Patient Assistance Robot

Keywords- Robotic arm, servo motor, sensors, raspberry-pi, ArduinoUno, H-bridge, line follower.

Our project is divided essentially into three parts- The pick and place arm, the line follower along with the obstacle detection and the home automation system. The three major parts are integrated together to form a system that can be of essential importance to the user. To achieve these goals we have made use of a number of hardware and software components.

We endure to make a smart assistance robot that can be beneficial to the patients, but to ensure this our robot should be robust and easy to manage. We use a line follower to ensure that the robot performs its assigned duties. The line follower is made using raspberry-pi and three IR sensors. There is a fixed black line at the bottom that are the tracks that will help the robot manoeuvre in the house or hospital. We install an obstacle detection system to ensure that there is no obstacle in the path of the robot and if there is any hindrance in its path then the bot will stop without causing any damage to the structure. This obstacle detection system is made using a raspberry-pi and an ultrasonic sensor. There is a pick and place arm that will pick the medicines form the location specified and take it to the patients. The robot can also be used to bring water, food and medicines to the patients as and when required. This ensures that the physically disabled people don't have to strain themselves to do the menial daily jobs. The pick and place robotic arm is made using servo motors, h-bridge and raspberry-pi. We have also included a home automation system that will help the user to control the lights and fans within room that has been implemented using an Arduino Uno and relays. The home automation system has an application that will help the user control the lights and fan using voice commands. For the home automation system we use a Wi-Fi module for serial data transmission. The application will recognise the voice command and convert to text before implementation. The Bluetooth module will then relay the data to the Arduino Uno which is connected to the light and fan relays. It is a well-planned robot that is designed to replace the traditional house help and take care of all the work itself. It is a self- sustained system and can be worked on to be of better use to the user.

Block Representation

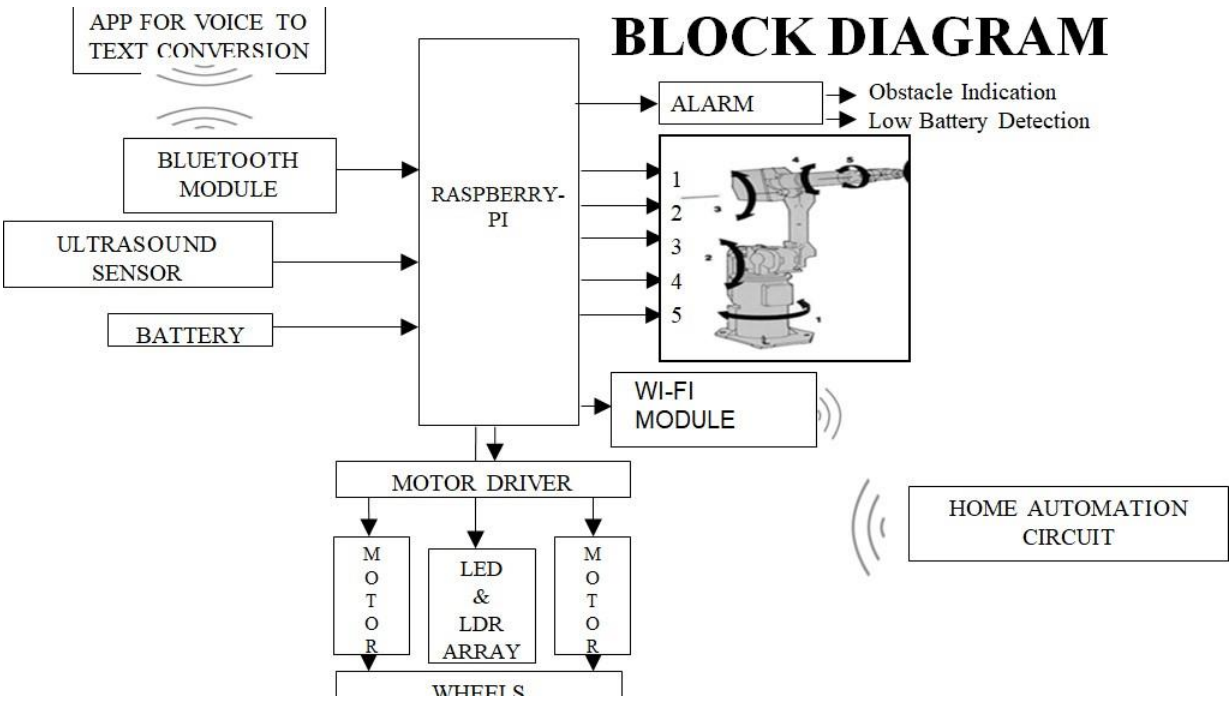


Figure 3.1 Block diagram of implemented system

3.1 Sub-system Description

The patient assistance robot is divided into 3parts:

1) Line Follower

2) Obstacle Detection

3) Pick and Place Arm.

