Chapter 1

INTRODUCTION

1.1 Overview

Defence services are of utmost importance for a country's security. Therefore the use of efficient and most effective technologies for this purpose becomes mandatory as these tech based devices are being exposed to most critical and harsh environments. The advent of new high-speed technology and the growing computer capacity has provided realistic opportunity for new robot controls. They can be built to take abuse and save lives by placing themselves in harsh or dangerous environments humans would rather not find themselves in. A dedicated Android application can be created to control an embedded robotic hardware, for surveillance and other related purposes, being employed at these remote areas. This idea is the motivation for the project.

A device is required which can survey in all the directions covering the 360 degree vision and without losing its contact from the remote transceiver. The major concern in area of surveillance is the speed of intrusion which has to be surveyed and the power management of the device for their long life. This device will provide a control over the range of surveillance through the use of application installed on android phone which will also provide a great graphical user interface. The project is named Wireless Android based Surveillance Device. An Android application is designed to control movement of this surveillance robot which can be easily installed in a hand held Android smart phone. The smartphone is interfaced to the bot by using any of these three wireless modules -- Bluetooth module (HC-05), RF module, Wi-Fi which is further interfaced with Arduino Uno board responsible for the bot movement control. This robot will detect any intrusion in its vicinity up to a range of 2 to 4 m with the help of an Ultrasonic sensor and the operator/server will be informed about it. For this modern technology to penetrate deep into the society, Android mobile is the most suitable option as everyone uses smart phones and these have become an integral part of day-to-day life. Hence a dedicated application can be created to control an embedded robotic hardware used for home security purposes or it can be used as a spy robot.

In this project report, all the related work along with the gaps in the study, problems formulation and the objective to go with this project has been mentioned in chapter 2 which also covers the methodology opted for the project and its applications. Chapter 3 gives the overview about various components that have been used in the project. Also it mentions the various tools required for designing the PCB and Android Application. In chapter 4 system architecture is described. The inter-relationship among different modules or functional units of the project comprises its architecture. The step by step control transfer from one module to another and the corresponding functioning of the system design have been mentioned.

1.2 Background of the Project

The central idea which motivated the design of project is to provide an autonomous bot, one notable situation where such a robot could be useful, and perhaps life-saving, is for terrestrial uses include surveillance or inspection in hazardous or difficult-to-reach areas. The designed bot since being exposed to harsh and dangerous environments, should be robust, remotely controlled, automatic (in terms of detecting any intrusion in its vicinity), reliable, easy to configure and operate, highly responsive and fast to signal the intruder detection. Hence, the above mentioned characteristics lead to design a project which has the capability to provide a solution to the same i.e.
“WIRELESS ANDROID BASED SURVEILLENCE SYSTEM”.

1.3 Functional Block Diagram

The entire embedded system consists of two parts, one is android application and the other one is an electronic controlling circuitry. In the first part the android device is used for communicating with the controlling circuit through Bluetooth module. The android application can be made using app inventor and installed in Smart phones. On the other hand the electronic circuitry consists of a microcontroller (ATmega328), a bluetooth module (HC-05) and an ultrasonic sensor. The android device sends a command which is received by the receiver of the Bluetooth module and forwards it through its USART serial interface to the microcontroller. After receiving the command, the microcontroller performs the necessary action.

