Seminar Report

On

Robot Car Voice/Bluetooth Controlled – Obstacle Avoidance

Submitted to

St. Xavier's Technical Institute, Mahim

In partial fulfilment of requirements for Diploma in

Electronics and Telecommunication Engineering

by

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has satisfactorily completed the Seminar work entitled **Robot Car Voice/Bluetooth Controlled – Obstacle Avoidance** *in partial fulfilment of requirements for Diploma in Electronics and Telecommunication Engineering as prescribed by St. Xavier's Technical Institute, Mahim, Mumbai for the academic year 2020 – 2021.*

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ABSTRACT

According to a Road Accident in India report (2019), a total of 4,49,002 road accidents of which 1,51,113 were fatal and 4,51,361 had injuries. So though this project we wanted to achieve the main objectives of Obstacle Detection and its Avoidance and through this reduce the accidents rate on the road. In this study, design and implementation of robotic car has been presented with regards to hardware, software and how using hardware and software the robotic car detects obstacle and avoid it. Arduino platform, Android Application and Bluetooth Technology has been used for the implementation of the system. It also consists of Sensors (i.e. Ultrasonic Sensor, I.R. Sensor) to achieve objectives of Obstacle Detection. The Arduino here acts as the brain of the car. The Android Application is used to send commands through Bluetooth Technology to the Arduino, the Arduino then processes the commands and give commands to the Motor Shield to drive the motors. If any obstacle is detected by the Ultrasonic Sensor or IR Sensor, the Arduino override the commands and the car stop there. [2] Thus, if we used sensors such as LIDAR, RADAR, in real life applications, the rate of accidents which is high now can come low. [1]

Key Words: Android based Devices, Robotic Car based on Arduino, Obstacle Detection, Obstacle Avoidance, Sensors.

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1. Introduction

The roots of foundation of robotics belong back in 1950s; more than six decades has passed since then, and robotic evolution has been running unparalleled. Today we can feel the presence of robots everywhere and in every field whether it is medical, military, education or governance and so on. [1] Robotics has become a helping hand for humans, and they are making our life easier, better and faster. Robotics is a boon for human kind, because robotic machines are giving alternatives, which is providing a greats support to physically impaired people. In the last decade, with the development of technology, sensors used with electronic devices have been used in many areas to facilitate life. Sensors are devices that convert energy forms into electrical energy. The sensors serve as a bridge connecting the environment and various electronic devices. The environment can be any physical environment such as military areas, airports, factories, hospitals, shopping malls, and electronic devices can be smartphones, robots, tablets, smart clocks. These devices have a wide range of applications to control, protect, image and identification in the industrial process. [2]

Today, there are hundreds of types of sensors produced by the development of technology such as heat, pressure, obstacle recognizer, human detecting. Sensors were used for lighting purposes in the past, but now they are used to make life easier. Thanks to technology in the field of electronics, incredibly fast developments are experienced. In this respect, it is possible to develop a new invention or a new application in every day and make life easier. Today, robot systems are developed with the use of artificial intelligence algorithms. The robotics field is one of them. The most important part of the robot is the perception. Perceive of the environment will be important for a robot design. For instance, it is very important to identify explosives by a robot to detect a terrorist in the military field by using sensors. A robot has to perceive some variables (like heat changes) around it, interpret it, and then decide to act accordingly. In this article, remote and autonomous controlled robotic car has been presented in terms of obstacle detection and avoidance by using sensors. The connection between the robot and the Android device has been established via Bluetooth technology.

The incoming data will be processed by Arduino Uno and according to the input value of the user, robot action can be performed. There are two main modes that control

the robotic car by Android application (mobile phone). These are user control mode and automatic mode. A menu with buttons has been seen on the screen to select the actions. These buttons will be used to move the robotic car forward, backward, right and left, stopping the car and switching to automatic mode. By selecting automatic mode, the user leaves the robot control and the robot finds its way without hitting the obstacles. The robot detects living beings that are encountered and gives warning. [3]

The robot finds its way without hitting spot and when it comes to the obstacle it perceives and stops. In this study, we carry out a novel vehicle design with real time obstacle detection and avoidance. To best of our knowledge, there is no previous study that investigates real time obstacle detection and avoidance by using Arduino Uno and Android Platform. This work is as follows, Section-1 consists of the Literature Survey, Section-2 consists of System Architecture, Section-3 consists of Technical Specification of the Robot Car, Section-4 consists of the Design and Implementation of the Car, Section-5 consists of Application, Section-6 consists of Future-scopes, Section-7 consists of Conclusion.

