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LINE FOLLOWING AND OBSTACLE AVOIDING ROBOT

Anusha B Kandikere
Electronics and Communication Engineering
Reva University
Bangalore, India
anushakandikere@gmail.com

Andela Sai Ramana
Electronics and Communication Engineering
Reva University
Bangalore, India
andelasairamana@gmail.com

A. Pratima
Assistant Professor
Electronics and Communication Engineering
Reva University
Bangalore, India
pratima.may10@gmail.com

Abstract

A line following robot is an intelligent robot that detects a line on sight, that is embedded on the ground and follows it. The path is predefined and visible as a black line on a white surface in high contrast color of the path can be a composite such as a magnetic marker or a laser-guided marker. To detect these lines, various sensors can be used. Generally, infrared sensors are used to detect the path that the robot must follow. The robot's movement is automatic and can be used for long-distance applications. The line follower can be modified by giving it the ability to detect obstacles. Using ultrasonic sensors, road trackers can detect obstacles and stop until the obstacle is removed. Since this smart line follower robot is capable obstacle detection, it will not be easily damaged, because it stops its movement until the obstacle is removed or until the path changes. This ability of the robot increases its application, especially in industries because obstacles are common in all workplaces and if the robot cannot detect the obstacle, it will be damaged failure, adding an extra advantage anywhere this smart road tracker is used. These robots can be used as automated equipment carriers in industries as an alternative to traditional conveyors. They can also be developed to be handled by a home app, and one of the most useful applications of this line-running robot is healthcare management.

Keywords: Contrast, Line Follower, Sensors, Obstacle Detection, Robot.

1. INTRODUCTION

The main goal of any robot is to minimize human effort. Depending on the purpose, different types of robots are designed for practical applications. In any work environment, proper supervision is essential for the best results. This smart and intelligent line robot can be used in industries to transport goods from one place to another. The

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main reason why this robot can be used to transport goods is the ability to set it up and forget it, which means that once the robot is placed on the desired path, the robot's operation is fully automatic. It is not necessary to control the robot manually. This makes line tracking robots more efficient and useful than other conventional robots. Traditional obstacle avoidance robots cannot help transport goods because there is no separate path for the robot. It will move randomly to avoid obstacles and will not reach the necessary decision. It is not possible to control the movement of the obstacle avoidance robot.

Meanwhile, this line-following robot has more useful applications. This common path robot can become smart and intelligent by giving it the ability to detect obstacles. This improves the operation of the line robot because in any working environment there are obstacles, so if the line follower fails to detect an obstacle in its path, it will hit it and be severely damaged the best results. Adding the functionality of an obstacle avoidance robot to a traditional runner robot will prevent any damage to the robot. This smart robot can also be installed to manage healthcare in hospitals, reducing human effort in monitoring patients and delivering belongings or medicines. Workers can be used for other jobs instead of transporting goods from one place to another, which can be done with this intelligent bot.

2. BACKGROUND DETAILS

In robotics, there are numerous structures invented which has exclusive packages in exclusive fields. Robotics could be a very popular field for research and manufacturing. Pakdaman M. et.al has designed a small line following robot that used IR sensors to detect the path laid down on the ground. [1] Priyank Patil has developed an AVR line following bot that can sense the line drawn on the ground with a sensor array. When its sensor is passing through the line drawn, it reads zero and vice versa. [2] That gadget has been designed for a robot competition. Colak I. et.al has designed a line follower robot to use in the malls for entertainment. That bot used a 4.8 cm wide black line to hold the load up to 400 kg. [12] Two wheels balancing robot was developed by Nor Maniha Abdul Ghani et.al, which has the line following functionality and for balancing it, they used an infrared distance sensor to solve the issue with inclination. [11] They also used a manual control with a remote controller. [12] A robot with 50-individual controls was generated by Gomi T. et.al from which the capacity and gait to lift the body may be improved. That robot can move in forward motion and examine in different conditions. [13] Roman Osorio C. et.al designed a smart line following robot, that modifies the overall performance of the motion with the assistance of a various types of magnetic sensors. That robot primarily was based on the V2X sensor which is a type of virtual compass. [14] This gadget has used an array of 8 IR sensors and numerous LEDs. M. Zafri Baharuddin et.al designed a robot module which may be used for navigation purposes. [15] An intelligent robot was designed by Bajestani S. E. M. that provides corrective feedback under influence of different colors of light. [16] They used a comparator circuit to enhance the sensitivity of the system. That comparator compares the voltage with the predetermined quantities from which a robot can move in an accurate real-time. Kazi Mahmud Hasan et.al designed a sensor primarily based on the color line following robot with obstacle avoidance, this robot can follow a few different colors. This robotic consists of electronic logic gates a as brain instead of microcontroller.