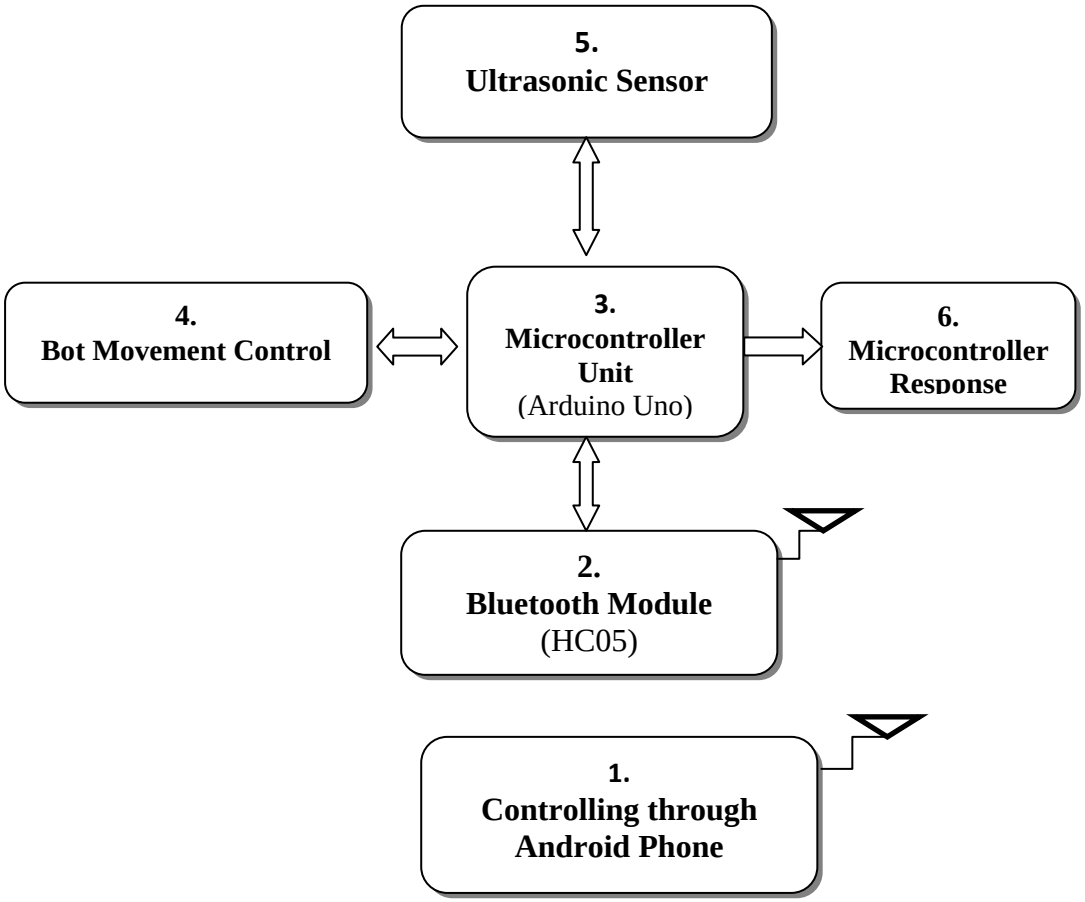

Figure 1.1: Functional Block Diagram

1.4 Standards Available

IEEE 802.15 (WPAN)

IEEE 802.15 is a working group of the Institute of Electrical and Electronics Engineer (IEEE) IEEE 802 standards committee which specifies wireless personal area network (WPAN) standards. It includes seven task groups.

- **Task Group 1: WPAN/Bluetooth**

  It is based on Bluetooth technology. It defines physical layer (PHY) and Media Access Control (MAC) specification for wireless connectivity with fixed, portable and moving devices within or entering personal operating space. Standards were issued in 2002[1] and 2005[2].

- **Task Group 2: Coexistence**

  It addresses the coexistence of wireless personal area networks (WPAN) with other wireless devices operating in unlicensed frequency bands such as

wireless local area networks (WLAN). The IEEE 802.15.2-2003 standard was published in 2003[3] and task group two went into “hibernation” [4].

- **Task Group 3: High Rate WPAN**

  IEEE 802.15.3-2003 is a MAC and PHY standard for high-rate (11to55 Mbit/s) WPANs. IEEE 802.15.3a was an attempt to provide a higher speed Ultra wideband PHY enhancement amendment to IEEE 802.15.3 for applications which involve imaging and multimedia.

- **Task Group 4: Low Rate WPAN**

  It deals with low data rate data rate but very long battery life (months or even years) and very low complexity.

- **Task Group 5: Mesh Networking**

  IEEE 802.15.5 provides the architectural framework enabling WPAN devices to promote interoperable, stable, and scalable wireless mesh networking.

- **Task Group 6: Body Area Networks**

  In December 2011, the IEEE 802.15.6 task group approved a draft of a standard for Body Area Network (BAN) technologies.

