



# Obstacle Avoiding Line Following Robot

## Team members

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## 02.Abstract

Robots are becoming important in various fields. This project is very useful to industries and modern technologies. Now a days technology, the industries are adopting automated robots in workplace instead of human. The purpose of this project is to design autonomously driven car which can perform path tracing and obstacle avoiding controlled by microcontroller. IR sensors track the path and ping ultrasonic sensor sense the obstacles on the line path. If there's any obstacle, the car will automatically move its position to left to right. The basic line follower robot follows the path either black or white color in inverted surface but having and obstacles in its path becomes a reasonable issue effect its utilization in workplace. The main thing is obstacle avoidance. This robot follows line detect obstacles and take necessary actions to avoid it. The Arduino uno board is control the system of this robot. Arduino uno board has six analog input pins A0 through A5. These pins can read the signal from analog sensors. Each Arduino board has its own microcontroller. The design includes two modules –line following and obstacles detection, both modules and its algorithm are implemented individually and at final both are combined in a such a way that the robot performs in specified task. The three sets of IR transmitter receiver and ultra-sonic sensors are implemented to detect its path and obstacles. Sensors and motor shields are connected to control system and power is taken from 11V battery.

## 03.Introduction

Our target is to propose a robot that avoids the obstacle which comes in its path this robot is introduced because in many of the industries we have seen that many heavy components which they have to move for one place to another place which is not possible without the help of machines. With this we got idea and we introduce the robot named as Obstacle avoidance robot using Arduino. Obstacle avoidance robot is design to allow robot to navigate in unknown environment by avoiding collisions. Obstacle avoidance is one of the most important aspects of mobile robotics. This robot senses obstacles in the path avoids it and resumes its running. We have made use of sensors to achieve this objective.

To make a line follower robot with object detection ability it is attached with an ultrasonic sensor, which is a device that can measures the distance between an object and robot by using sound waves. It calculates the distance between the line following robot and the object obstructing it by sending a sound wave of a specific frequency and detecting the bounced sound wave at receiver it is important to understand that some objects might not be detect by ultrasonic sensor. This can be applied for military purposes, delivery services, transportation systems, blind assisting applications. This robot can listen to a command received by the serial to start or stop the route. Obstacle avoidance robot can be used in mobile robot navigation system, can be used for household work like automatic vacuum cleaning and can be used in dangerous environments, where human penetration could be fatal.

The reason behind using BO motors is it consumes less power supply and can work properly on 9-volt battery. The construction of the robot circuit is easy and small. The main component behind this robot is ATmega328p microcontroller which is a brain of this robot. The idea proposed in this paper is by using machine vision to guide the robot. The field of machine vision has growing at a fast pace. Machine vision applications can be divided into four types from a technical point of view. They can be used to locate measure, inspect, and identify. The robot proposed in this paper is guided with the help of machine vision. The best part of our project is that if any obstacle is encountered by the robot the robot automatically stops.

Adding the features of obstacle avoiding robot to a traditional line follower robot prevents any damage to the robot. This intelligent robot can also be installed for health care management in hospitals, which decreases the human effort in monitoring patients and delivery things or medicines. The workers can be used for other tasks instead of transporting goods from one place to other which can be carried out with this smart and intelligent line follower robot. This is very easy and safe way to communicate with patients.

## 04.Project Overview

This is a project of robot which follow its own path and avoids the obstacles which comes in its path. This robot is introduced because; In many industries we have seen that many heavy components which they have to move for another one place to another one place which is not possible without the help of machines. Specially ; In this corona epidemic situation many inducers faced this problem. With this we got an idea to introduce a robot which is best solution for these problems. This robot can follow its own path and it is an intelligent robot because; this robot can avoid the obstacle which comes through its path, and also this robot can listen to a command received by used in dangerous environments, where human penetration could be fatal and can be used for other industrial worlds.

## 05.Individual Contribution

We are team Alfred and there are four members in our team. All the members are (B.SC Hons.) IT Undergraduates at Sri Lanka Technological Campus. Each member in our team has their own strengths and weaknesses. When learning teams are properly structured and everyone contributes 100 percent, it can be an effective way to develop skills and sharpen existing ones. In this, I will summarize the personal contribution of team members to the team project and evaluate the success or effectiveness of the team projects.