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3. METHODOLOGY

The line-following robot consists of two infrared sensors and one ultrasonic sensor. When the sensor on the left reaches the black line, the robot turns left at the black line, and when the sensor on the right detects the black line. The robot rotates to the right until the left and right sensors detect white, and only the robot moves forward. If the robot comes across a path where there is another black strip lying perpendicular to the path then the robot stops at that instant. If the black line is perpendicular to this road, the robot will stop immediately. The ultrasonic sensor library must be installed in the Arduino IDE. In the program, both IR sensors must be initialized. The four output pins of the motor need to be initialized. Three variables must be declared, two for the two IR sensors and one for the ultrasonic sensor. Two variables declared for the IR sensor will read the value of sensor IR1 and sensor IR2. Variable declared for the ultrasonic sensor to check for any obstacle within the mentioned distance. If the ultrasonic sensor detects an obstacle in its path, all motors must stop, and all four motor output pins must be programmed LOW, which means they must stop working. Therefore, when the ultrasonic sensor detects an obstacle, the motors will stop, and the robot will stop until the obstacle is removed from its path. When there is no obstacle and no black line is detected, the robot will move forward.

3.1 BLOCK DIAGRAM

Below is the block diagram of the line robot. The Arduino UNO microcontroller sends a set of signals to the L298N and uses the L298N Motor Driver. All kinds of processing take place in the Arduino UNO microcontroller. Two DC motors are connected to the motor driver as well as two IR sensors and one ultrasonic sensor are connected to the motor driver. They send signals over the L28N to the Arduino. The 9v battery powers the entire system.

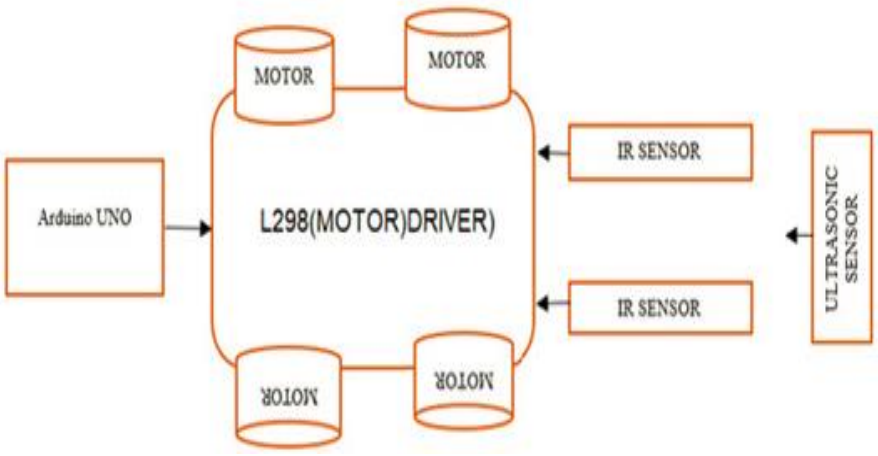

Fig.1: Line follower block diagram

4. WORKING PRINCIPLE

These robots are quite cheaper and easy to design. The infrared sensor is used to detect the black line on the path and the ultrasonic sensor is used to detect the obstacles along the way. The robot then responds to the sensor

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reading and does something. This robot can perfectly follow a -thick line at least 1 inch wide and even follow the most complicated path consisting of turns/obtuse angles and intersections of these black lines.