Materials used

Line follower:

- Raspberry Pi 3
- IR Sensor Module
- DC Motor
- L293D Motor Driver
- Chaises
- Power bank

Obstacle detection

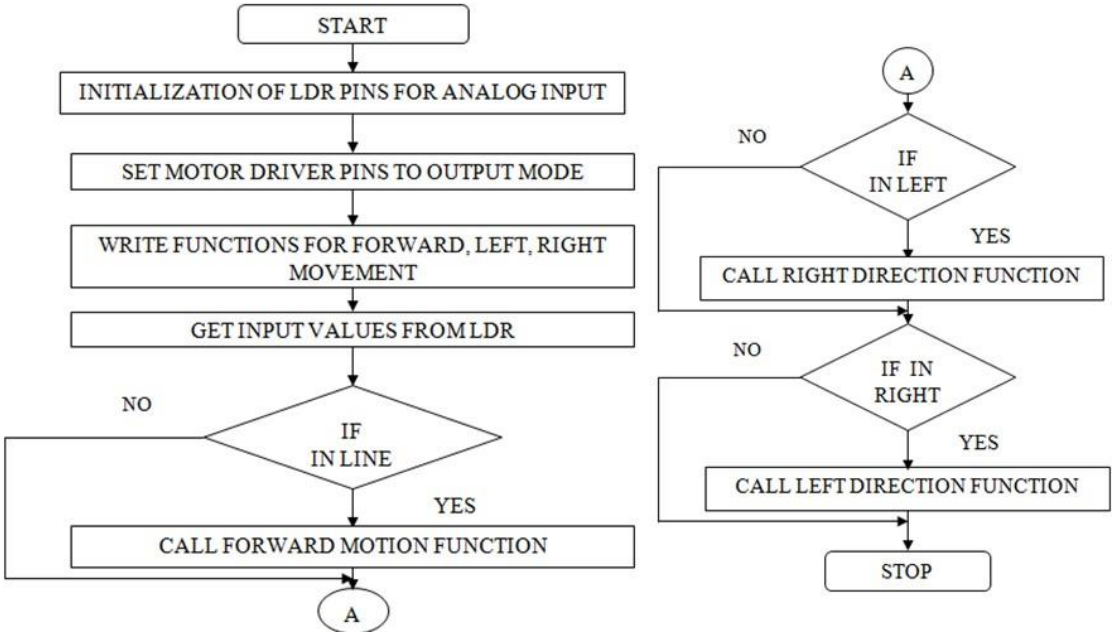
- Ultrasonic Range Finder Sensor – HC – SR04
- Motor Driver IC – L293D
- Geared Motors x2
- Power Supply

Home Automation System:

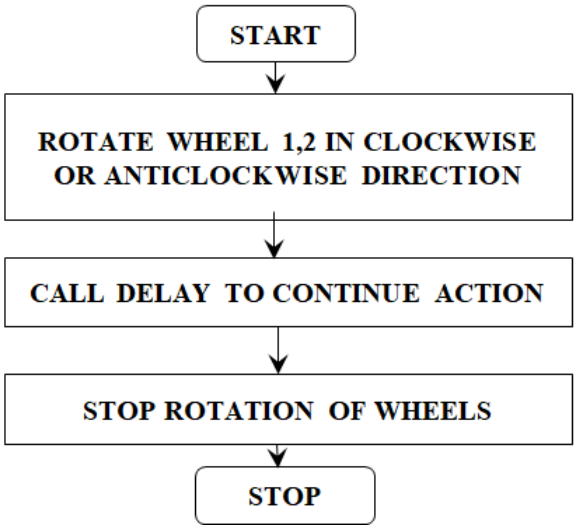
- Arduino Uno
- Relays
- Wi-Fi Module
- Voltage Regulator

Process Flowchart:

ROBOTIC MOVEMENT

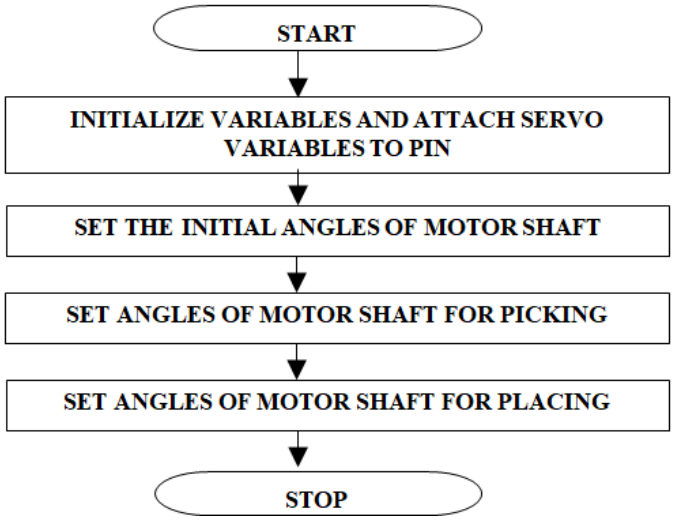


ROBOT DIRECTION FUNCTIONS



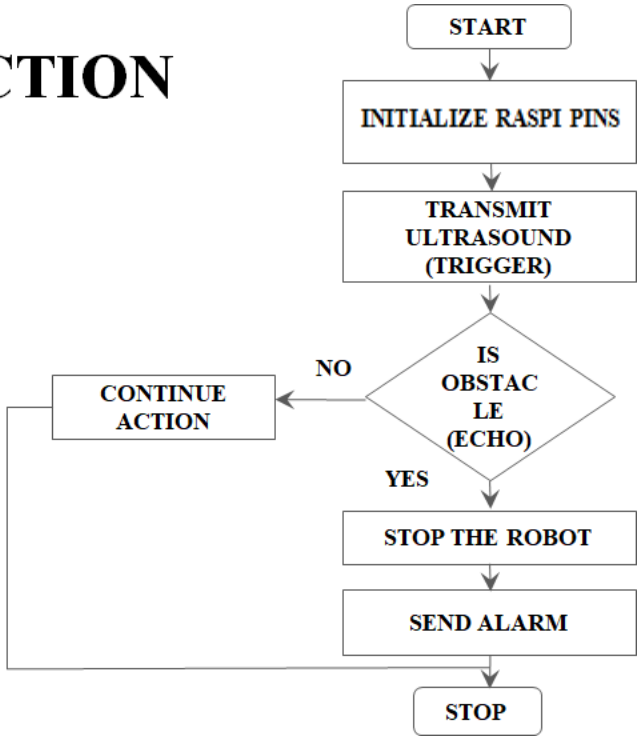
- Forward, right and left direction movements.
- Control the direction of rotation of wheels.