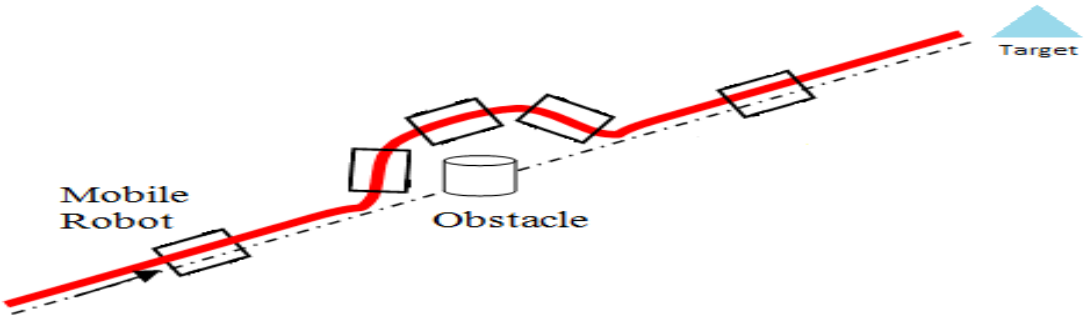

Fig. 1: Desired Mobile Robot Trajectory and Path around an obstacle.

2. Literature Survey

In this section, similar studies in the past have been explored and some of the methods and working principles used are summarized.

S. S. Pujari et al. [5] designed a Robot for the working families that could monitor children remotely and communicate with the camera. Raspberry Pi 3, camera module, Wi-Fi and Bluetooth technology used by the robot. For Raspberry Pi, the heart was defined as the Robot and used the Python language to code it.

M. R. Mishi et al. [6] designed a robotic car. Arduino Uno and Raspberry Pi were used together to control robot in this project. GPS was also used to trace the car and the

distances between the obstacle and the path are measured. The data in the cloud was used without having to be online. Thus, the multimotion system was controlled.

D. Chakraborty et al. [7] designed and developed a robotic car using sensors and Bluetooth technology. They had established communication between smart device and the robot. Thanks to the phone camera, they had observed the living beings. The obstacles in the opposite direction were prevented from colliding with the ultrasonic ranging sensor. Images recorded with the camera were recorded in the database and analysed.

S. J. Lee et al. [8] designed an autonomous robotic car used Arduino Uno R3 for robot's brain. Also, Bluetooth module and the ultrasonic sensor had been used in this paper. The robot scanning the placed QR codes could move along the road in autonomous form thanks to the QR codes. It also provided voice communication with the Android device in the Text-to-speech feature. It also moved with the help of an ultrasonic sensor without hitting the objects around it. In this view, range information was collected. In order for the motion of the robot to be smooth, the deviation was minimized by the PID algorithm.

E. Amareswar et al. [9] designed a robot used for the military area. Thanks to the metal detector, the robot played an important role in the detection of explosives, and the surroundings could be viewed thanks to the camera of the used Android device. This robot system consisted of Android device, Bluetooth module, a microcontroller (Arduino Uno), DC motors, motor driver, wireless camera and metal detector.

In this study, real time obstacle detection and avoidance with remote and autonomous controlled robotic car based on Arduino has been carried out by using Android application.

3. Block Diagram

Proposed work is to control the vehicle through voice and joystick and if any obstacles are detected by the sensors in its way with automatic braking system, the car will come to a halt. It can be divided into three main procedures given as follows: (a) Input of the voice and joystick command through android app. (b) Detection of Obstacle by the vehicle. (c) Automatic braking system. [2]