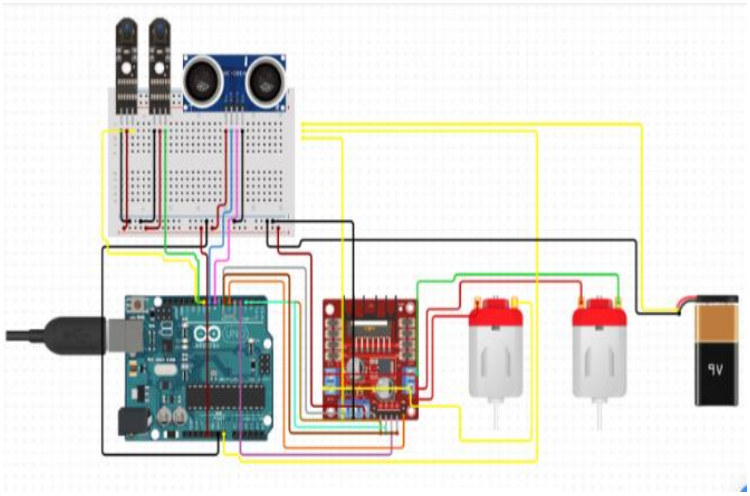

Fig.2 Circuit Diagram

When two infrared sensors connected to both sides of the robot detect a white line, the two motors rotate clockwise, and the robot moves forward. Similarly, when both infrared sensors detect a black line (that is, the intersection of black lines), both motors also rotate clockwise, and the robot moves forward.

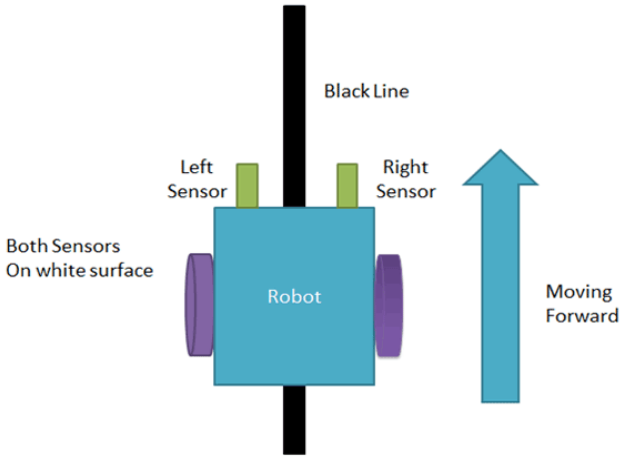

Fig.3: Forward movement

When one of the infrared sensors (say the one on the right) detects a black line while the other (the one on the left) detects a white line, then that path turns to the right, for the robot to turn to the right. To move the robot to the right, the right motor is stationary, and the left motor rotates clockwise, so the robot rotates to the right.
To make a sharp right turn, turn the left motor clockwise while turning the right motor counterclockwise.

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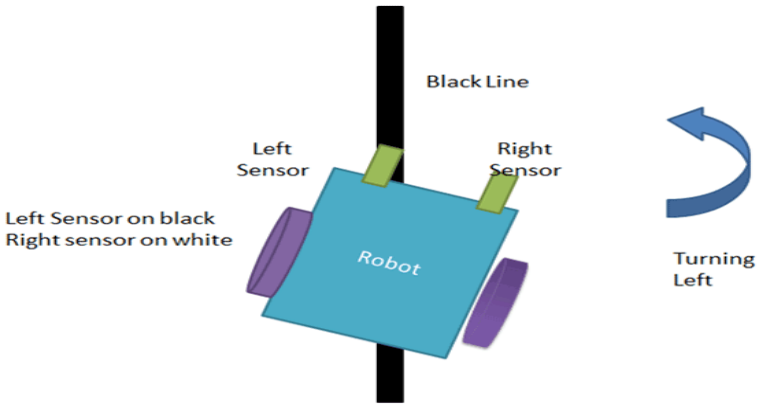

Fig.4: Turning right

When one of the infrared sensors (say the one on the left) detects a black path while the other sensor (right) detects a white path, then that path turns left, let the robot move to the left. To make the robot move to the left, the left motor is stationary, and the right motor rotates clockwise, so the robot rotates to the left. To make a sharp left turn, turn the right motor clockwise while turning the left motor counterclockwise.

