Multifunctional Robot using Arduino and Wi-Fi shield

B.E. Project Report-A

Submitted in partial fulfillment of the requirements

For the degree of

Bachelor of Engineering

(Electronics Engineering)

by

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is a bonafide work done by

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and is submitted in the partial fulfillment of the requirement for the degree of

Bachelor of Engineering

(Electronics Engineering)

to the

University of Mumbai.

Examiner 1	Examiner 2	Supervisor
Project Coordinator	Head of Department	Principal

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Abstract

The purpose of this project is to develop a multifunctional robot using arduino and wifi-shield. It is basically a helper bot which could be used at different places such as hospitals, mines, household chores. The functions of this robot are to pick and place material used by patients in hospital and dispose the used materials which can spread germs or bacteria of diseases, this can disposes tissues syringe, needles etc. It can also be used for surveillance since it will also have a camera. One can use this robot for patients under observation, to keep record of their activities. This robot is equipped with hardware and software. This robot can be controlled by using the remote controller and also using computer program. The main objective of this project is to develop a prototype a multifunctional robot robot that can be used as a teaching method to deliver a better understanding of basic function, operation and programming of a robot. The application of this project is also can be used in other related field such as industry, mining, medical, military and so on. This project was successfully developed and tested and the hardware and the software could be integrated and working well without error.

Keywords: Wi-Fi shield,sensors,Arduino IDE,IP Webcam,Multi-functional robot.

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Abbreviations

IC	Integrated Circuit
PCB	Printed circuit board
Tx	Transmitter pin
Rx	Receiver pin
IEEE	Institute of Electrical and Electronic Engineers
PLC	Programmable Logic Controller
PWM	Pulse Width Modulation
FTDI	Future Technology Devices International

Chapter 1

Introduction

Robots these days are reducing human efforts and enhancing the lifestyles,they can be used in dangerous or remote conditions. Basically, the multifunctional robot can be controlled manually and automatically. The robot will initially provide a remote control and control of movement of bot and also the other functions included in it. Next, the purpose of this robot is to pick up object from one place to another and also to move back and forth. We can mainly use it in hospitals where the things used by patients (tissues, syringes, needles) can cause the spread of contagious diseases, hence we can use this robot to dispose such materials without the damage of getting infected by the bacteria and viruses. This robot will have some utilitarian features such as camera, Wi-Fi control, movable parts so that it will be able to lift objects etc. The hardware and software which is been used is definitely a user-friendly programmed that will connect through robot. Motors will be used to move the bot . The camera used will be a part of surveillance and will be controlled by Wi-Fi shield. Some extra features such as metal detection will be used for mining industry and military purposes.

1.1 Motivation

In this project titled as "Multifunctional Robot using Arduino and Wi-Fi shield we are planning to make a robot which will reduce human efforts. This project is based on Arduino and can be used in various situations. The design of the robot is kept simple so that it can be accessed by every individual with using a remote controlled.The camera used in this robot can be used to record videos which can be seen on the mobile phones or laptops using the IP Webcam Application. The multifunctional robot can also be able to pick and place objects as well as it can avoid obstacles with the help of sensors

1.2 Objectives of the project

For this project objectives are ,

1. To develop a robot which will be useful for medical purposes such as disposal of infectious materials used by patients in hospital for example tissues, syringes, needles etc.

2. To design a multifunctional robot with Wi-Fi shield which can operate a surveillance camera , which will be further used for observing patients in hospitals and also for

military and industrial uses.

3. To design a robot with the abilities of metal detection using metal detector sensors.

4. To build both robot hardware and software system that could be integrated to support the application system of multifunctional robot.

5. Doing the theories and practical researches to develop the multifunctional robot and to generate the report on it.

1.3 Problem Definition

Robots have become important over a wide range of application from manufacturing,surgery, handling of hazardous materials.Consequently it is important to know how they work and what problems exist in designing a real robot. In the hospitals the things used by the patients can cause the spread of disease germs or bacterial infections, these objects can be picked and disposed by the multifunctional robot. Metal detection module can detect any kind of threat thus can be used in military applications.It can also be used in house-hold chores, basically it will reduce human efforts.

1.4 Organisation of Report

report is organised as follows:

- Chapter 2 includes the literature survey
- Chapter 3 includes the hardware implementation
- chapter 4 discusses the software implementation
- chapter 5 shows the result of the proposed design method
- chapter 6 focuses on conclusion,chapter 7 is work plan.

Chapter 2

Literature Survey

PLC (Programmable Logic Controller) has been and still is the basic component of the industrial automation world. Industrial application made the PLC systems being very expensive, both to buy and repair, and also because of the highly specific skills requested to software designers to extract the maximum potentials from controllers.