FLOWCHART FOR ARM MOVEMENT

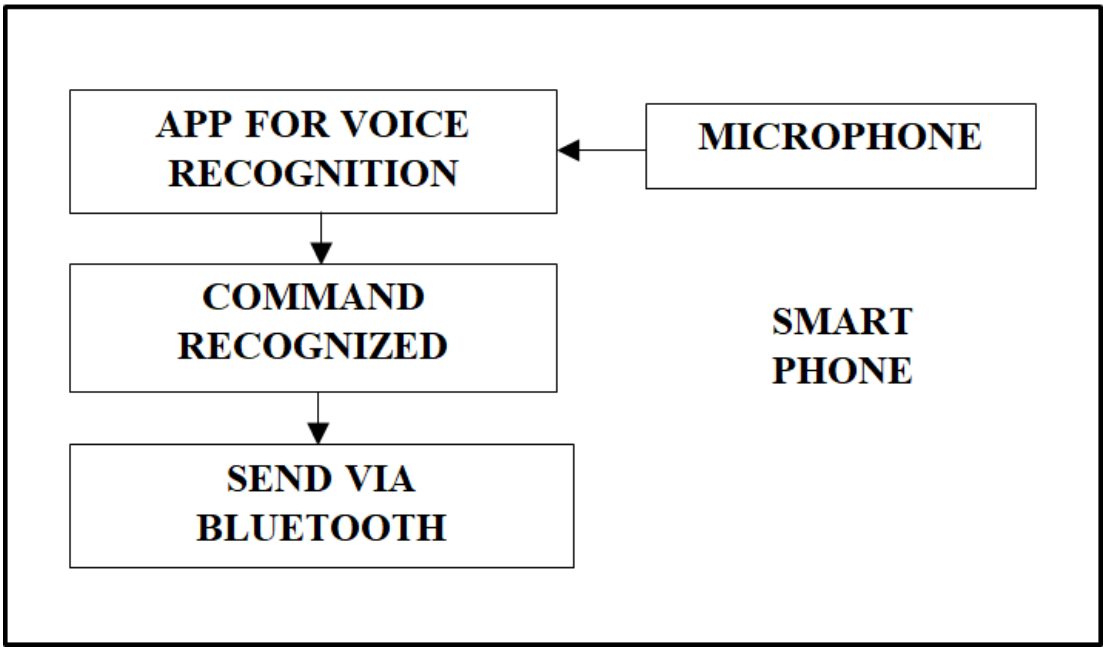


OBSTACLE DETECTION

- Used to detect obstacles in the line of motion.
- When the robot is moving through desired path, the ultrasonic sensor transmits the ultrasonic waves continuously from its sensor head.