- **Task Group 7: Visible Light Communication**

  As of December 2011, The IEEE 802.15.7 Visible Light Communication Task Group has completed draft 5c of a PHY and MAC standard for Visible Light Communications (VLC).

1.5 Scope of the Project

Human life is the most valuable thing on this earth, so to reduce this risk and to portray the same job there is a requirement of a highly efficient machine so such kind of robots could be placed there to help the defence and military forces. The robot is capable of detecting any intrusion and measuring its velocity so can be used for tracking any intrusion and can tell its distance and location also if static.

1.6 Applications of the Project

i. **Military Application:** As the device is capable of moving automatically and manually so can be employed in remote areas for the detection of any unauthorized entry of antisocial elements.

ii. **Obstacle Detection:** The ultrasonic sensor attached to the device is capable of detecting of any obstacle in front of it.

iii. **Velocity and Distance Measurement:** the ultrasonic sensor is based on the emitting the sound waves and by measuring the return time of waves and the velocity of sound(340km/hour) can be used to measure the velocity of the moving object by pointing it at two simultaneous points.

iv. **Security System:** The object detection capability of this project makes it capable of suitable for the security systems also.

1.7 Advantages of the project

This project provides a good graphical user interface and eases the handling and operation due to the involvement of android operating system. It is robust because of the Aluminium sheet used in making its frame. The microcontroller (ATmega328) is fast in its response.

1.8 Limitations of the project

The main limitation is posed by high speed moving intruder which could limit its application and moreover the range of ultrasonic is limited to 5 meter only which reduces the surveillance area of the system. The use of GSM provides a long distance wireless communication but it is not so reliable in the remote area where no network coverage is available so RF communication could be a better choice.

1.9 Summary

This chapter gives the overview of the project. It mentions the problems that lead to the initiation of the project and the various prerequisites that are required. The main functional blocks of the project are introduced and a brief introduction is given. The scope of the project and advantages are discussed so as to highlight the utility of the project. The advantages and limitations of project are also mentioned.

Chapter 2

LITERATURE SURVEY AND PROBLEM OUTLINE

This chapter includes the literature survey providing the past work that has been done on the same platform and the gaps in the study. It also describes the problems that lead to design this project as well as the objectives and the methodology used to achieve the goal.

2.1 Related Work

V. B. Jagdale et al. [5] designed High Definition Surveillance System Using Motion Detection Method based on FPGA DE-II 70 Board. He proposed the motion detection algorithm technique for High definition surveillance system using FPGA DE-II 70 development & Educational Board. Those techniques reduced the data storage capacity for recorded video by using Block-Based MR-SAD motion detection technique to detect the video motion which would reduce unwanted recording of the surveillance video.

Mrinmoy Sengupta [6] developed Microcontroller Based Infrared Tracking Device in 2D Motion that has the capability to track IR signals emitted from a source and chases the IR emitting source. The vehicle was a two wheeler device, the rotation of which was controlled according to motion of the intrusion and there were two free wheels attached for the stability of motion and support for the robot. The brain of the whole project was the AT89S52 microcontroller that controlled and coordinated the rotation of the wheels corresponding to the signal received from the IR sensor.

Dhiraj Singh Patel et al. [7] published Mobile Operated Spy Robot in International Journal of Emerging Technology and Advanced Engineering Volume 3, Special Issue 2, January 2013.In that project, a camera was used and it was instructed through phone using a DTMF decoder. There were twelve DTMF signals, each of which were made up of two tones from the following selection: row frequencies 697Hz, 770 Hz, 852 Hz, 941 Hz, Vertical frequencies : 1209 Hz, 1336 Hz, and 1477 Hz corresponding to which a digital output was obtained. According to the outputs the microcontroller was programmed for the forward, backward, right and left motion of

motors. Whenever any button was pressed by the sender, it was received by the receiver phone through GSM communication and the DTMF portrayed the job to give the digital output corresponding to the button pressed. This digital output was fed as input to the controller corresponding to which controller was programmed and made to work correspondingly.