Arduino is a kind of universal open source programmable controller, although it is only the core and in any case it has been built for general applications; with a little of external hardware; essentially interfaces capable of transferring signals from sensors and to actuators, reducing the EMI which may damage the microcontroller and an appropriate software may, however, become something very similar to a PLC. Since for a long time PLCs earned a trust and reliability of industy due to its ruggedness and performance but its programming softwares makes it costlier.
Now a days, some of manufacturers avail low cost PLC units but they charged high for its softwares. Arduino has the core of Atmega microcontroller which makes it a strong competitor of PLCs. As open source electronics development becomes a hot topic now a days, it is recommended to find out effective innovative solutions in place of traditional methods.

In this project titled as "Multifunctional Robot using Arduino and Wi-Fi shield we are planning to make a robot which will reduce human efforts. This project is based on Arduino and can be used in various situations. The design of the robot is kept simple so that it can be accessed by every individual with using a remote controlled.The camera used in this robot can be used to record videos which can be seen on the mobile phones or laptops using the IP Webcam Application. The multifunctional robot can also be able to pick and place objects as well as it can avoid obstacles with the help of sensors

In recent years, wireless technology has given rise to a large number of available mobile tools and their emerging applications are becoming more and more sophisticated by years. Therefore, many mobile robot platforms use wireless technology to communicate with off-line computing resources, human machine interfaces or others robots. Many mobile robots have equipped with wireless technology such as Bluetooth,Wi-Fi, Wireless LAN etc.
Currently, more than 100 million anti-personnel mines are under the ground all over the world. These mines not only disturb the economic development of mine-buried nations, but also injure or kill more than 2000 people a month. As a result, the removal of landmines has become a global emergency.

The current method of removing mines manually is costly and dangerous. Moreover, removal of all mines by this method would require several hundred years (it would takes one thousand according to a CMAC report based on Cambodian Mine Action Center Current Activities 1998), during which time, more mines might be buried in war zones.

It is basically a helper bot which could be used at different places such as hospitals, mines, household chores. The functions of this robot are to pick and place material used by patients in hospital and dispose the used materials which can spread germs or bacteria of diseases, this can disposes tissues syringe, needles etc. It can also be used for surveillance since it will also have a camera. One can use this robot for patients under observation, to keep record of their activities. This robot is equipped with hardware and software.

This robot can be controlled by using the remote controller and also using computer program. The main objective of this project is to develop a prototype a multifunctional robot robot that can be used as a teaching method to deliver a better understanding of basic function, operation and programming of a robot. The application of this project is also can be used in other related field such as industry, mining, medical, military and so on

Chapter 3

Hardware Implementation

Components used in this project are as follows:

3.1 Arduino UNO Board

Arduino/Genuino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your UNO without worring too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

The Arduino/Genuino Uno board can be powered via the USB connection or with an external power supply. The power source is selected automatically.
External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the GND and Vin pin headers of the POWER connector.
The board can operate on an external supply from 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may become unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

The power pins are as follows:
Vin-The input voltage to the Arduino/Genuino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source).

5V-This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V).

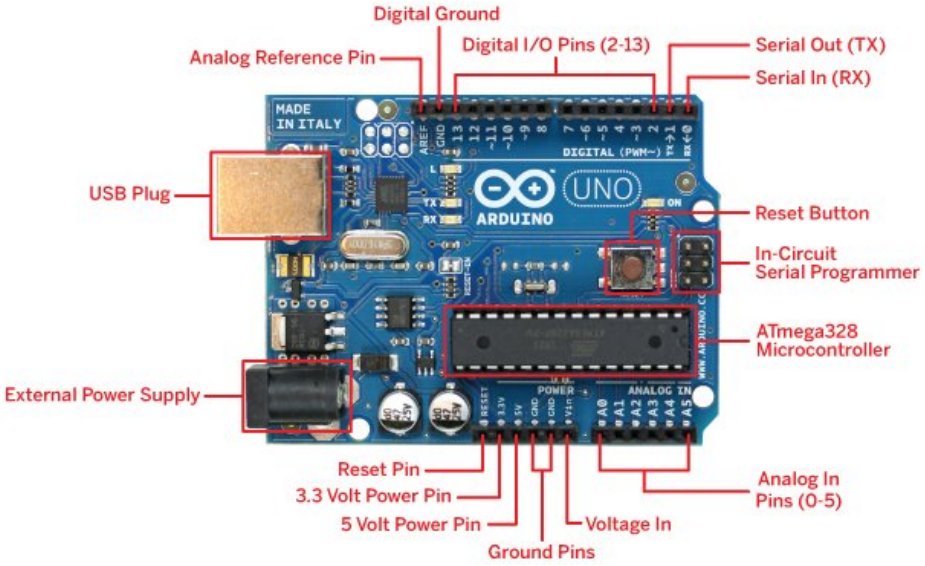

Figure 3.1: Arduino UNO Board [8]

GND-Ground pins.