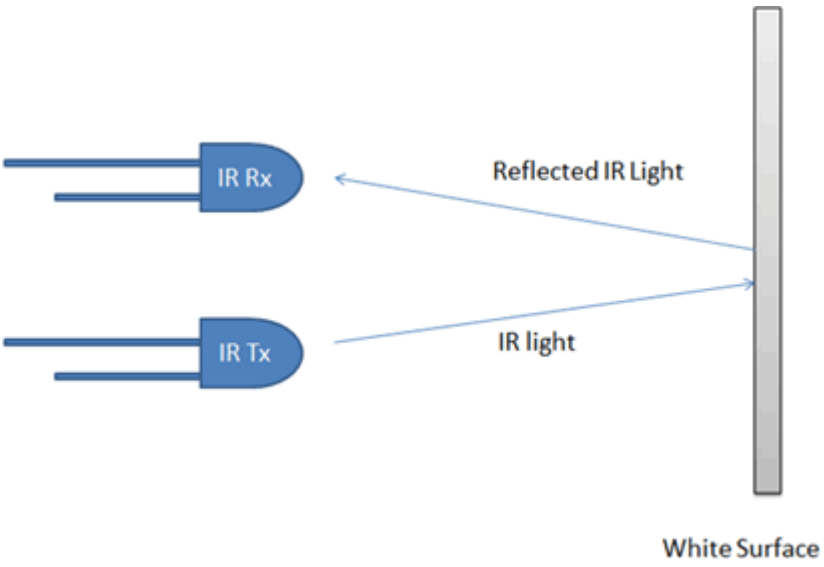


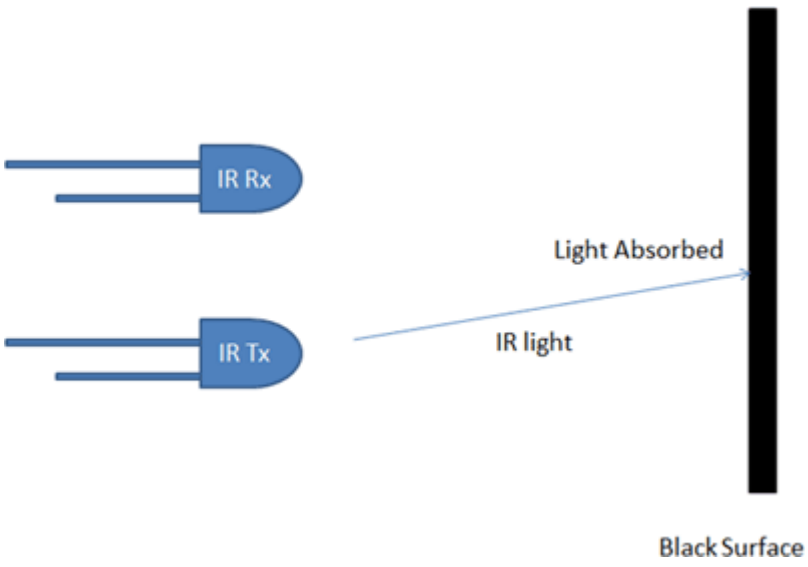
BLOCK DIAGRAM OF APP



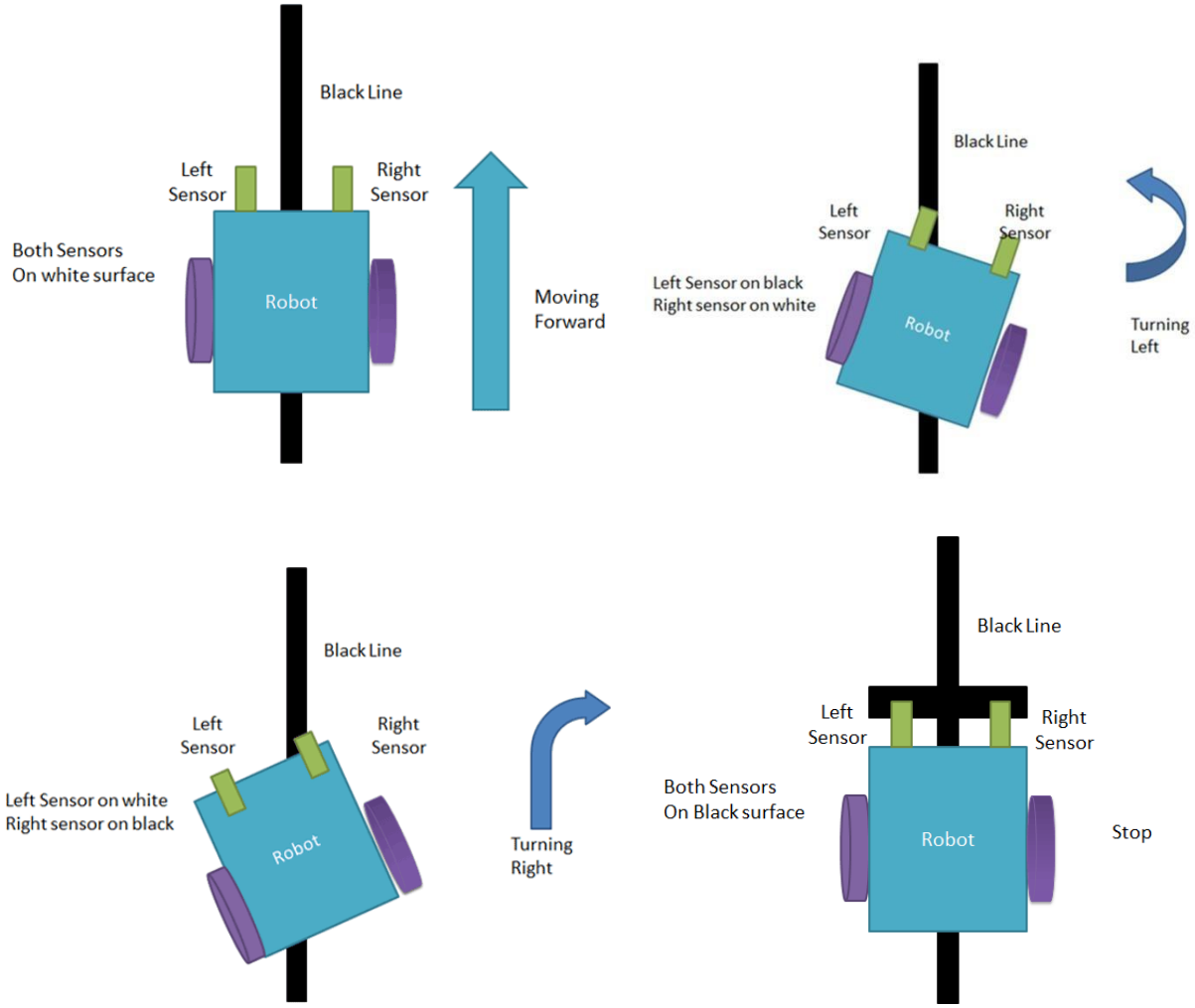
4.1 Analog Frontend

4.1.1 Line Follower



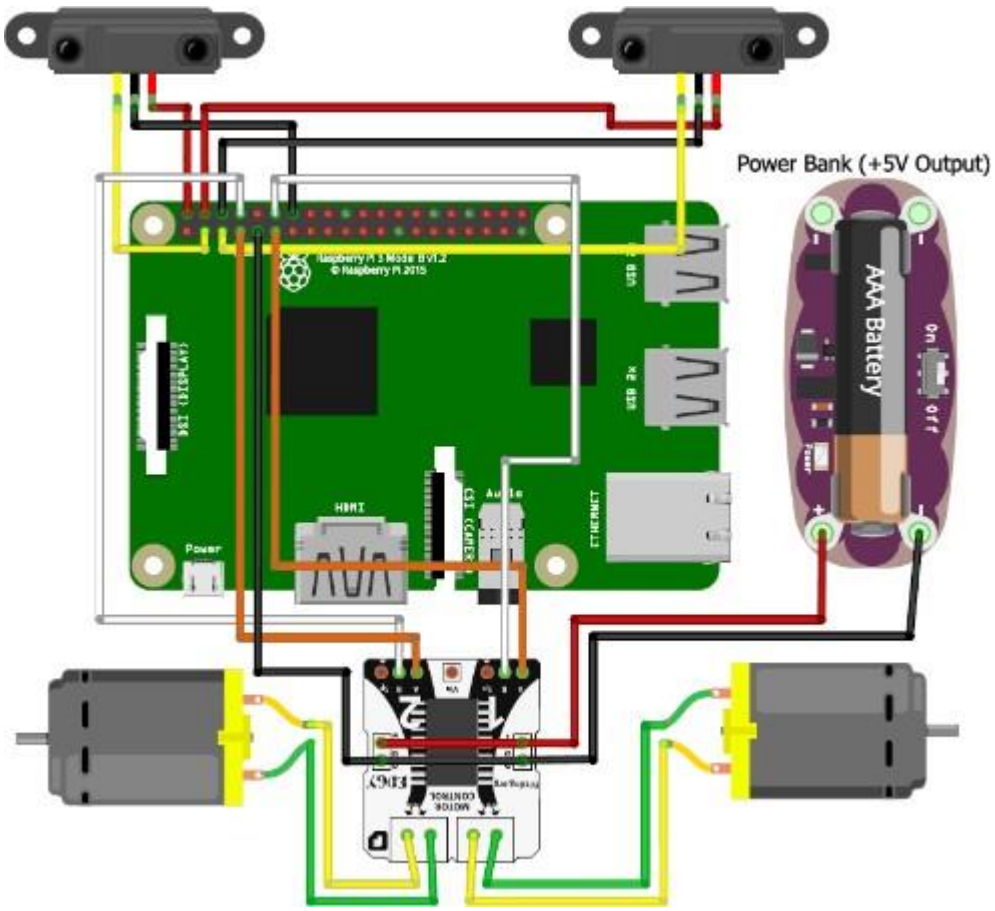


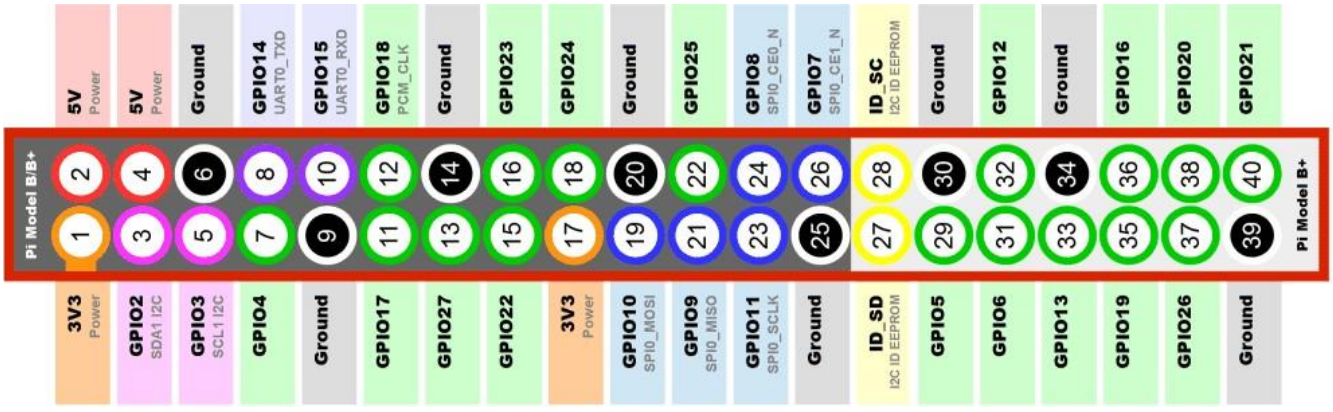
The Line Follower Robot uses three IR sensors i.e. one to detect left motion, one to detect the forward motion and one to detect right motion. The IR sensor completely absorbs the black line and reflects from the white surface. So, the IR sensors transmit light and once the light is completely absorbed by the surface, the robot moves in that particular direction. For the movement of the robot, we use four L293D motor drivers.