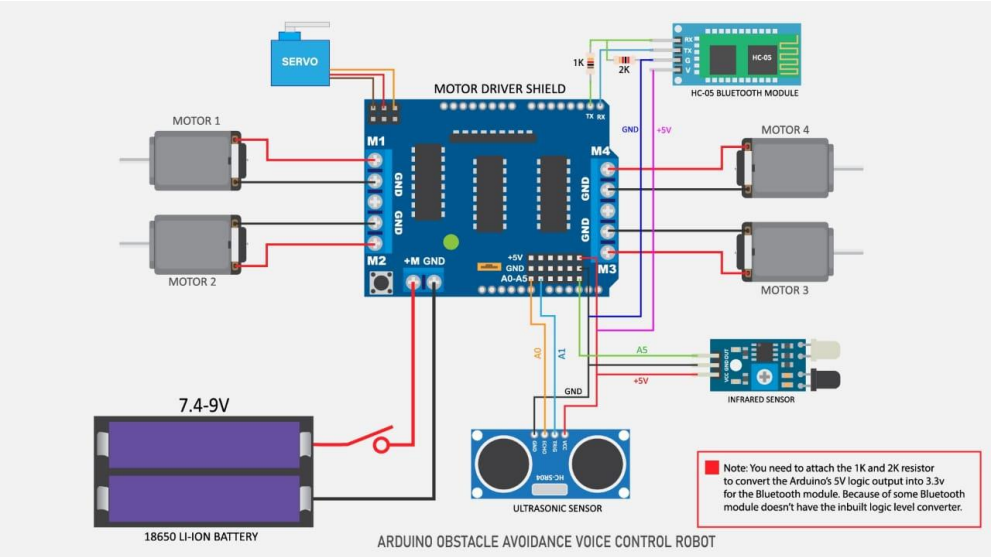

Fig. 2: Block Diagram of Project

(a) Arduino Uno R3:

Arduino Uno R3 Connections in the Project
The Arduino Uno R3 is mounted on the Arduino Motor Shield and in the process we connect all the pins of the Arduino Uno R3 to the Arduino Motor Driver Shield.

Arduino Uno is the robot's brain. Arduino Uno uses the ATmega328 microprocessor. Arduino has 14 pins. The most popular Arduino card is the Arduino UNO model shown in Figure. It can be easily programmed with Arduino libraries. Easily programmable is the biggest advantage of other microprocessors. [1] Programming in the Arduino Uno is carried out specifically in the integrated development environment (IDE). The programming language is selected as Embedded C language. Using signals from sensors, it helps to design robots and systems that affect the environment.

Fig. 3: Arduino Uno R3

(b)HC – 05 Bluetooth Module:

HC – 05 Bluetooth Module Connections in the Project	
1.	The Rx Pin of Bluetooth Module is connected to the Tx Pin of Arduino Motor shield which is connected to the Arduino.
2.	The Tx Pin of Bluetooth Module is connected to the Rx Pin of Arduino Motor shield which is connected to the Arduino.
3.	The GND Pin of Bluetooth Module is connected to the GND Pin of Arduino Motor shield which is connected to the Arduino.
4.	The Vcc Pin of Bluetooth Module is connected to the +5V Pin of Arduino Motor shield which is connected to the Arduino.
We attach the 1K and 2K resistor to convert the Arduino's 5V logic output into 3.3V for the Bluetooth module. Because in some Bluetooth Module doesn't have the inbuilt logic level converter.	

The HC-05 Bluetooth module shown in Figure. Provides communication between the devices at a short distance of approximately 10 to 20 meters. Communicates with Arduino via Serial Communication (USART). The Bluetooth module can only respond to incoming connection requests, so it can not send a connection request to another Bluetooth module. The Bluetooth module has a total of 4 pins. These are VCC, GND, Rx, and Tx. VCC and GND are supplied by Arduino for use in the Bluetooth module. Arduino's Tx pin must be plugged into the Rx part of the Bluetooth module so that commands from the Arduino can be detected by the Bluetooth module. Messages from Bluetooth need to be plugged into the Tx pin of the Arduino's Rx pin Bluetooth module in order to access Arduino. A password is required to connect to the Android device via Bluetooth module. [2]

Fig. 4: HC – 05 Bluetooth Module

(c) Arduino Motor Shield:

Arduino Motor Shield Connections in the Project
The Arduino Uno R3 is mounted on the Arduino Motor Shield and in the process we connect all the pins of the Arduino Uno R3 to the Arduino Motor Driver Shield.