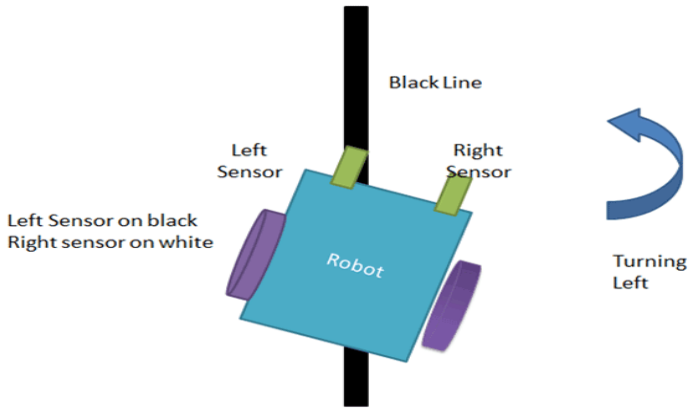

Fig.5: Turning left

When the ultrasonic sensor in front of the robot detects an obstacle (within programmed range) while moving forward, the engine stops spinning, and the robot stops. The robot starts moving as soon as the obstacle is removed.

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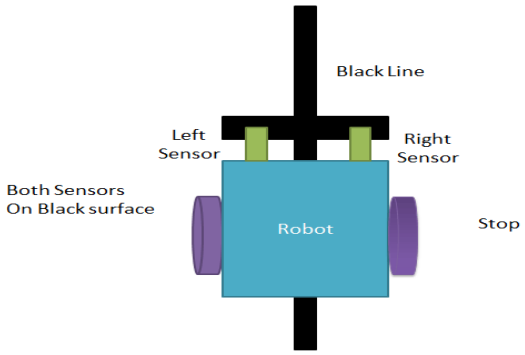

Fig.6: Stop

5. SYSTEM ARCHITECTURE

Table.1: Connection Between Motor Driver and Arduino

Motor Driver	Arduino
IN 1	9
IN 2	8
IN 3	7
IN 4	6
EN A	10
EN B	5
VCC/ 12V	Vin / 5v
GND	GND
5V	Vin

Table.2: Connection between IR Sensor and Arduino

IR Sensor	Arduino

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Sensor 1:

VCC	VCC
GND	GND
OUT	A0

Sensor 2:

VCC	VCC
GND	GND
OUT	A1

Table.3: Connection between Ultrasonic Sensor and Arduino

Ultrasonic Sensor	Arduino
GND	GND
ECHO	A3
TRIG	A2
VCC	VCC or 5V

6. SYSTEM IMPLEMENTATION

6.1 LINE FOLLOWING

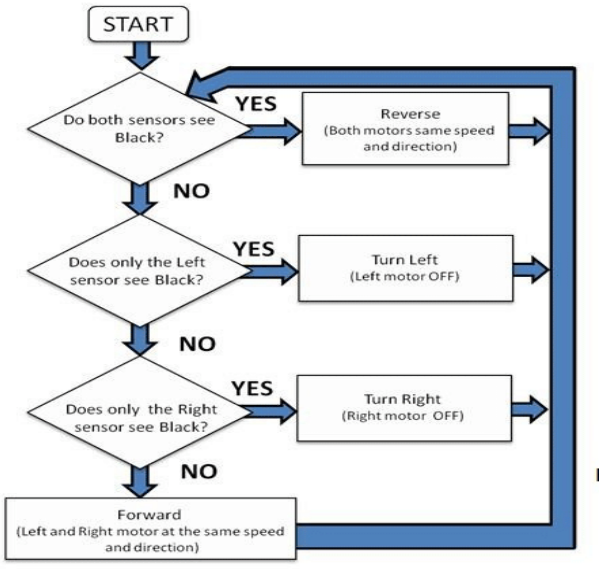

Fig.7: Flowchart for Line Following

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6.2 OBSTACLE AVOIDING

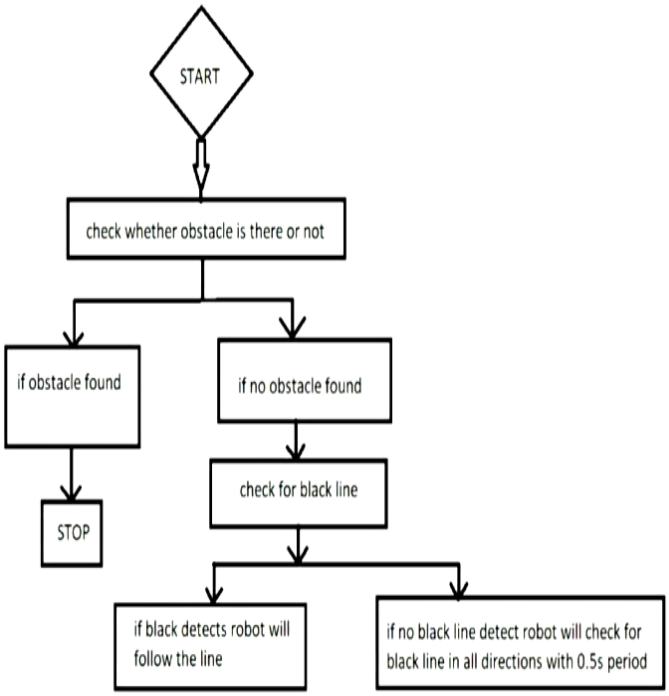

Fig.8: Flowchart for Obstacle

7. COMPONENTS USED

7.1. HARDWARE REQUIRED

7.1.1Infrared Sensor (proximity sensor):

An infrared sensor is an Infrared radiation-emitting electronic device that detects the environment. The IR light emitted by the LED strikes the surface and gets reflected back to the photodiode. These sensors are used for path detection in this module.

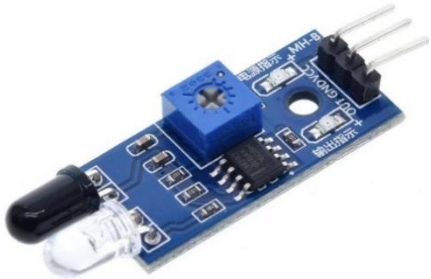

Fig.9: IR Sensor

7.1.2 Ultrasonic Sensor (HCSR0):

It measures the distance to an object using ultrasonic sound waves. Ultrasonic sensors use a transducer to send and receive ultrasonic pulses that relay information about an object's distance. High-frequency sound waves reflect off the boundaries to create distinct echo patterns. It detects obstacles in this module.

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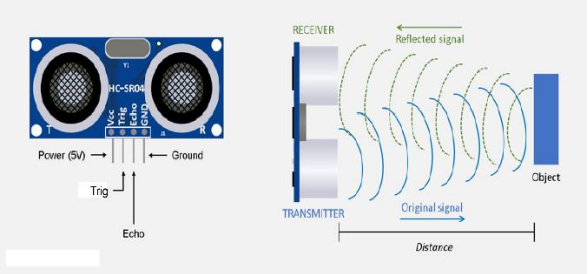

Fig.10: Ultrasonic Sensor

7.1.3 Motor Driver L298N:

The L298N is a monolithic circuit integrated into 15-pin milliwatt and PowerSO20 packages. This is a high current, high voltage, full dual bridge driver designed to accept the inductive loads of standard TTL logic level sand drives such as relays, solenoids, DC, and stepper motors. Two trigger inputs are provided to turn the device on or off independently of the input signal. The emitters of the lower transistors of each bridge are interconnected, and the corresponding external terminal can be used to connect an external sense resistor. Additional power input is provided for the logic to operate at a lower voltage

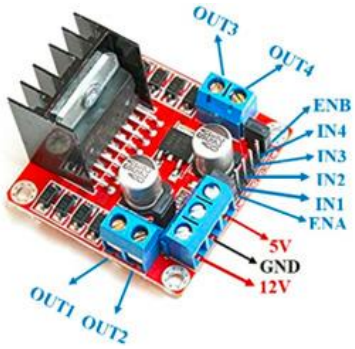

Fig.11: Motor Driver

7.1.4 Geared BO Motors

We use two geared motors on the back of the line tracking robot. These motors provide more torque than normal motors.