### **E.M.M.S. Ekanayaka (AA1679)**

I'm E.M.M. S Ekanayake as the team leader of our project first of all I would like to thank our project advisor Mr. Thilina Hearath. I am a responsible person for handling team members and identifying what are the areas that they skilled in for contributing to this project continuously. I organized an online meeting to divide the work and gave each member of the group a part to work on it for the project and all team members gave a very good support to successful this project.

I mainly focused on line following and obstacles avoiding Robot. I have researched about this robot for long time through the internet then I started to develop the Robot. At the first place I selected the suitable products such as; sensors, motors, cables and drivers etc. Then I assembled all the components and weld ports from the bouth to the motor driver's shield. I have gained so much of knowledge about Arduino language.

We learned so much from each other in our team. When starting the project, we did not enjoy the team concept because in some situations; not everyone gave their 100 percent of contribution for the project works. However, towards the end each team member seems to be more cohesive and working toward a common goal which is the final evaluation of our project. So, we have learned the success of any works team is dependent on each of the team member. The most important factor in our team is the mutual respect of others opinions, values and standards. The standards for each team member to follow should be patience, open-mindedness and gentleness. These standards and values are not ways of criticizing others, or judging them. All values and standards are useful in a diverse society.

## **G.A. Anuja Dewnim (AA2113)**

I'm G.A. Anuja Dewnim as the Arduino Programmer of our team. First, I researched about this robot and the Arduino programming language through Internet and books. After practice them I started to program the robot. Then I have checked whether each components are working properly.

For an example,

1. Testing whether the L293D motor driver shield can properly control the four motors.
2. Whether the ultrasonic sensor measures the distance accurately
3. The function of the IR sensors on a black and white surface.

After assembling all the components correctly and plugging them into the sensor pins correctly, I started developing the code. Here I installed the Arduino IDE before developing the code and then installed the Arduino libraries required for the project (AFMotor, NewPing). Then I started testing the part related to the line following robot and started developing the code. I also designed the block diagram for this line following and obstacle avoiding robot as well as designing the flow char and developing the algorithm.

**Nethmi Liyanage (AA1840)**

For this project I've done so many researches about obstacles avoiding and line following robot. As the member of TEAM ALFRED with all due respect I would like to thank our project advisor Mr. Thilina Herath. And I would like to thank my all team member who supports to finish this project successfully. We worked together as a team and shared the work. The group leader organized an online meeting to divide the work and gave each member of the group a part to work on it for the project. Me and my other team member who is called Nikini done the report, project proposal and the presentation. Other two looked at the technical side. Now we have knowledge about Arduino programming language which is similar to c language. And we were able to do it successfully on a very low budget. I've read so many articles about obstacles avoiding and line following robot and gained so much of knowledge about it. This was very interesting topic and we all enjoyed.

**Nikini Perera (AA1838)**

I'm prioritized the documentary side of our project because I'm good in document related activities such as writing, summarizing so our group members had to contribute individually to complete this task. Also, I have gave my contribution to Arduino Programming from my role. And also, I have researched some Arduino articles and share my ideas with my group members. In this process I was assigned to research about our project plan and share this information among the group members. And also, when our group members are trying to planning the budget I collect some details with my friend who calls Nethmi to finalized the budget plan.