Arduino Motor Shield is a motor driver card using L298. This shield is also designed to provide speed and direction control for DC Motor drive and to measure their current. [4]

Fig. 5: Arduino Motor Shield

(d) DC Gear Motor:

DC Gear Motor Connections in the Project	
1.	The MOTOR 1 Positive Terminal is connected to the M1 Terminal and the MOTOR 1 Negative Terminal is connected to the GND Terminal of the Arduino Motor Driver Shield.
2.	The MOTOR 2 Positive Terminal is connected to the M2 Terminal and the MOTOR 2 Negative Terminal is connected to the GND Terminal of the Arduino Motor Driver Shield.
3.	The MOTOR 3 Positive Terminal is connected to the M3 Terminal and the MOTOR 3 Negative Terminal is connected to the GND Terminal of the Arduino Motor Driver Shield.

4.	The MOTOR 4 Positive Terminal is connected to the M4 Terminal and the MOTOR 4 Negative Terminal is connected to the GND Terminal of the Arduino Motor Driver Shield.

Direct current (DC) motor converts electrical energy into mechanical energy using direct current. DC motor is an electric machine that works with the principle of "A current carrying conductor is exposed to humid when it enters a magnetic field". The main components of DC motors are consisting of 6 pieces. These are coils, magnets, rotors, brush, stator and direct current source.[6]

Fig. 6: DC Gear Motor

(e) Ultrasonic Sensor HC – SR04:

Ultrasonic Sensor HC – SR04 Connections in the Project	
1.	The GND Pin of Ultrasonic Sensor is connected to the GND Pin of Arduino Motor shield which is connected to the Arduino.
2.	The ECHO Pin of Ultrasonic Sensor is connected to the A0 Pin of Arduino Motor shield which is connected to the Arduino.
3.	The TRIG Pin of Ultrasonic Sensor is connected to the A1 Pin of Arduino Motor shield which is connected to the Arduino.
4.	The Vcc Pin of Ultrasonic Sensor is connected to the +5V Pin of Arduino Motor shield which is connected to the Arduino.

HC-SR04 ultrasonic sensor uses Sonar (Sound Navigation and Variable) to calculate the distance to the object. Using sonar, the distance between robot and obstacle are measured. It makes the best measurement between 2- 400 cm. Ultrasonic

sound waves have frequencies between 20 kHz and 500 kHz. Ultrasonic sensors are sensors that emit ultrasonic sound waves and can determine the distance between them by calculating the time it takes for them to strike the obstacles.

The sensing range of ultrasonic sensors can reach up to 30 meters under appropriate conditions. Ultrasonic sensors have two transducers. One of them is an ultrasonic speaker and the other is an ultrasonic microphone.

With the electronic circuit, the time between the propagation of the sound wave from the ultrasonic loudspeaker and the detection of this sound wave by the obstacle and the reflection by the ultrasonic microphone is measured and the distance between the obstacle and the ultrasonic sensor is calculated as a result of dividing this time by the sound speed. [8]

Fig. 7: Ultrasonic Sensor HC – SR04

(f) IR Sensor:

IR Sensor Connections in the Project	
1.	The OUT Pin of Infrared Sensor is connected to the A5 Pin of Arduino Motor shield which is connected to the Arduino.
2.	The GND Pin of Infrared Sensor is connected to the GND Pin of Arduino Motor shield which is connected to the Arduino.
3.	The Vcc Pin of Infrared Sensor is connected to the +5V Pin of Arduino Motor shield which is connected to the Arduino.

Active infrared sensors both emit and detect infrared radiation. Active IR sensors have two parts: a light emitting diode (LED) and a receiver. When an object comes close to the sensor, the infrared light from the LED reflects off of the object and is

detected by the receiver. An infrared sensor (IR sensor) is a radiation-sensitive optoelectronic component with a spectral sensitivity in the infrared wavelength range 780 nm … 50 μm. IR sensors are now widely used in motion detectors. [6]

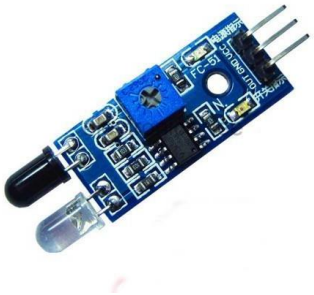

Fig. 8: Infrared Sensor

(g) SG – 90 Servo Motor:

SG – 90 Servo Motor Connections in the Project	
1.	The Control Pin of Servo Motor is connected to the S Pin of Arduino Motor shield which is connected to the Arduino.
2.	The GND Pin of Servo Motor is connected to the GND Pin of Arduino Motor shield which is connected to the Arduino.
3.	The Vcc Pin of Infrared Sensor is connected to the + Pin of Arduino Motor shield which is connected to the Arduino.