3.2 DC Motors

DC motors consist of one set of coils, called armature winding, inside another set of coils or a set of permanent magnets, called the stator. Applying a voltage to the coils produces a torque in the armature, resulting in motion.
Stator - The stator is the stationary outside part of a motor.
The stator of a permanent magnet dc motor is composed of two or more permanent magnet pole pieces. The magnetic field can alternatively be created by an electromagnet. In this case, a DC coil (field winding) is wound around a magnetic material that forms part of the stator.
Rotor - The rotor is the inner part which rotates. The rotor is composed of windings (called armature windings) which are connected to the external circuit through a mechanical commutator. Both stator and rotor are made of ferromagnetic materials. The two are separated by air-gap. Winding A winding is made up of series or parallel connection of coils.
Armature winding - The winding through which the voltage is applied or induced.
Field winding - The winding through which a current is passed to produce flux (for the electromagnet). Windings are usually made of copper.

Motor Spec (Model 25GA370D12, i = 20.3)
1. Voltage: 24.0VDC
2. Output Speed: 300 RPM
3. No-Load output current: 70 mA
4. Rotation Output: CW / CCW
5. Noise: No Gear Noise

Figure 3.2: DC Motor [11]

6. Stall output: : Slip Gear, Broken Gear is no allowed
7. Output shaft of the axial clearance: =¡ 0.1 0.3mm, Horizontal clearance requirement =¡ 0.05
8. Stall Current: 2.0A
Electrical Spec
1. No-Load Speed: 6000 RPM
2. No-Load Current: =¡ 50mA
3. Rotation: CW 4. Motor: 370

3.3 Ultrasonic Sensors

Ultrasonic sensors are based on measuring the properties of sound waves with frequency above the human audible range. They are based on three physical principles: time of flight, the Doppler effect, and the attenuation of sound waves.
Ultrasonic sensors are non-intrusive in that they do not require physical contact with their target, and can detect certain clear or shiny targets otherwise obscured to some vision-based sensors. On the other hand, their measurements are very sensitive to temperature and to the angle of the target.
Wire connecting direct as following:
1) 5V Supply
2) Trigger Pulse Input
3) Echo Pulse Output
4) 0V Ground

Figure 3.3: Ultrasonic Sensor [10]

3.4 Motor Driver Module L298N

These L298 H-bridge dual motor controller modules are inexpensive and available from the Tronixlabs Australia store. Furthermore if you're completely new to the world of Arduino we highly recommend you review a copy of "Arduino Workshop", and if you have questions, ask in our customer forum.
There is also an onboard 5V regulator, so if your supply voltage is up to 12V you can also source 5V from the board.
1. DC motor 1 "+" or stepper motor A+
2. DC motor 1 "-" or stepper motor A-
3. 12V jumper - remove this if using a supply voltage greater than 12V DC. This enables power to the onboard 5V regulator
4. Connect your motor supply voltage here, maximum of 35V DC. Remove 12V jumper if less than 12V DC
5. GND
6. 5V output if 12V jumper in place, ideal for powering your Arduino (etc)
7. DC motor 1 enable jumper. Leave this in place when using a stepper motor. Connect to PWM output for DC motor speed control.
8. IN1
9. IN2
10.IN3
11.IN4
12.DC motor 2 enable jumper. Leave this in place when using a stepper motor. Connect to PWM output for DC motor speed control.
13. DC motor 2 "+" or stepper motor B+
14. DC motor 2 "-" or stepper motor B

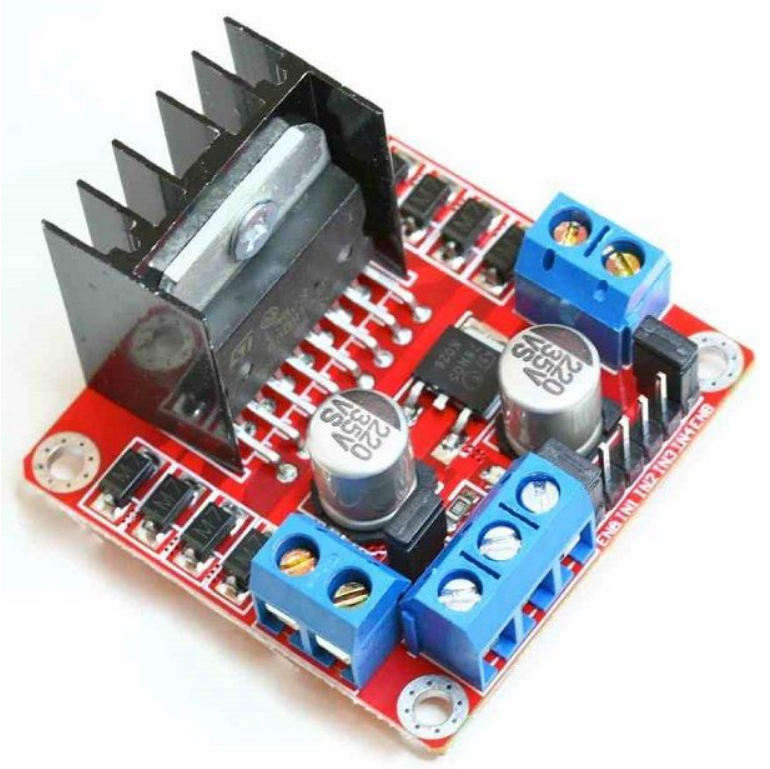

Figure 3.4: Motor Driver Module L298N [16]