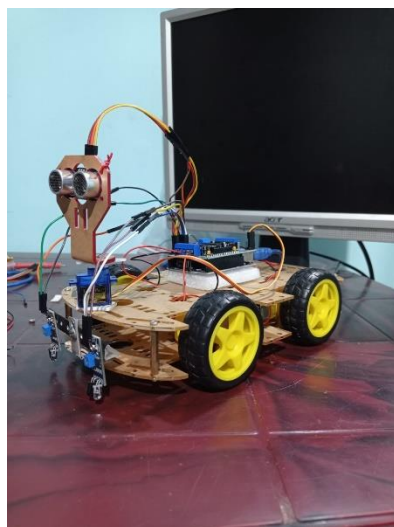


## 06.Methodologies








Basically, we used Arduino Programming Language is based on a very simple hardware programming language that is similar to the C Language. To run this program, we used Arduino IDE to control the robot. When creating our project mainly Obstacle avoidance and line following Robot is designed in order to navigate the robot in an unknown environment by avoiding collisions. Obstacle avoiding line following robot senses obstacles in the path, avoid it and resumes its running. There are some very popular methods for robot navigation but here we hope to use the line following. We are using IR sensors to detect the line and moving forward through the line. In this system, steering algorithm ensures that the robot does not have to stop in front of an obstacle during its navigation. The sonar system is used in HC-SR04/HCSR04 ultrasonic sensor to determine the distance to an object like bats do and it offers excellent non-contact range detection from about 2 cm to 400 cm or 1feet to 13 feet. The ultrasonic sensor emits short and high-frequency signals. If they detect any object, then they reflect back echo signal. It is taken as input to the sensor through the Echo pin. When an obstacle is detected while the robot going through in the direction Echo pin will give input as high to the microcontroller. And we have to calculate the time of distance from obstacles. After determining the time, it converts into a distance. If the distance of the object is short, then the speed of the robot gets reduced and will turn in a backward direction and then can go in the left or right direction. The movement of the robot will be stopped whenever there is an obstacle is present on its path which can be detected by ultrasonic sensors. Ultrasonic sensors give time in length to the microcontroller.

In here we used tools like Multimeter, Glue Gun, Electronic Bouth Soldering, Basic Electronic Tool Kit and the technologies that we used in here is Embedded system.