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors. Servomotors are not a specific class of motor, although the term servomotor is often used to refer to a motor suitable for use in a closed-loop control system. If the motor as a controlled device, associated with servomechanism is DC Motor, then it is commonly known as a DC Servo Motor. If AC operates the controlled motor, it is known as a AC Servo Motor. Servos are also used in – line manufacturing, where high repetition yet precise work is necessary. Servomotors are used in applications such as robotics, CNC machinery or automated manufacturing, elevator. [5]

Fig. 9: SG – 90 Servo Motor

(h) 18650 Li – Ion Batteries:

18650 Li – Ion Batteries Connections in the Project	
1.	The Positive Terminal of the Battery is connected to the +M Terminal of Power Supply of Arduino Motor shield which is connected to the Arduino.
2.	The Negative Terminal of the Battery is connected to the GND Terminal of Power Supply of Arduino Motor shield which is connected to the Arduino.

A lithium-ion battery or Li-ion battery is a type of rechargeable battery. Lithium-ion batteries are commonly used for portable electronics and electric vehicles and are growing in popularity for military and aerospace applications. The 18650 cell has voltage of 3.7v and has between 1800mAh and 3500mAh (milli-amp-hours). 18650s may have a voltage range between 2.5 volts and 4.2 volts, or a charging voltage of 4.2 volts, but the nominal voltage of a standard 18650 is 3.7 volts. [4]

Fig. 10: 18650 Li – Ion Batteries

4. Flow of the Project

The controller (Mobile Phone) sends signal through the Bluetooth Technology to the Bluetooth Module which received it. The Bluetooth Module forwards the data received to the Arduino. The Arduino processes the input and then give the desired output. If the user sends a signal of Right through the Mobile Phone the Arduino processes this input and the Servo Motor on which the Ultrasonic sensor is mounted will turn 90 degrees left and the Robotic Car will turn right and if the signal send is Left through the Mobile Phone the Arduino processes this input and the Servo Motor on which the Ultrasonic Sensor is mounted will turn 90 degrees right and the Robotic Car will turn Left. And if the user sends a Forward or Backward signal the Robotic Car will move forwards or backwards respective to the input signal. The Ultrasonic Sensor is mounted on the front of the Robotic Car and the Infrared Sensor is mounted on the back of the Robotic Car. If these sensors find any obstacles in the way they send their signal to the Arduino and if at that moment the users send another signal through the Mobile Phone, it overrides the signal and the car comes to a stop. Also if no signal is send at that moment the car will comes to a stop. Thus, the main Objectives of Obstacles Avoidance and Detection is achieved.

Position of the Motors to achieved the Desired Direction	
Desired Direction	Position of the Motors
Forward	Motor 1: Forward
	Motor 2: Forward
	Motor 3: Forward
	Motor 4: Forward
Backward	Motor 1: Backward
	Motor 2: Backward
	Motor 3: Backward
	Motor 4: Backward
Right	Motor 1: Backward
	Motor 2: Backward
	Motor 3: Forward
	Motor 4: Forward

Left	Motor 1: Forward
	Motor 2: Forward
	Motor 3: Backward
	Motor 4: Backward

We have used the “Arduino Bluetooth Controller” App created by “SA Tech”, by using this app we give commands to the Robotic Car. We have used the two modes that are there in the app.

(a) Joystick Mode

In this mode, we control the Robotic Car by Joystick that is displayed on the screen in the app.

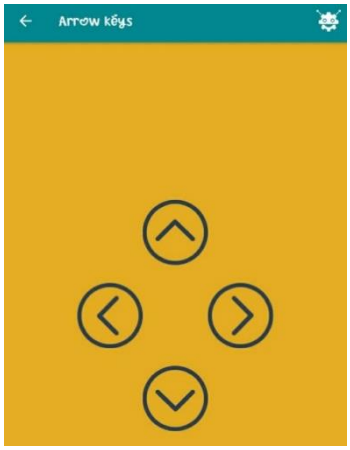

Fig. 11: Joystick Mode

(b) Voice Mode

In this mode, we control the Robotic Car by Voice, for e.g.: If we say “move forward”, the car will move forward.