3.5 WiFi Shield

The Arduino WiFi Shield connects your Arduino to the internet wirelessly. Connect it to your wireless network by following a few simple instructions to start controlling your world through the internet. As always with Arduino, every element of the platform hardware, software and documentation is freely available and open-source. This means you can learn exactly how it's made and use its design as the starting point for your own circuits.

1. Requires an Arduino board.
2. Operating voltage 5V (supplied from the Arduino Board).
3. Arduino Due compatible.
4. Connection via: 802.11b/g networks.
5. Encryption types: WEP and WPA2 Personal.
6. Connection with Arduino on SPI port.
7. on-board micro SD slot.
8. ICSP headers.
9. FTDI connection for serial debugging of WiFi shield.
10. Mini-USB for updating WiFi shield firmware.

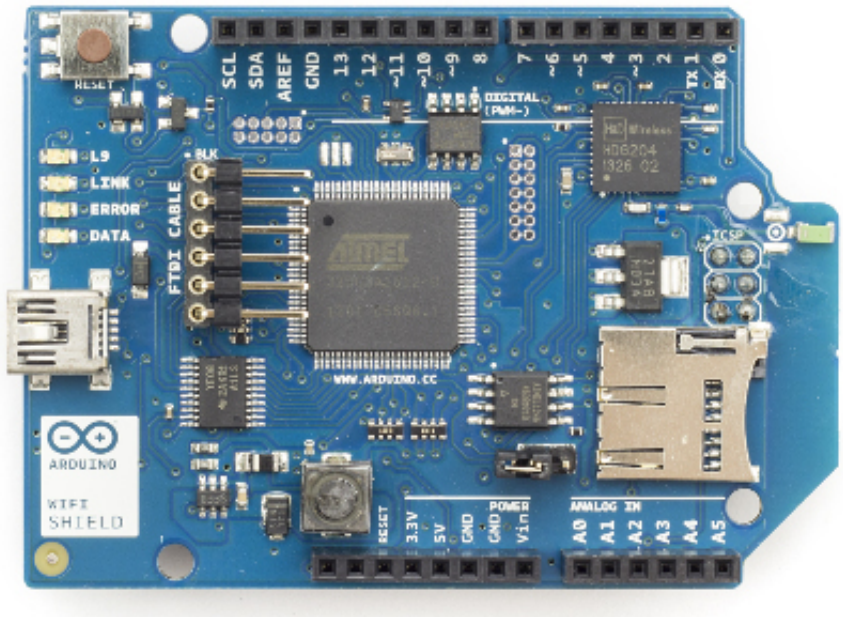

Figure 3.5: WiFi Shield [9]

3.6 Servo Motor

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.

Figure 3.6: Servo Motor[12]

A servomotor is closed-loop servomechanism that uses position feedback to control its motion and final position. The input to its control is some signal, either analogue or digital, representing the position commanded for the output shaft.

The motor is paired with some type of encoder to provide position and speed feedback. In the simplest case, only the position is measured. The measured position of the output is compared to the command position, the external input to the controller. If the output position differs from that required, an error signal is generated which then causes the motor to rotate in either direction, as needed to bring the output shaft to the appropriate position. As the positions approach, the error signal reduces to zero and the motor stops.

3.7 Metal Detection Module

This is a pulse induction metal detector made by Future Electronics Egypt (Arduino Egypt). It uses a single search coil and pic micr-controller.
It can detect metal objects under ground, through wall and above ground as well. Typical minimum depth range from 25 to 30 cm underground. This range is obtained with very rough quick made coil (not optimized) using 10 cm diameter object.
With optimizaed coil range of detection increase to more than 40 cm.
The metal object detection is indicated by LED. Recommended voltage supply is 12 V with small current. However the Metal detector was extensively tested and found to be stable operation in range of voltage supply (9 : 12 V).

Figure 3.7: Metal Detection Module [13]

3.8 Circuit Diagram

Circuit Diagram of Wi-Fi controlled robot is given below. We mainly need a Arduino and ESP8266 Wi-Fi module. ESP8266s Vcc and GND pins are directly connected to 3.3V and GND of Arduino and CH-PD is also connected with 3.3V. Tx and Rx pins of ESP8266 are directly connected to pin 2 and 3 of Arduino. Software Serial Library is used to allow serial communication on pin 2 and 3 of Arduino.