**Figure 01:**



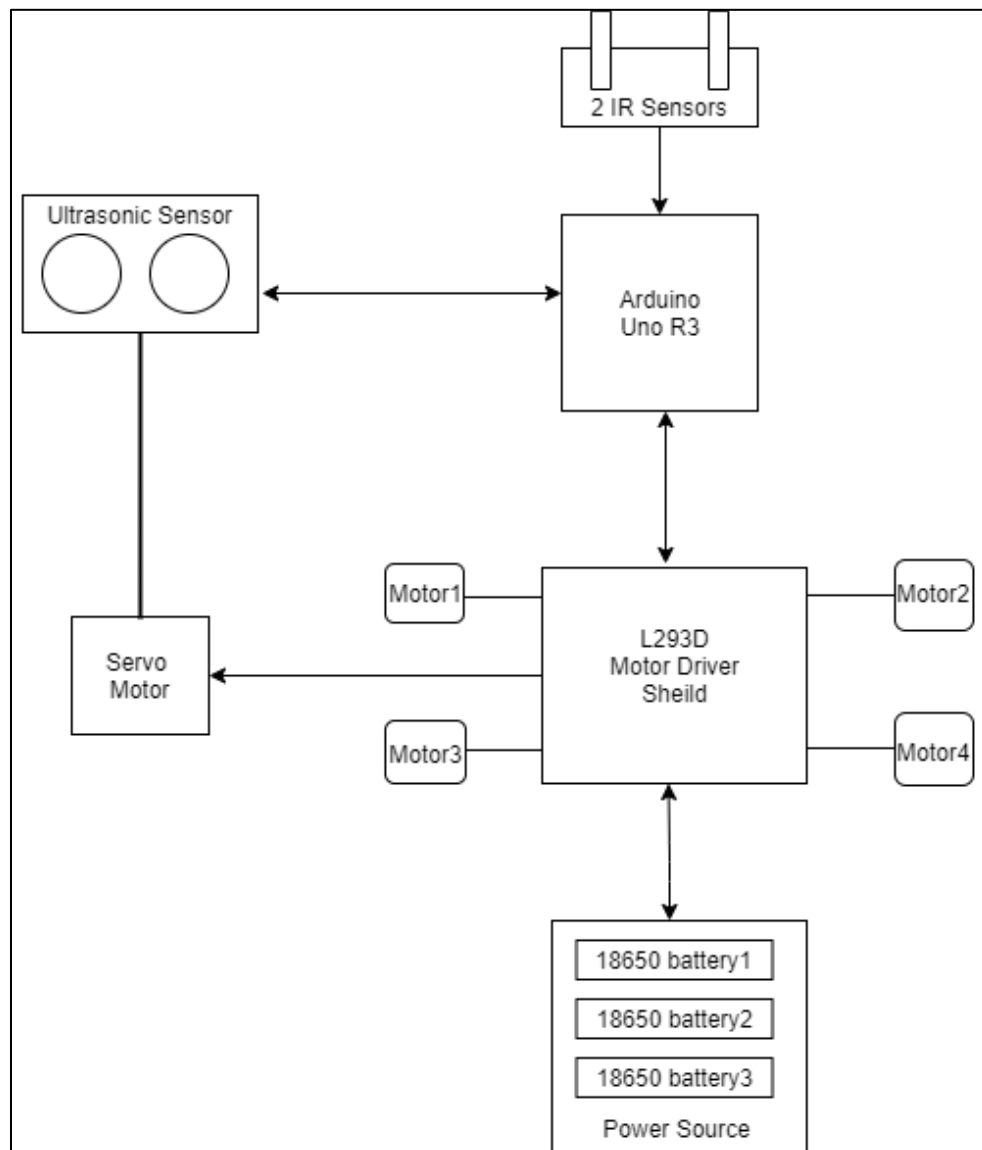
## (6.1) Components

Components	Purpose	Image
Arduino Uno	Controls the system	
IR sensors	This sensors use to detect the line	
L293D motor shield	the motor shield is a driver module for motors that allows you to use Arduino to control the working speed and direction the motor.	
Ultrasonic sensor	detect obstacles in extreme conditions.	
Battery	Provide power to the robot	
Jumper wires	Allowing them to be used to connect two points to each other without soldering. These are typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed.	
Motors and wheels	Motors are the devices which make the robot movable and wheels in robot are meant to grip the driving surface. This provides traction and allows it to move forward.	

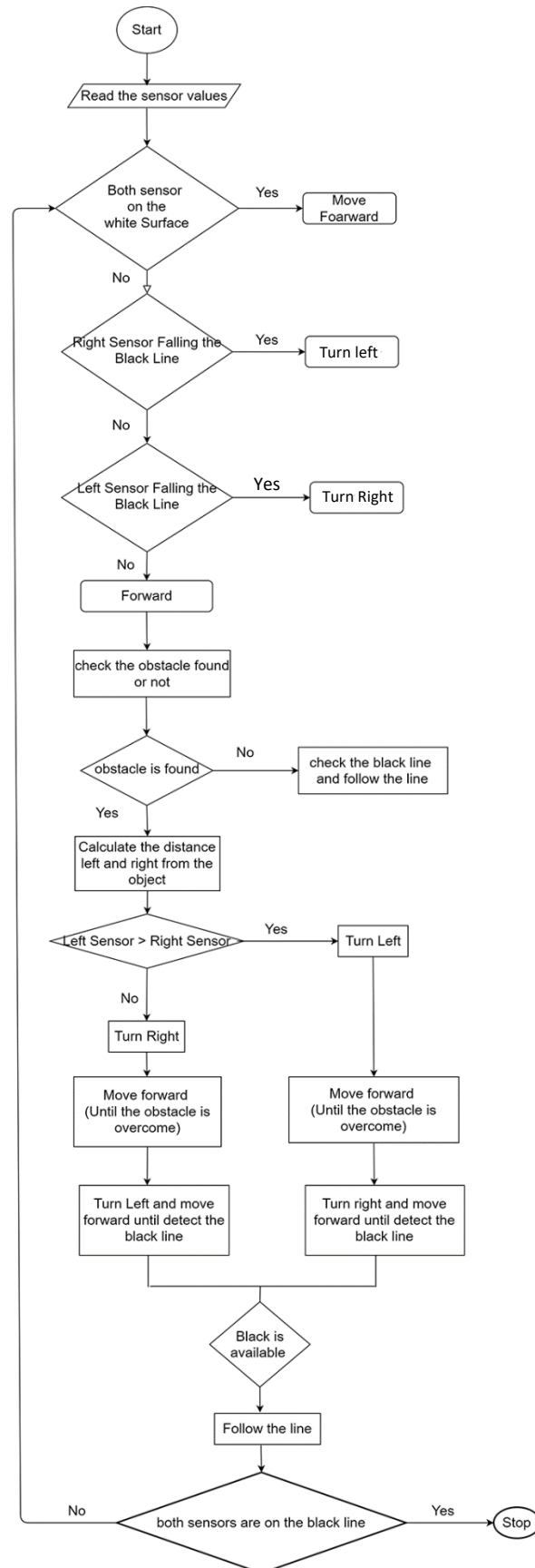
## (6.2) Block Diagram of the Robot

Here's the block diagram of the robot is shown in picture. This robot is built using Arduino uno board, 2 IR sensors, Motor Driver, servo motor, car chassis and TT gear motor with wheels. It shows that the Arduino Uno board sends a signal to the L293D Motor Shield.