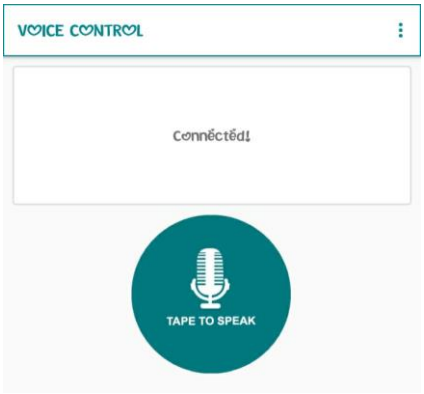

Fig. 12: Voice Mode

5. Work Done So Far

Date	Work Done
14th August	Discussion of what Project to select.
19th August	We decided the topics of the Project and created the Synopsis.
12th September	We got the Project Guide (Mr. Rakeshkumar Saroj).
24th September	We found out various research papers on our Project Topic.
30th October	We found out which components we are going to use for our project and learnt the basic of the components and learnt its working simple.
7th November	We decided the budget of the project.
10th December	We purchased the components required for the project.
11th December	We check whether the components are in working condition.
13th December	We made our self – made Chassis for the Robotic Car.

Fig. 13: Self – made Chassis of the Robotic Car

15th December	We assembled the 4 DC Gear Motors along with wheels, Arduino Uno R3, Arduino Motor Shield on the chassis.
25th December	We made the holder for the Ultrasonic Sensor.

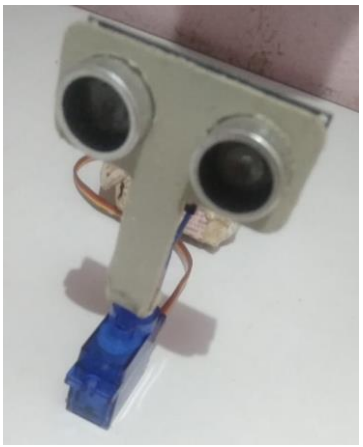

Fig. 14: Self – made Holder for Ultrasonic Sensor

30th December	We were told to make a PPT Presentation related through the project.
2nd January	We completed the connections of the Project
16th January	We presented our PPT Presentation to our Project Guide and the External Examiner.
19th March	We took the help of the Project Guide to make our Project Report and we discuss among ourselves about which topics each should do.
8th May	We started the coding of our project.
8th June	We created a Technical Paper for Our Project.
10th June	We took part in our college "NEXTECH" event.

12th June	We completed the coding of our project.
16th June	Our Project was Ready.
18th June	We completed our Project Report
25th June	We presented our Project to our Project Guide and External Examiner.

Fig. 15: Robot Car Voice/Bluetooth Controlled – Obstacle Avoidance

6. Conclusion & Future

In this Project we are developing a model of a car that can be controlled by using the Voice Mode and Control Mode. According to a survey in 2015, about 1.5 lakhs peoples are killed in road accidents and about 5 lakhs are injured. So through this project we want to make a model of a car which has auto detection/avoidance features which will help to minimize the accidents on roads. [2] In this Project by taking input from the Android Application, the basic movements of the robot are provided. Communication between the robot and application is made by the HC05 Bluetooth Module. The Ultrasonic Sensor HC-SR04 and IR Sensor is used to prevent the robots from crashing.

Voice and Bluetooth controlled robot are undeniable going to be a future market for many industrial application and domestic purposes related to automation in daily activities.

Recognition system in order to increase accuracy and more gesture methods. The improvement can be achieved by adding sensors on the left and right side of the robot.

We can also add wireless camera in this Robot to provide the necessary data from the surrounding environment.

Also GPS (Global Position system) can be added to the proposed automated system by the help of which its location can be tracked. This Robot use as a firefighting robot by adding temperature sensor, water tank and making some changes in programing then you can use as a firefighting robot. [2]

In future this project also be made a fully automated humanoid robot which can be used to detect the enemies in war field and shoot them down this way many military soldiers can save their lives. [3]

Fig. 16: Fire – Fighting Robot

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