Move Smart
A Survey of Automated moving bots and their utilization

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Abstract

In the present day's many industries are using robots due to their high level of performance and reliability and which is of great help for human beings. With this thought in mind this paper presents a new vision pertaining to combination of obstacle detection robot and line follower robot, which will be a life changing model in hospital and medical automation in feasible and economical way.

Keywords: *Performance and Reliability, Obstacle Detection, Line follower, Arduino*

1. Introduction

Robotic Systems provide unique techniques to automate tasks which are complex and hard to perform in real world. They often provide an approach which has been perhaps never thought of. The tool that a bot uses to bridge the chasm between a real world problem and its automated solution includes sensors, controllers, geometrical reasoning, a definite logic and time frame of work. If all these resources are utilized effectively, a unique automated solution is generated. This paper presents the concept of a smart bot which can be developed using the features of line follower and obstacle detecting bots. The rationale for developing this concept is that these features can be helpful in automation of the instruments used for patient's mobility within hospital (wheelchairs & stretchers)

This project focused upon the development and study of two robots: an obstacle avoiding robot and a path following robot built using an arduino microcontroller. The bots basically work using Ultrasonic sensor used for detecting obstacles and infrared sensors for finding paths. We have worked upon their separate functioning and utilization of their unique features. Moreover, the study also includes usage of accelerometers and Bluetooth modules which can also be integrated with the above bots. All the described sensor modules are integrated using an arduino microcontroller which was coded using an open source arduino IDE. We developed a miniature bot and used a 5V DC voltage to generate the output.

Integration of the features of both the bots can be done easily and this concept can be implemented for the automation of wheelchairs and stretchers in hospital. This assembly would be very economical as compared to the present day's automated wheel chairs.

2. Description

The overall assembly is simple and easy to construct. It requires only a basic knowledge of working with microcontrollers and prototyping boards. The codes used [4][5] to implement it are also simple and easy to understand. The IDE used is open sourced software: Arduino IDE 1.8.3[2].

The assembly uses standard components which do not require much maintenance. In our course of study, we used arduino as microcontroller. However, in the real world implementation, an industry grade microcontroller can be used in its place to generate good output. A rechargeable Lithium Ion battery is used as a power supply, which has a good life and is easy and safe to use. This assembly would also not consume much space and thus the system is handy and easy to attach.

The project includes two different parts as mentioned: One is the obstacle avoiding bot which basically detects an obstacle coming on its path using ultrasonic beams and guides the system accordingly, second is the path following bot which basically detects and follows the path using infrared beams and follows it for its movement. The description of each components used, their individual mechanisms and integrated results are described below –

Obstacle Detecting Robot –

The Obstacle avoiding bot basically works using ultrasonic range finding sensors to avoid collisions. This helps a moving machine to detect obstacles in front of them and accordingly stop or change its path. To program the system accordingly, we used an open sourced prototyping board.

The complete assembly of this bot required the following hardware components - Arduino-Uno, Ultrasonic Ranging Module (HC SR-04), Motor Driver IC-L293D, Robot chassis, Motors (DC driven). The working of each components are described below –

Arduino is basically an Atmega 328p microcontroller based prototyping board. It is one of the most economic and widely used technologies to program the sensors accordingly and generate their outputs. It consists of 14 digital pins and uses DC input source for its operation. It can be used with a large number of sensors and actuators.[2]

HC-SR04 Ultrasonic Ranging module is the main sensor used in this. It has two pins namely Trigger and Echo. The former triggers an ultrasonic burst from the transmitter. This burst comes in contact with the obstacle present at a certain distance within its range and the signal after hitting it gets reflected back and identifies the position of obstacle. [7]

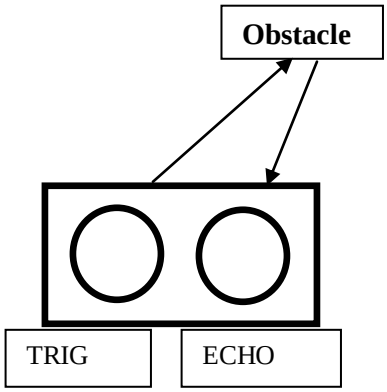

Figure 1: Block Diagram of working of HC-SR04 Ultrasonic Ranging Module

L293D Motor driver IC is used to provide bi-directional drive currents to the two motors fixed in two wheels.

The assembly is shown below and its working is described.