four Dc Motors are connected to the motor shield. Connect the servo motor to motor driver servo1 slot and Two IR sensors and Ultrasonic Sensor are connected to the motor shield and ultrasonic sensor is mounted on the servo motor. They send signals through the motor shield to the Arduino. The power source for the motor driver shield system 3.7 X 3 battery is connected to the motor shield

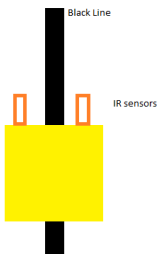


## (6.3) Flow Chart



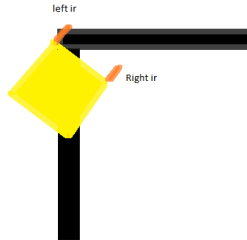
## (6.4) How it operates

01



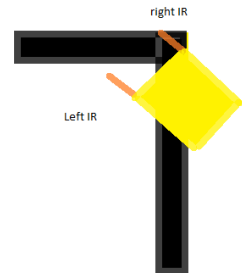
Both sensor in the white surface move forward

02



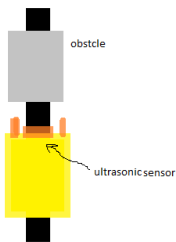
Left IR sensor detect the black line turn right

03



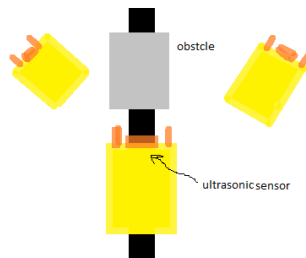
Right IR sensor detect the black line turn left

04



Obstacle is found and calculate distance of the obstacle and stop the robot then calculate distance left and right from the object

05

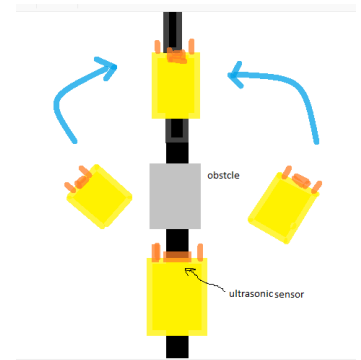


Then robot check  
Left Sensor > Right Sensor

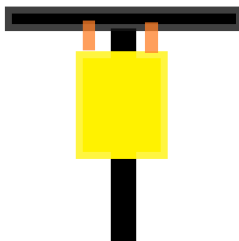
If yes, Turn Left and Move forward  
(Until the obstacle is overcome) then Turn right and move forward until detect the black line

If no, Turn Right  
Move forward  
(Until the obstacle is overcome)  
Then Turn Left and move forward until detect the black line

06



07



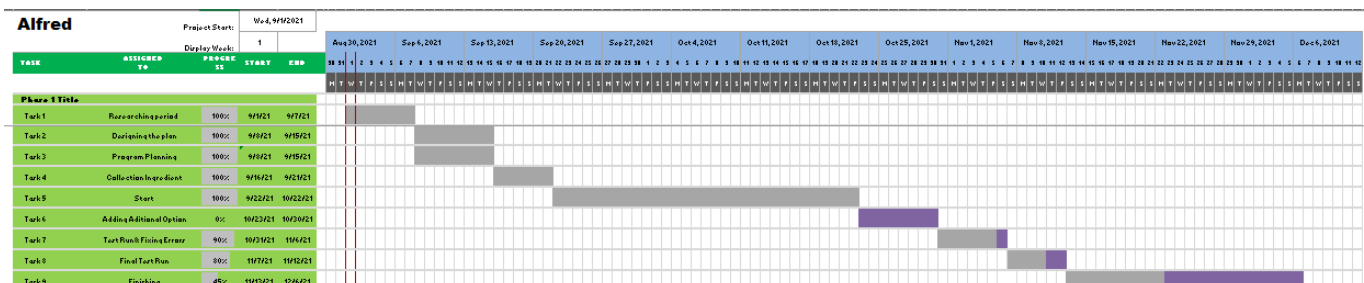
both sensors are on the black line stop the robot