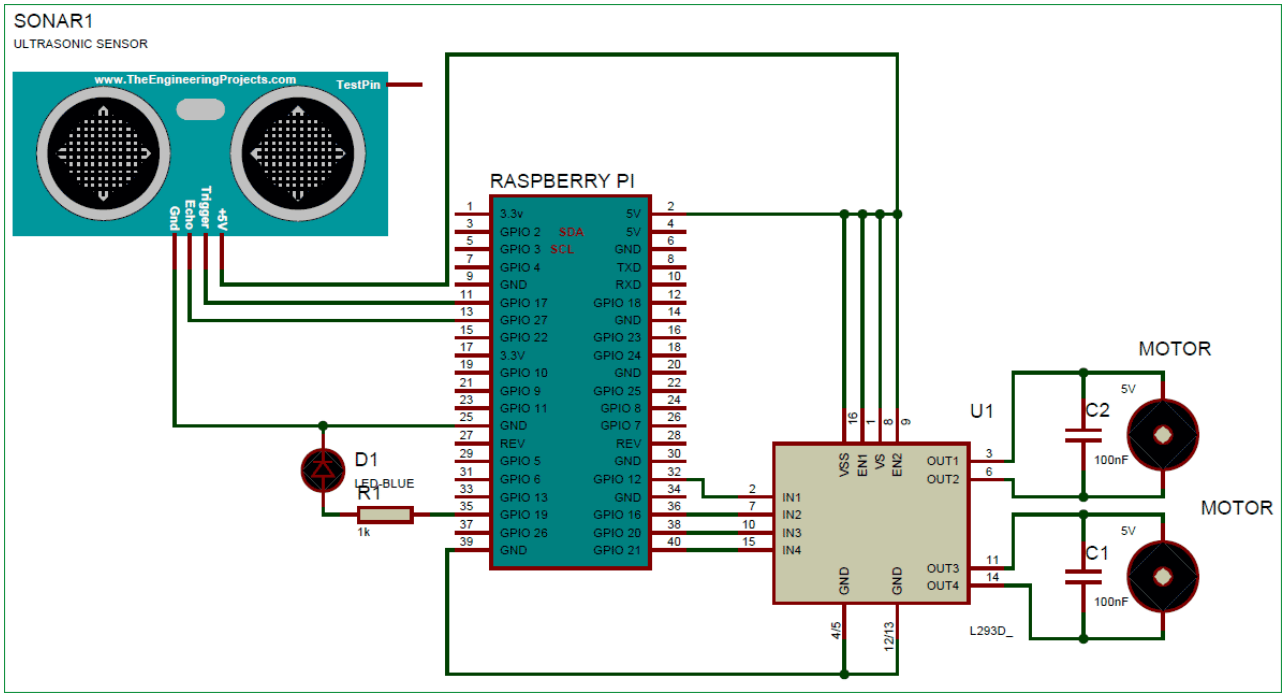
If left sensor comes on black line then the raspberry-pi instructs the robot to turn left by rotating the right wheel. If right sensor comes on black line then the PI instructs the robot to turn right by rotating the left wheel alone. If both sensors come on black line, robot stops. This way the Robot will be able to follow the line without getting outside the track.

The complete circuit diagram for this Raspberry Pi Line Follower Robot is shown below:

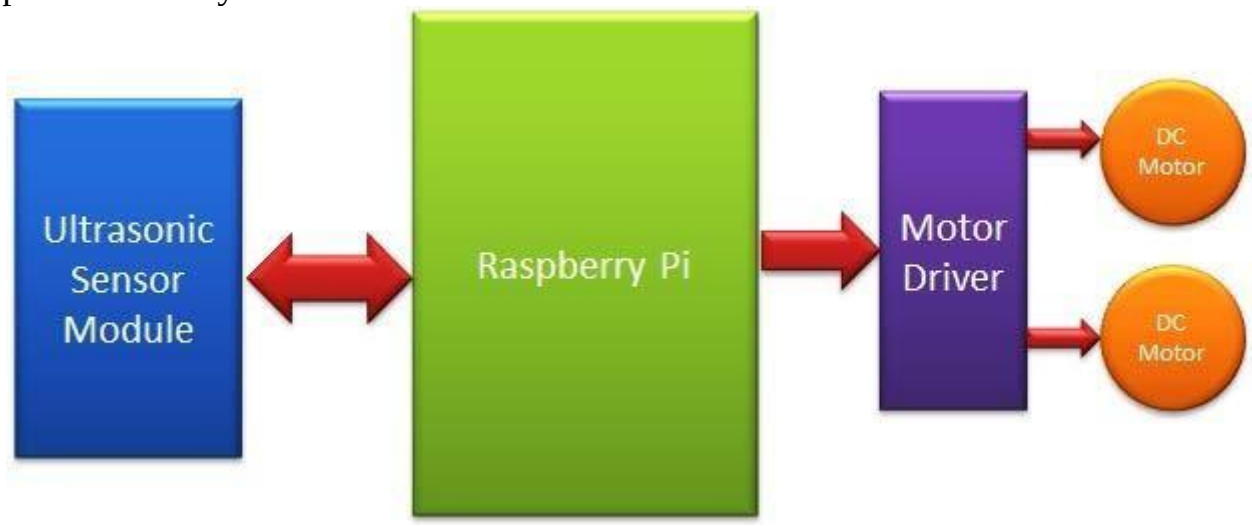

Power Bank (+5V Output)
AAA Battery
On
Off
HDMI
ETHERNET
Power


Pi Model B/B+
Pi Model B+
1 5V Power
2 5V Power
3 GPIO2 SDA1 I2C
4 GPIO3 SCL1 I2C
5 GPIO4
6 Ground
7 GPIO14 UART0_TXD
8 GPIO15 UART0_RXD
9 GPIO18 PCM_CLK
10 Ground
11 GPIO23
12 GPIO24
13 Ground
14 GPIO25
15 GPIO8 SPI0_CE0_N
16 GPIO7 SPI0_CE1_N
17 ID_SC I2C ID EEPROM
18 Ground
19 GPIO12
20 Ground
21 GPIO16
22 GPIO20
23 GPIO21
24 3V3 Power
25 GPIO10 SPI0_MOSI
26 GPIO9 SPI0_MISO
27 GPIO11 SPI0_SCLK
28 Ground
29 ID_SD I2C ID EEPROM
30 GPIO5
31 GPIO6
32 GPIO13
33 GPIO19
34 GPIO26
35 Ground
36
37
38
39
40