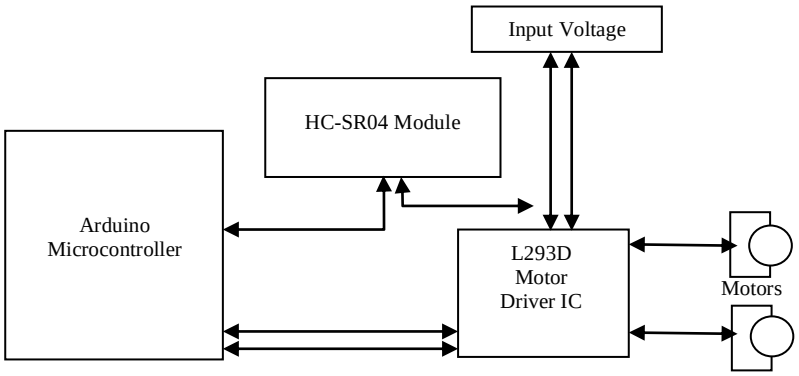

Figure 2: Block representation of Obstacle Detection Circuit

The system was assembled following the above circuit diagram. All the connections were made accordingly.When the robot is powered on, both the motors of the robot will run normally and the robot moves forward. During this time, the ultrasonic sensor continuously calculates the distance between the robot and the reflective surface. This information is processed by the Arduino. If the distance between the robot and the obstacle is less than a prefixed threshold distance, the left wheel motor is reversed in direction and the right wheel motor is operated normally. This will rotate the robot towards right. This rotation continues until the distance between the robot and any obstacle is greater than a threshold range. The process continues forever and the robot keeps on moving without hitting any obstacle. The sonic burst transmitted in our study consisted of 8 pulses at 40 kHz and was made logic high for about 10 micro seconds.

Line Follower Robot

The line follower bot uses Infrared module as its main component for its working. Line following can be implemented in two ways: system following white line in a dark arena or the system following black line in a white or light shaded arena. Since, the latter one is more common in real world implementation; we implemented it in our project.

In this assembly also, we used arduino as our microcontroller due to its familiarity and ease of use. The assembly of this bot required similar components as the former one, the only difference being that it uses infrared modules facing downward direction towards the moving arena.

Infrared Module basically consists of two components: an infrared LED and a photodiode. The LED emits light which falls on the path traced in the arena. The surface either absorbs it or reflects it back which is traced by the photodiode. This mechanism is programmed accordingly in real time and thus guides the vehicle to follow the path.
The assembly is shown below and its working is described.

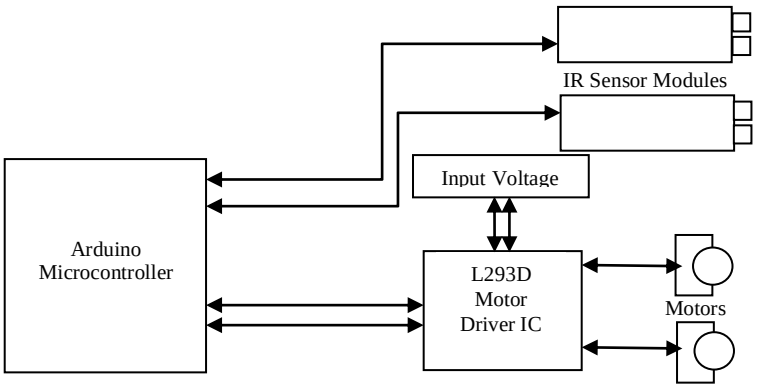

Figure 3: Block representation of Line Following Robot's

The connections were made following the above circuitry and observations were made. IR Sensors, which consists of IR LED and Photodiode. They are placed in a reflective way i.e. side – by – side so that whenever they come in to proximity of a reflective surface, the light emitted by IR LED will be detected by Photo diode. Following which, instructions are generated to guide the motors through L293D motor driver IC. Thus, the motors work in a guided way and allow the vehicle to follow the black path.

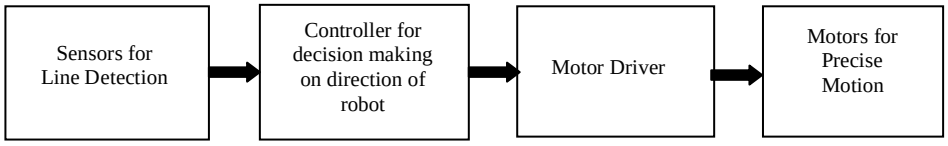

Figure 4: Block Diagram for Line Follower Robot

Besides the course of study, we also worked on usage of accelerometers and Bluetooth modules. Our major aim associated with this project is concentrated with stretcher and wheelchair automation in hospitals. Besides implementation of the technologies used in above described bots, to provide enhanced experience and more mobility, we also worked upon the techniques of integration of HC-05 Bluetooth Module and Digital tilt accelerometer module. These modules are economic and are compatible with our main system. They can also be programmed and can be attached to arduino or other similar microcontrollers.

The main idea behind the integration of such units is that in times when the concerned person wants the complete arrangement to control by himself, it can be easily controlled wirelessly with a hand worn glove fitted with an accelerometer module. Moreover, Bluetooth modules may help to control the automated system using smart phones and would give free movement access to the user.

3. Applications

- The obstacle detecting bot finds its usage in automated military equipments to explore hard to reach places.
- The line follower bots are common in Assembly lines in automated manufacturing units to transport goods without the human intervention.
- Obstacle Detection system finds its usage in almost all kinds of automated navigation vehicles and machines.

- Attaching an obstacle detecting unit in heavy vehicles may also help to avoid collision in times of emergency. This however needs brake automation as well in parallel.

4. Implementation and Future Scope

The current future scope of this project is to design and develop a real prototype of automated wheelchair by integration of all the technologies described above. This development also needs to be economic and relatively low in cost as compared to other available alternatives.

Another scope associated with this project is to produce a machine with relative logic and decision making capabilities to follow the shortest possible path to reach the destination. This would require the integration of concepts of Artificial Intelligence.

Thus, if all the above ideas would be combined and implemented, it would result in an economic automated wheel chair and stretcher. This would help also help physically disabled people to move around freely without any physical efforts.

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