## 07.Project Management

Our project name is “Line following and Obstacle avoiding Robot”. Our target is to propose a robot that avoids the obstacle which comes in its path this robot is introduced because in many of the industries we have seen that many heavy components which they have to move for one place to another place which is not possible without the help of machines. E.M.M.S. Ekanayaka is our project manager. He is doing his role well as a Project Manager. We started our project on 1<sup>st</sup> of September, 2021. And our project ends on 6<sup>th</sup> of December, 2021. Our actual budget as follows.

### (7.1) Time allocation

<b>Alfred</b>			Project Start: Wed, 9/1/2021	
			Display Week: 1	
TASK	ASSIGNED TO	PROGRESS	START	END
Phase 1 Title				
Task 1	Researching period	100%	9/1/21	9/7/21
Task 2	Designing the plan	100%	9/8/21	9/15/21
Task 3	Program Planning	100%	9/8/21	9/15/21
Task 4	Collection Ingredient	100%	9/16/21	9/21/21
Task 5	Start	100%	9/22/21	10/22/21
Task 6	Adding Additional Option	0%	10/23/21	10/30/21
Task 7	Test Run & Fixing Errors	90%	10/31/21	11/6/21
Task 8	Final Test Run	80%	11/7/21	11/12/21
Task 9	Finishing	45%	11/13/21	12/6/21



## (7.2) Budget plan

Product	Quantity	Price
Arduino UNO R3 ATMEGA328P ATMEGA16U2 with cable.	01	Rs.1,740.00
L293D Motor Driver/Servo shield	01	Rs.380.00
Micro servo SG90G Servo Motor	01	Rs.290.00
40x1 Male Header SIL	01	Rs.20.00
4WD Smart Robot Car Chassis kit	01	Rs.1,490.00
Male to Male 10cm Jumper Wire	40	Rs.140.00
Male to Female 10cm Jumper Wire	40	Rs.140.00
Female to Female 10cm Jumper Wire	30	Rs.105.00
HCSR04 Ultrasonic Sensor	01	Rs.180.00
HC-SR05 Ultrasonic Sensor Bracket	01	Rs.80.00
Mini Rocket Switch (ON/OFF)	01	Rs.15.00
IR Sensor	02	Rs.714.00
9v Rechargeable Battery	01	RS.1000.00
SUBTOTAL:	Rs.6,294.00	
SHIPPING:	Rs.280.00	
PAYMENT METHOD:	BANK TRANSFER	
<b>TOTAL:</b>	<b>6,574.00</b>	

Our actual budget is same as our budget plan in project proposal. We have not any sponsors because our cost is very low.

### (7.3) Team Management

We all know that for team projects to succeed, good team management needs to be implemented. While the practice of team management can be done solo in order to achieve the plan's purpose, it can't happen without team. The first thing that need for team management is good communication. When starting the project our team does not have good communication but after we have good communication with each other. We use our communication media as Zoom meetings and WhatsApp. Each member has good understanding and all are good listeners.



## 08.Conclusion

This project developed an obstacle avoiding robot to detect and avoid obstacles in its path. The robot is built on the Arduino platform for data processing and Arduino IDE software counterpart helped to communicate with the robot to send parameters for guiding movement. For obstacle detection, one ultrasonic distance sensors were used that provided a wider field of detection. The robot is fully autonomous and after the initial loading of the code, it requires no user intervention during its operation. When placed in unknown environment with obstacles, it moved while avoiding all obstacles with considerable accuracy. In order to optimize the movement of the robot, we have many considerations for improvement. However, most of these ideas will cost more money and time as well. But we used modern technologies to develop this product with the minimum budget allocation. IOT and embedded system are the main technologies that we used in here. Line following and obstacles avoiding car is successfully completed. Many efforts were put in into design and Implementation as well. During the project, we did lot of researches about the system. Also, now we have idea about how it works and we have knowledge about Arduino Programming Language. This project will give so much of benefits to the industry and world as well. And this can be used as household work and so many other indoor applications.