A L298N Motor Driver IC is used for driving DC motors. Input pins of motor driver IC is directly connected to pin 8, 9, 10 and 11 of Arduino. And DC motors are connected at its output pins. Here we have used 9 Volt battery for driving the Circuit and DC motors.

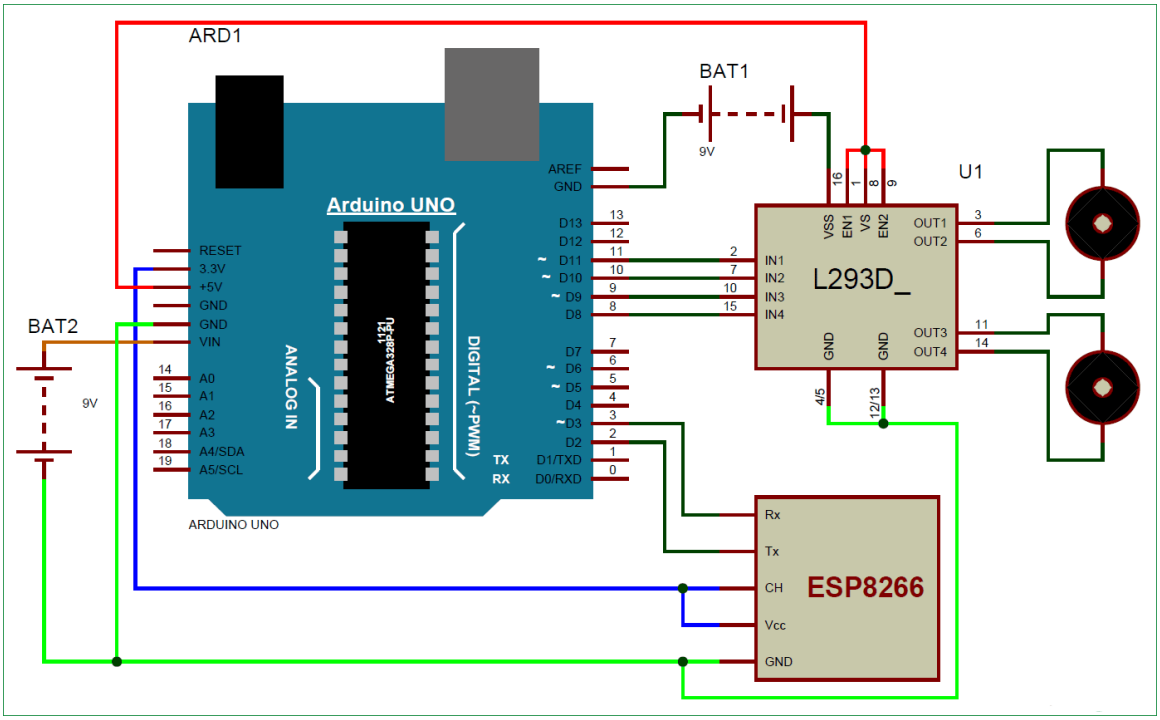

Figure 3.8: Circuit Diagram [7]