Fig.12: Motors

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7.1.5 Battery

An electric battery is a device made up of two or more electrochemical cells that convert stored chemical energy into electrical energy. Each cell contains an anode or cathode and a cathode or anode. The electrolyte allows the ions to move between the electrodes and terminals, allowing current to flow out of the battery to do the job. The primary battery (single-use or "disposable") is used once and thrown away; The electrode material cannot be changed during discharge

Fig.13: Battery

7.1.6 Arduino Uno r3

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board and IDE that runs on your computer, used to write and upload computer code to the physical board. The Arduino IDE uses a simplified version of C++.

Fig.14: Arduino

Arduino Uno is a microcontroller board based on the datasheet file,

http://www.atmel.com/dyn/resources/prod_documents/doc8161.pdf

Further information about Arduino Uno, can be read it on [25].

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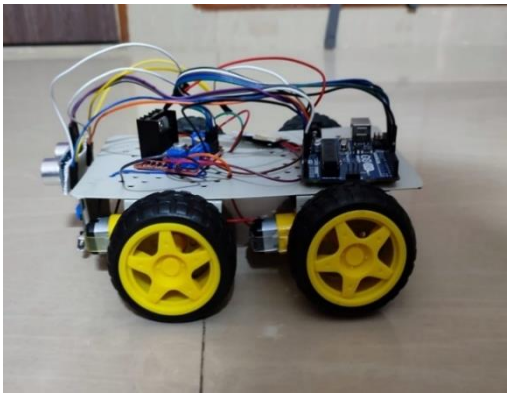

Fig.15: Proposed model

7.2. SOFTWARE REQUIRED

7.2.1 Arduino IDE Compiler

Arduino Compiler or Arduino Software (IDE) includes a text editor, notification area, text content panel, A toolbar with buttons for writing code unusual localization and some menus. The Arduino compiler is used to generate packages and to comfortably use the hardware sensor. It I open-source software and a platform on which the electronic equipment is mainly based on the complete and is fully fluent to the user hardware and software utilities. This compiler read input from the sensors, and it activates other sensors connected to the main sensor. The Language we use to write the program is Embedded C, a version of the C programming language.

7.2.2 NEWPING LIBRARY

A support library for working with ultrasonic sensors. When I first received an ultrasonic sensor, I was not satisfied with its poor performance. I soon realized that it was not the sensor that was the problem, but the available ping and ultrasound libraries that were causing the problem. NewPing library allows you to use ultrasonic sensors, and measure distances, with Arduino.

8. RESULTS

The line following robot avoided obstacles and retraced the track beyond the obstacle detected. So, an experimental result was taken on the time taken by the robot to reach back to the track after bypassing the obstacle, considering the different lengths of obstacles, keeping the speed of the robot constant.

9. CONCLUSION

The main objective of the proposed system was to create a robot that automatically follows a guided path or a line and also avoids obstacles. The robot moves on a designated path using infrared sensors and detects obstacles on its path using ultrasonic sensors. When it encounters an obstacle in its way, the robot will stop and deviate. It returns to the original path when it overcomes an obstacle.

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Fig.16: Working Model

9.1 APPLICATIONS

9.1.1 Industrial applications: These robots can be used as automated equipment carriers in industries replacing traditional conveyor belts.

9.1.2 Automotive applications: These robots can also be used as automatic wagons on the road with built-in magnets.

9.1.3 Indoor application: they can also be used in the household for domestic purposes such as floor cleaning, etc.

9.1.4 Guide apps: they can be used in public places like shopping malls, museums, etc. to provide directions.

9.1.5 Mobile robot navigation system.

9.1.6 They can be used for household tasks such as automatic vacuuming.

9.1.7 They can also be used in hazardous environments where human entry can be fatal.

9.2 ADVANTAGES

9.2.1The movement patterns of this robot are usually automatic.

9.2.2. The system in the robot looks like a single installation.

9.2.3. It is relatively cheap.

9.2.4This type of robot is simple to build.

9.2.5. They can also be used for long distances.

9.2.6. The robot can also be used as a mobile surveillance system.

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9.3. FUTURE WORK

9.3.1. We can make changes to prototype so it can move in reverse and any direction possible.

9.3.2. We can change engines to make the module move faster.

9.3.3. We can add extensions to track and control the bot using smartphones.

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