4.1.2 Obstacle Detection:



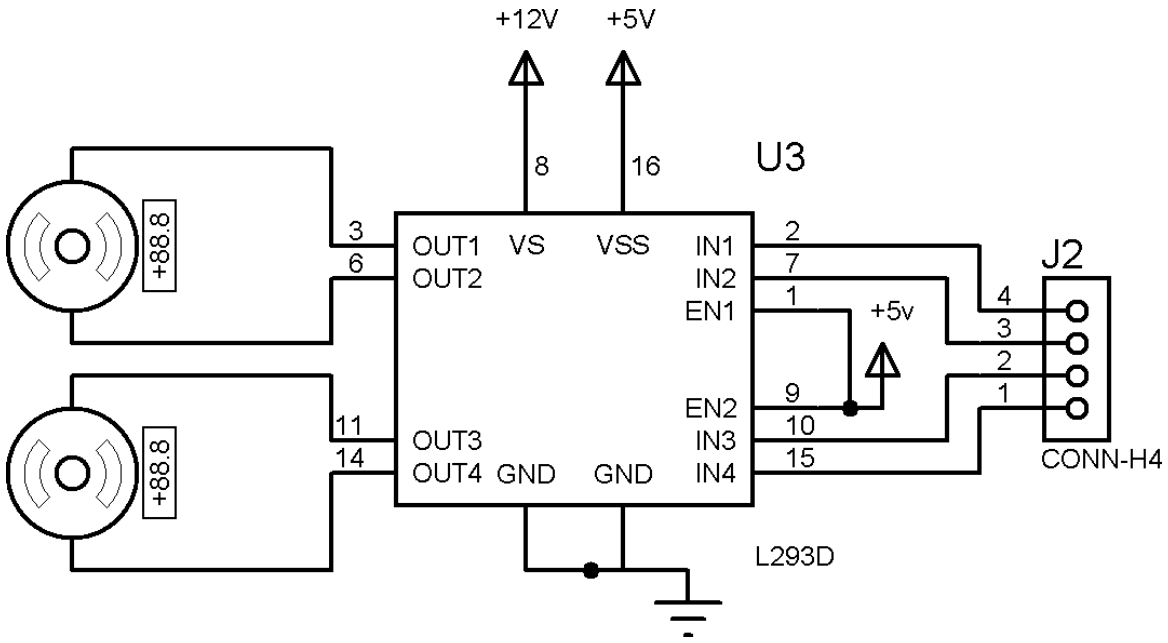
This is the second part of our project i.e. the obstacle detection. For obstacle detection we have made use of ultrasonic sensor and is placed on the front side of the robot. This sensor senses any object that is in front of the robot. If an object is detected by the sensor, the robot will stop its movement and wait for a given time period as set by the user.



Here in this project, we have selected 15cm distance for taking any decision by Raspberry Pi.

4.1.3 Robotic Arm:

For the implementation of the robotic arm we use two DC motors and chassis. The chassis are connected at the joints and the DC motors are placed at the gripper end and the shoulder end. Servo motors connections are given to the motor driver L293D and the to the GPIO pins on the raspberry pi.
The GPIO pins are programmed in a way such a way that the DC motor at the gripper end rotate in clockwise direction to open and anticlockwise direction to close the grip. The same principle is used for moving the arm up and down.