Chapter 4

Software Implementation

4.1 Arduino IDE

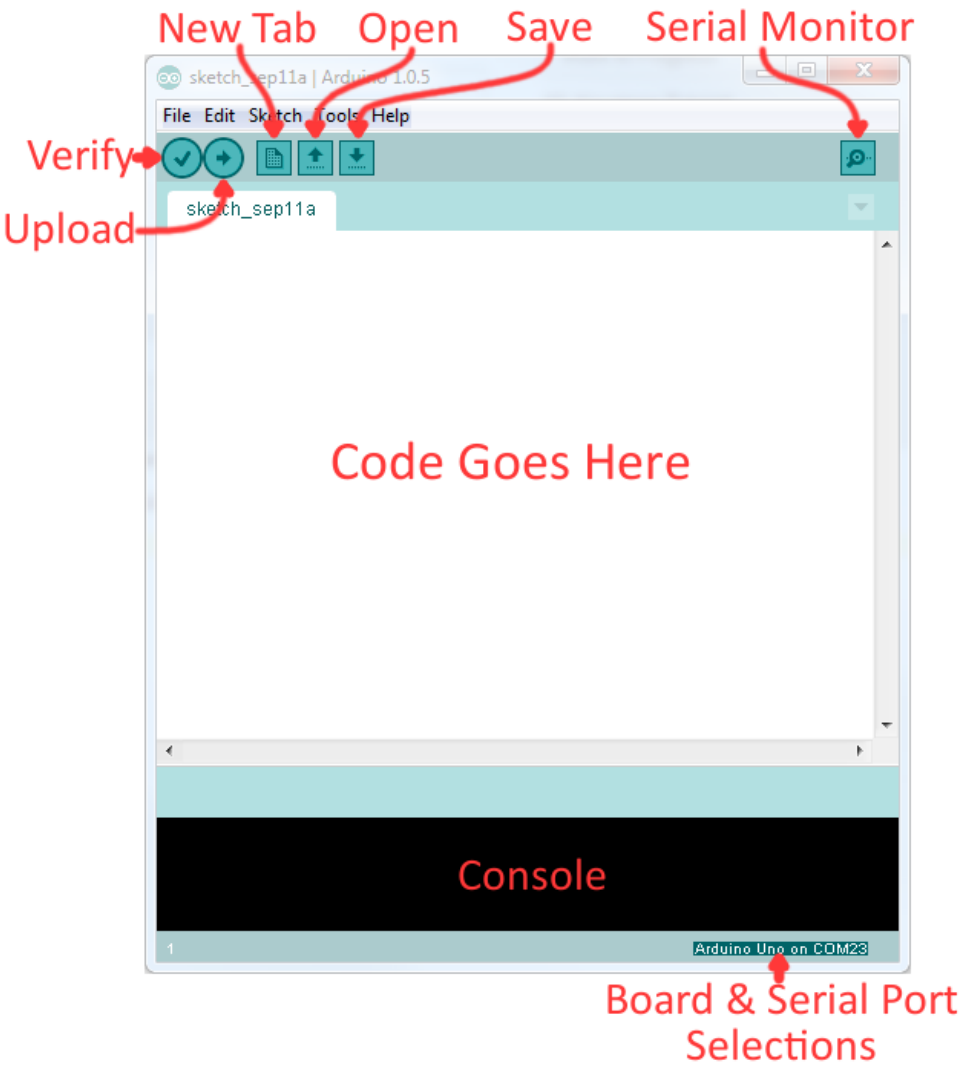

Figure 4.1: Arduino IDE [14]

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. The environment is written in

Java and based on Processing and other open-source software. This software can be used with any Arduino board.
There are two special functions that are a part of every Arduino sketch: setup() and loop() . The setup() is called once, when the sketch starts. It's a good place to do setup tasks like setting pin modes or initializing libraries. The loop() function is called over and over and is heart of most sketches.
The .pde file extension is the one used by the Processing, Wiring and the Arduino IDE. Processing is not C based but Java based and with a syntax derived from java. It is a Java framework that can be used as a java library. It include a default IDE that use .pde extension.

4.2 IP Webcam application

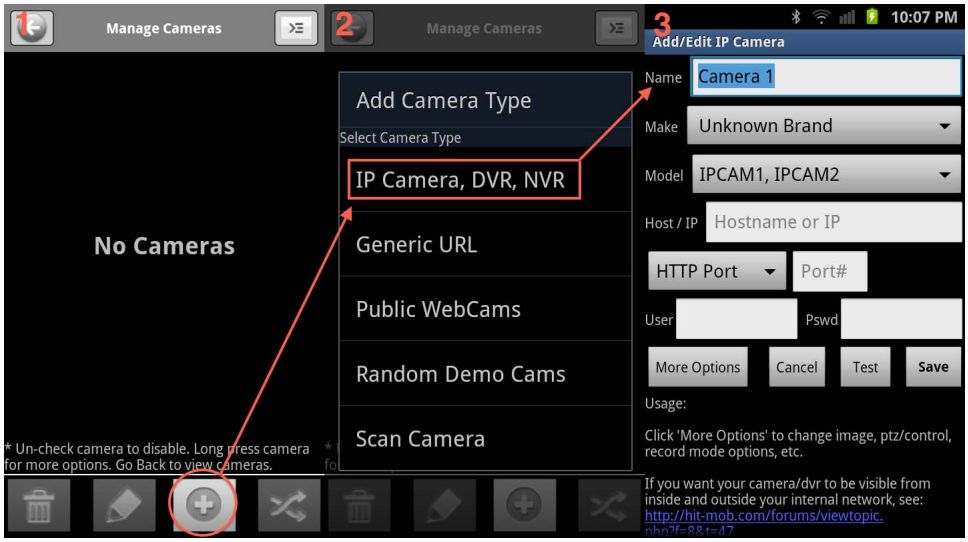

Figure 4.2: IP Webcam application [15]

IP Webcam turns your phone into a network camera with multiple viewing options. View your camera on any platform with VLC player or web browser. Stream video inside WiFi network without internet access. Optional Ivideon cloud broadcasting is supported for instant global access.
Two-way audio supported in tinyCam Monitor on another android device. Use IP Webcam with third-party MJPG software, including video surveillance software, security monitors and most audio players.

Features include:
Video upload to Dropbox, SFTP, FTP and Email using Filoader plugin
Several web renderers to choose from: Flash, Javascript or built-in
Video recording in WebM, MOV, MKV or MPEG4 (on Android 4.1+)
Audio streaming in wav, opus and AAC (AAC requires Android 4.1+)
Motion detection with sound trigger, Tasker integration.
Date, time and battery level video overlay.
Sensor data acquisition with online web graphing.