## **(8.1) Discussion**

### **(8.1.1) Applications**

Line following and obstacles avoiding robot can be applied to many situations in order to reduce labor cost. This technology can use in restaurants and the factories as well. In restaurants this robot can be applied as a waiter which carrying and serve foods to the customer's tables. This is very easy and some countries have already started using this technology. And for the factories the robot can transport goods, parcels etc. to the destination.

“Treating corona virus patients” is the biggest challenge that health care workers face these days. For this problem the best solution is using a technology without human effort. This technology is very helpful for this task. The objective of the system is to identify the patients ward, perform robot path planning for the delivery of medicines to patients, measuring the body parameters through sensors.

### **(8.1.2) Future works**

This report is all about line follows and obstacles avoiding robot. Still we are in the developing process of this project. We are hoping to add new and more features in the future. Like adding WI-FI adopter to the robot and adding Bluetooth module

## (8.2) Future Improvements & Development

This intelligent robot can also be installed for health care management in hospitals, which decreases the human effort in monitoring patients and delivery things or medicines. The workers can be used for other tasks instead of transporting goods from one place to other which can be carried out with this smart and intelligent line follower robot. This is very easy and safe way to communicate with patients. To this corona pandemic this is very helpful and safest way of communicate with patients. We hope to use this technology in ward inceptions. The ward inception robot uses the camera to obtain the information of obstacles, such as the size of obstacles and distance between the robot and obstacles. Then the robot will construct a virtual obstacle by using the information collected by the laser sensor and camera. With this system we can develop a smart hospital environment. In these days this technology is very helpful to communicate with patients because of this corona virus. “Treating corona virus patients” is the biggest challenge that health care workers face these days. For this problem the best solution is using a technology without human effort. This robot is very helpful for this task. For the particular case we can use autonomous nursing robots and autonomous doctor robots, major essential issues are effective robot path planning for the delivery of medicines to patients, measuring the body parameters through sensors. The objective of the system is to identify the patients ward, perform robot path planning for the delivery medicines to a patient, and measure the patient body parameters through the sensors.

A new controller system which consists of three ultrasonic sensors and one camera is developed to detect the patient and doctor can see the patient, patient can see the doctor through the camera. There is a voice controller system so they can talk each other through that. Voice synthesis is generated to produce response by audio to the patients for the information they would like to know (like medicines, treatment therapy etc.) The robot uses sensors to measure the patient body parameters and updates these data to the hospital patient database system in a private cloud mode. Sensors may provide extra information for face recognition systems to identify patient’s faces in both static and video sequences. Consequently, it is necessary to have a complete system for autonomous nursing robot that fully supports all the tasks. Those are the future improvements and developments in our project

## 11.References

Article title: Obstacle Avoiding Robot

Website title: Arduino Project Hub

URL: [https://create.arduino.cc/projecthub/diyprojectslab/obstacle-avoiding-robot-2a69d5?ref=part&ref\\_id=8233&offset=35](https://create.arduino.cc/projecthub/diyprojectslab/obstacle-avoiding-robot-2a69d5?ref=part&ref_id=8233&offset=35)

Article title: Arduino Uno Rev3

Website title: Arduino Online Shop

URL: <https://store.arduino.cc/usa/arduino-uno-rev3>

Article title: Before you continue to Google Search

Website title: Google.com

URL: [https://www.google.com/search?q=5v+dc+motors&rlz=1C1CHBF\\_enPK842PK842&oq=5V+DC+](https://www.google.com/search?q=5v+dc+motors&rlz=1C1CHBF_enPK842PK842&oq=5V+DC+)

Article title: HC-SR04 Ultrasonic Sensor

Website title: Components101

URL: <https://components101.com/ultrasonic-sensor-working-pinout-datasheet>

Article title: Line Follower Robot Arduino

Website title: Arduino Project Hub

URL: <https://create.arduino.cc/projecthub/robocircuits/line-follower-robot-arduino-299bae>

Website title: Instructables.com

URL: <https://www.instructables.com/Obstacle-Avoiding-Robot-Arduino-1/>

## End of the Report