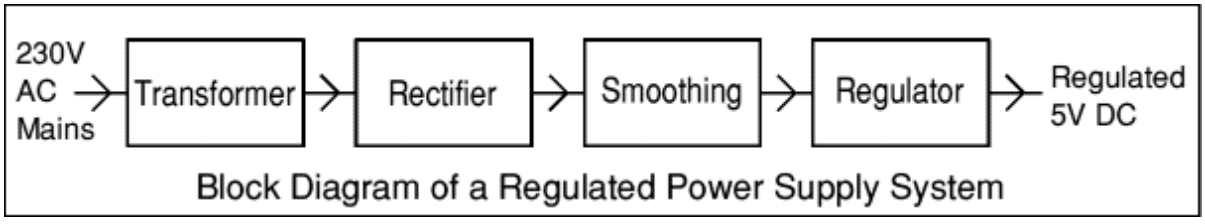


4.1.4 Home Automation System:

1. Power Supply

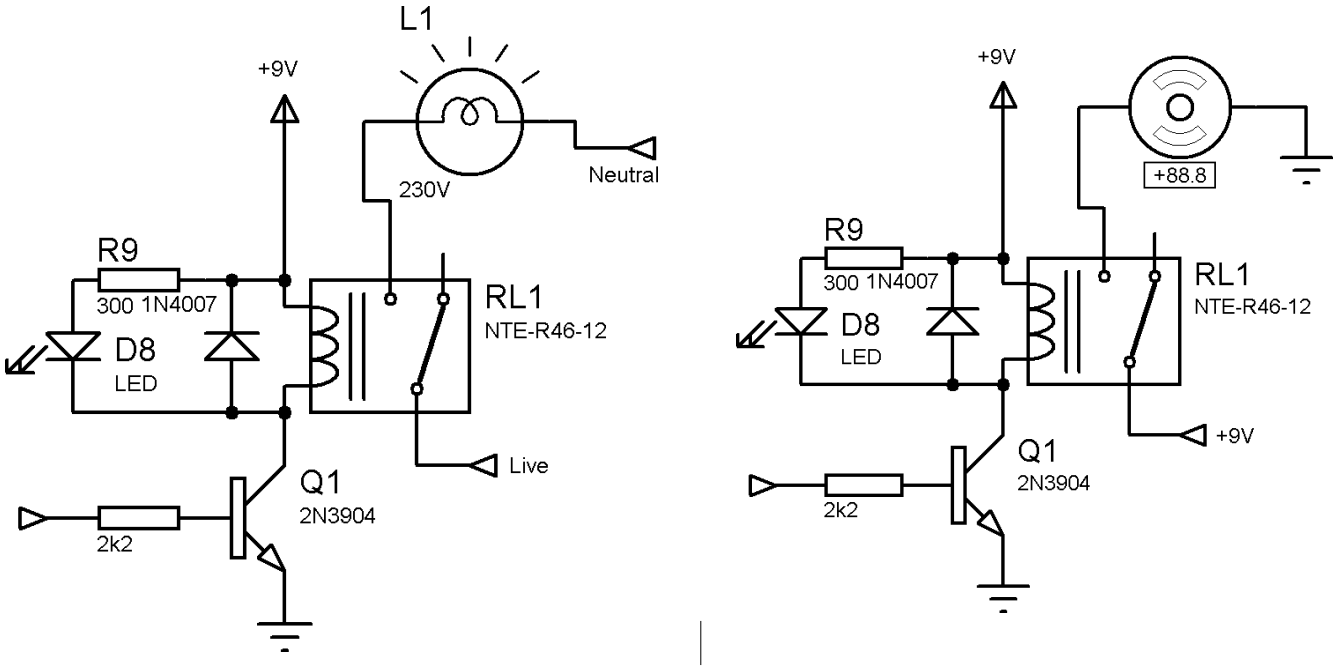
There are many types of power supply. Most are designed to convert high voltage AC mains electricity to a suitable low voltage supply for electronic circuits and other devices. A power supply can by broken down into a series of blocks, each of which performs a particular function.

For example a 5V regulated supply:



Block Diagram of a Regulated Power Supply System

2. Relays for lights and Fans:



The home automation system is implemented using an Arduino Uno. A Wi-Fi module is connected to the Arduino Uno. Two relays the control the lights and fans have also been included in the circuit. The Raspberry pi receives data from the application that converts speech to text. The application is made using android for beginners. Once the data is received it is transmitted to the raspberry pi using the Wi-Fi Module. The data received by the raspberry pi is processed and the pins are changed accordingly which provide the trigger pulse to the relay and switch it on.

5.1 Conclusion:

In this project we are aiming to make a robot that will provide assistance to the medical industry as well as in the domestic industry.

While we looked into various aspects of the robotic industry and researched on the types of robots currently being used we realized that the use of robots is very limited in the medical industry and hence we are trying to make a easy to use robot that can be of assistance to the patients that are bed ridden or immobile.

5.2 Future Scope

The work presented in the project can be extended in several directions. Here several research directions are presented which might be followed for further applications. The possible improvements that can be brought to the used method are as follows:

1. Real time imaging can be done using a camera.
2. The robot can be used for picking up objects in the floor with the help of a camera.
3. The system can be linked via internet for making video calls possible.
4. The system can be controlled using touch screen.
5. Applying intelligence to detect obstacles and change the path.
6. Incorporate a vacuum cleaner function for cleaning the room.
7. Monitoring ECG, blood pressure, temperature of patient.

References

1. Van der Loos, H.M. and D.J. Reinkensmeyer, *Rehabilitation and health care robotics*, in *Springer Handbook of Robotics*. 2008, Springer. p. 1223-1251.

2. Gombolay, M., et al. *Robotic Assistance in Coordination of Patient Care*. in*Proceedings of Robotics: Science and Systems (RSS)*. 2016.

3. Nirmal, T., *Multipurpose Robot for Patients and Military Applications.* International Journal of Electronics Communication and Computer Technology (IJECCT), 2014.

4. Chauhan, G. and P. Chaudhari, *Robotic Control using Speech Recognition and Android.* International Journal of Engineering Research and General Science, 2015. **3**(1).

5. PATEL, S.M. and S.J. PASHA, *Home automation system (HAS) using android for mobile phone.* 2015.

6. Dhawade Pooja, J., Y. Lathkar, and B. Date Purushottam, *Smart Home Using Android Application.* IJRET: International Journal of Research in Engineering and Technology, 2014. **3**(4): p. 365-367.

7. https://www.instructables.com › technology › robots

8. https://circuitdigest.com/microcontroller-projects/raspberry-pi-line-follower-robot

9. https://www.electronicshub.org/obstacle-avoiding-robot-arduino/

10. https://www.electronicshub.org/robotic-arm/

11. https://www.thoughtco.com/timeline-of-robots-1992363