Videochat support (video stream only for Windows and Linux via an universal MJPEG video streaming driver)
Cloud push notifications on motion and sound, cloud recording for motion-triggered records, online video broadcasting powered by Ivideon.
Extensive baby and pet monitor features: night vision, motion detection, sound detection.

Lite version is supported with unobtrusive ads. It's fully functional, but lacks Tasker integration, customizable user interface (only editor is present) and has a watermark over recorded videos.

4.3 Block Diagram

This Project multifunctional robot using Arduino and Wi-Fi shield is primarily controlled by Arduino UNO microcontroller.
The agenda of this project being it will continuously capture images which we will be acquiring as livefeed and will sense the object IP camera would be used for the same we would send this image using WIFI.
WIFI shield would be interfaced with the Arduino Being a microcontroller it would be programmed accordingly which would finally yield the motion of the robot as dc motors would interfaced with the Arduino.
Alternate path has also been defined for the same which comprises of ultrasonic sensors and servo motors, servo motors are used to accomplish the purpose of continuous tracking of position which it would be receiving from ultrasonic sensors.

ipwebcam is used to deal with the video data from camera, and then send it via the Http protocol to the third party.

The third party such as mobile phone through wifi access routers, send control instructions in the TCP connection.

After receiving instructions through ser2net, router would send instruction to the binding of a serial port, this is Arduino UNO.

After receiving instructions, Arduino can control the expansion board (or shield), and then the shield would control motor, sensors, servos, and other electronic components. Finally, the motor and steering gear will execute instructions.
Block diagram of the project is as shown in the fig 4.3

