)



(b)

Figure 2 IR sensor

IV. WORKING OF ROBOT

There are varieties of sensors those can be implemented for detection of an obstacle in its path. Some of the popular sensors are IR sensors, SONAR, LIDAR which can directly measure the distance of obstacle. As reduction of the cost is an important factor in the design of our line following robot, we have considered IR sensors as our primary choice and designed the system with IR sensor so we can make it a low cost line following obstacle detector robot. IR sensors provide the distance of objects directly in front of the sensor beam. This sensor can be used for most indoor applications where no important ambient Infrared light is present. The IR sensor used, basically is of 'always ON' type. The sensor can be divided into two parts: Transmitter and Receiver. Transmitter has an IR LED (TX), constantly emitting light and hence this sensor is known as always ON type. The second part, Receiver consists of a photodiode (RX). Transmitter keeps on emitting IR light, which is sensed by the receiver and the sensor value is the input to the microcontroller. Based on the input, appropriate signals are fed to the motors/motor driver and accordingly the wheels perform motion. The wheel motion causes changes in the sensor value which acts as the feedback (new sensed value of sensor) and become the new set of input values for the system. This process continues infinitely and hence it is called a "closed loop".

We have made use of 2 IR sensors pair which will not reflect light when they come across a black surface. When the sensor is on the line it will give a digital output of 1. At the times when it is not on the line it is giving an output of 0.

For linear motion, the bottom sensor is on the black line it will return a 0 (LOW) signal. When the robot goes a little out of the line, the microcontroller stops the robot and by checking left or right movement by providing right signal to the motor driver until it again comes to the right path i.e. on the black line.

When there is any obstacle in the front of sensor, the emitted light gets reflected back to the sensor. When reflected IR light beam falls on the photodiode, the voltage drop increases and the cathode's voltage of photodiode goes low depending on the intensity of reflected light beam. This voltage drop can be detected using an Op-Amp (operational Amplifier LM358). From the working principle of Op-Amps, we can notice that the output will go high when the volt at the cathode of diode

drops under a certain voltage. So the output will be high when IR light is detected, which is the purpose of the receiver [6]. Detection range of the sensor can adjusted using potentiometer/variable resistor (Vr) present in the sensor. An LCD is also mounted for the indication of detection of obstacle. Also a GSM module is used to send an alert message to the client.

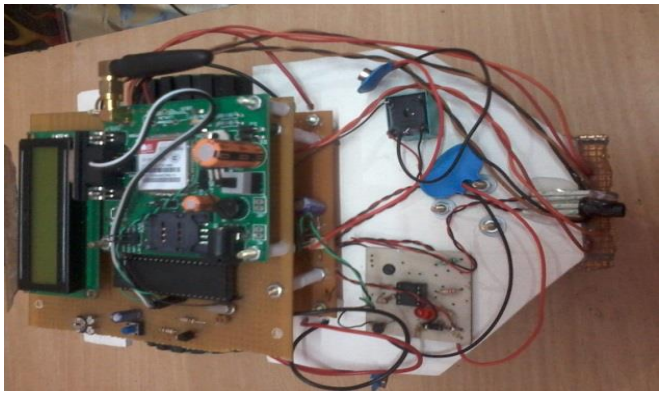


Figure 3.Proposed Model of Line Following Robot

V. FUTURE SCOPE

Line following robot with obstacle detection system can play a vital role in various field such as hospital and logistics industries etc. Robotics is fast grooming technology. By using robot in the industries the cost and work can be reduced, making it an efficient industry. In India there is a high demand of various material or services which can be efficiently met by the use of robots. Live monitoring of environment is difficult so a camera can be placed. An accelerometer can placed on the line following robot to check and control the speed of robot. A WI-FI module can be integrated with it so we can also monitor it through our computers.

VI. CONCLUSION

The line following robot and obstacle monitoring project was challenging and rewarding experience. It provides the opportunity to apply and expand upon the knowledge taught at the institution. The proposed robotics system showed acceptable behaviour when applying the line following method and obstacle monitoring using GSM module.

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