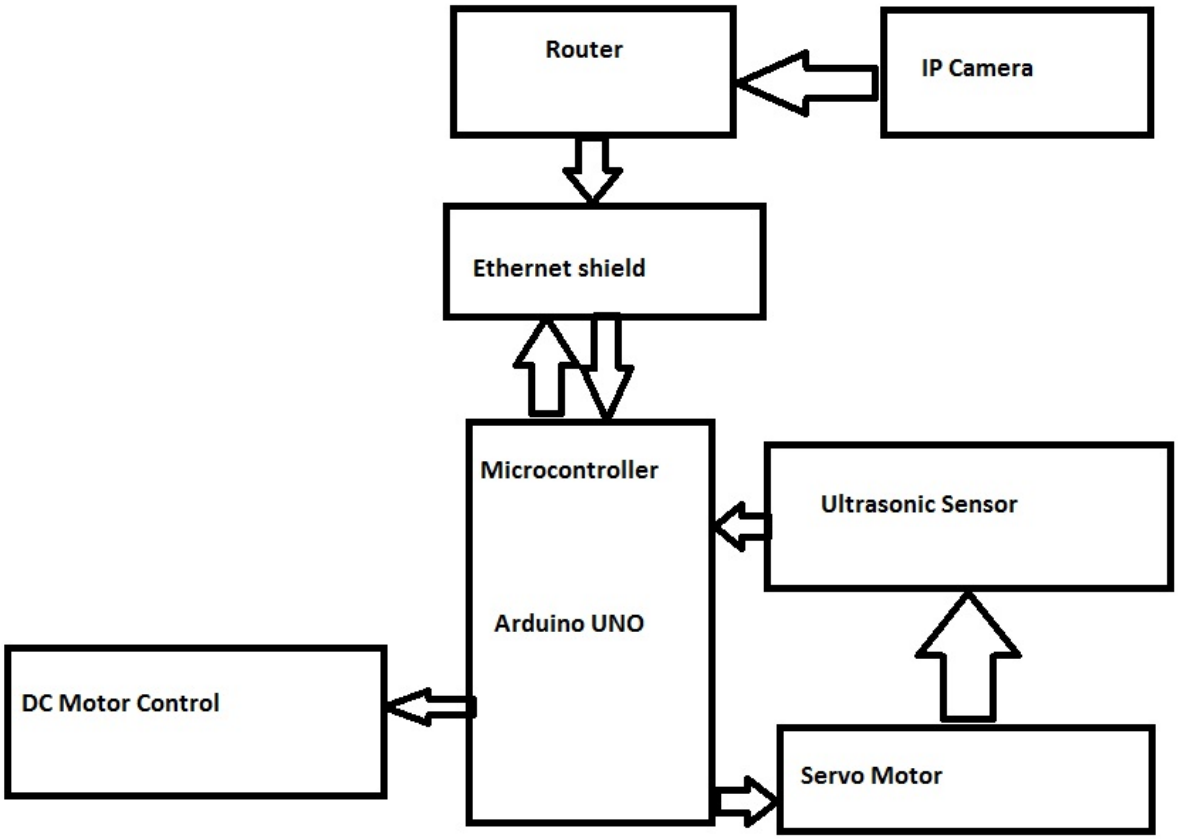

Figure 4.3: Block Diagram

4.4 Code

Arduino Code for obstacle avoiding robot using ultrasonic senor and arduino is given below

```
const int trigPin = 11;
const int echoPin = 10;
const int in1 = 9;
const int in2 = 8;
const int in3 = 4;
const int in4 = 3;
void setup()
{
pinMode(trigPin, OUTPUT);
pinMode(echoPin, INPUT);
pinMode(in1, OUTPUT);
pinMode(in2, OUTPUT);
pinMode(in3, OUTPUT);
```

```
pinMode(in4, OUTPUT);
}
long duration, distance;
void loop()
{
digitalWrite(trigPin, LOW);
delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);
duration = pulseIn(echoPin, HIGH);
distance = duration/58.2;
if(distance5)
{
digitalWrite(in1, LOW);
digitalWrite(in2, HIGH);
digitalWrite(in3, HIGH);
digitalWrite(in4, LOW);
}
else
{
digitalWrite(in1, HIGH);
digitalWrite(in2, LOW);
digitalWrite(in3, HIGH);
digitalWrite(in4, LOW);
}
delay(50);
}
```

NOTE

As the project is based on Arduino, the programming is very easy and can be easily modified. Doesnt require the Arduino Motor Shield. When using a 9V battery, at least 2 such batteries are needed to power the robot. It is better to use 3 9V batteries (one for Arduino and ultrasonic sensor, one for L293D and other for motors).
The ultrasonic sensor should not be connected directly to power supply as it might affect the normal performance. Additionally, a servo motor can be fixed to the ultrasonic sensor and only ultrasonic sensor rotates according to the servo. Based on the distance, the entire robot rotates. Instead of ultrasonic sensor, an IR transmitter receiver pair can also be used.

Chapter 5

Result

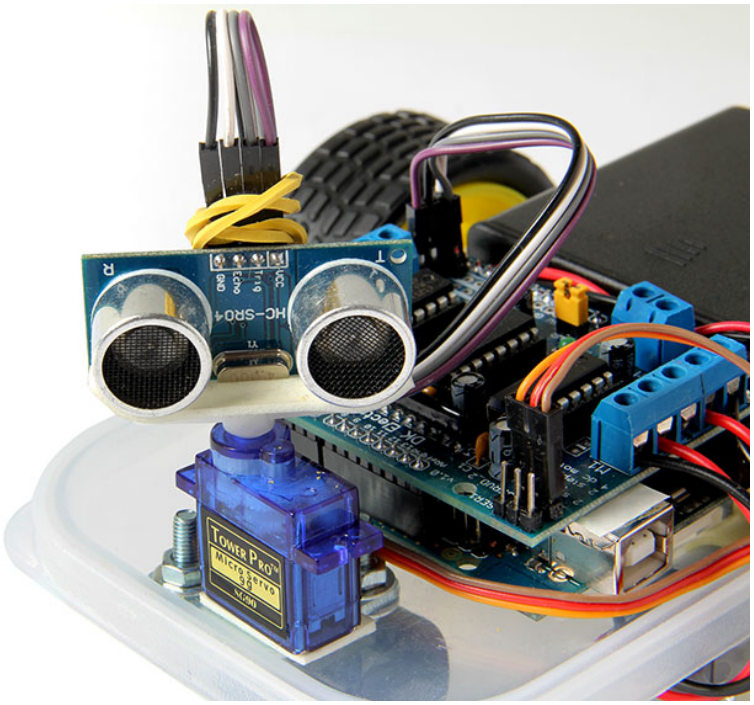

Figure 5.1: Result [20]

- Obstacle avoiding robots can be used in almost all mobile robot navigation systems.
- They can be used for household work like automatic vacuum cleaning.
- They can also be used in dangerous environments, where human penetration could be fatal.

Chapter 6

Conclusion

The aim of our project is to construct a multifunctional-bot. As its name implies it is an efficient robot which could be used in hospitals, military, household-chores, etc. The robot can be operated manually or automatically. The robot will initially provide a remote control and control of movement of bot and also the other functions included in it. Next, the purpose of this robot is to pick up object from one place to another and also to move back and forth. We are adding some features such as an IP web-camera , a robotic arm to pick up things, ultrasonic sensors and servo motor to cause the movement of this sensor.

Chapter 7

Work Plan

The entire idea of project implementation can be subdivided as follows,below is the approach for achieving target consisting of work done until now and the plan for next few months.

Sr no.	Task to be completed	Expected date of completion
1	Realisation of project	October 2016
2	Interfacing Ultrasonic sensor with Arduino	October 2016
3	WiFi controlling algorithm	November 2016
4	Code for WiFI shield	January 2017
5	On paper mechanical plan for robotic hand	January 2017
6	Hardware Implementation	February 2017
7	Synchronization of hardware and software	March 2017
8	Final Product	March 2017

Table 7.1: Work Plan

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Date Signature