MP Sunil [8] has published Design of an Event Based Surveillance System Using Advanced Technology, which was an IR sensing collision avoiding mobile robot surmounted with ultrasonic sensor and camera for the detection of intrusion and taking its image and storing it to USB drive and sending message through the GSM modem to a distant telephone. This possessed some disadvantages like unavailability of the signals for GSM communication and the images stored locally to USB could not be transmitted.

S Bhat [9] published Vision Based Robotic System for Military Applications -- Design and Real Time Validation in Signal and Image Processing (ICSIP), 2014 Fifth International Conference on 8-10 Jan. 2014 Page no.20 – 25 INSPEC Accession Number: 14198983. This paper presented the design, development and validation of vision based autonomous robotic system for military applications. Sum of Absolute Difference (SAD) algorithm was used for the implementation of the proposed image processing algorithm. It worked on the principle of image subtraction. The developed algorithm was validated in real time by change-based moving object detection method. The novelty of this work was the application of the developed autonomous robot for the detection of mines in the war field. Developed algorithm was validated both in offline (using MATLAB simulation) and in real time (by conducting an experiment). Real time experimental results matched well with those of the offline simulation results. However, there was only a small mismatch in distance and accuracy of the target detection, which was due to the limitations of the hardware used for the implementation.

Sangaralingam et al. **[10]** published Design of Surveillance Robot with Obstacle Sensing and Movement Control Using Arm Controller. It was configured in two modes-one in which it was manually operated and in the other it was operated autonomously. The proposed system consists of two sections which was Robotic section and monitoring section respectively. In the robotic section ultrasonic sensor was used for the obstacle detection. The camera attached to the robot captured the

image and transferred it through wireless. So in the monitoring system they could watch the things happening in the real terminal unit. There were two basic modes of operation-mode1 and mode2. In mode1 camera was always ON and in mode2, whenever an obstacle was detected only at that time camera would be ON otherwise it was OFF. So based on the application the mode was selected.

P. karthikeyan et al. [11] proposed design of robotic system for defence and Military applications .They used wireless communication .These robots could exchange information to its nearer network. The robot comprised of motors, gear, gear box and mechanical system for locomotion. There were sounds, light and other sensor to guide the robot to collect the necessary information from the environment and also to do the work as per the instruction given in it. The sensed environmental data can be analysed and perform the corresponding tasks by using powerful software which was coded in the microcontroller. It was also planned to be equipped with microphones, speakers, display devices, etc. to interact with human beings.

After studying the related work done as Design of robotic system for defence and Military applications **[11]** was controlled using hand motion i.e. accelerometer and is genuinely configured in two modes i.e. automatic and manual and rather than using two transmitter and receiver pairs is provided with low power wireless solution i.e. ZIGBEE transceiver. **[10]** Microcontroller Based Infrared Tracking Device In 2D Motion focused on tracking the intrusion using IR sensor. **[9]** Mobile Operated Spy Robot in International Journal of Emerging Technology and Advanced Engineering provided an economical and easy interface to the robot through phone using DTMF. **[8]** Design of an Event Based Surveillance System Using Advanced Technology provided a solution for a long distance communication to the robot. The robot clicks and stores the images of any intrusion it found in USB. **[7]** Design Of Surveillance Robot With Obstacle Sensing And Movement Control Using Arm Controller as provided the two modes of control over the robot ones when robot itself will look for its path using obstacle detector and other is manual where user can place the anywhere he want corresponding to controls provided and is a good GUI project. **[5]** High Definition Surveillance System Using Motion Detection Method used the FPGA instead of controller due its better speed and easy interfacing with peripheral through VGA display, camera and SD card along with it the memory used for storing the video is utilized properly using the video algorithm

2.2 Gaps in the Study

The analysis shows that every project has its own advantages and limitations. Some of the gaps in the study were as follows:

- In case of [5] the major drawback was the mismatch in distance and accuracy of the video recording which was done with the help of Block-Based MR-SAD.
- In [6] Infrared Tracking Device in 2D Motion IR sensor was used for tracking which is a low range device and can recognize only one type of intrusions either it could be black or white in colour and a no track to the project could be make.
- The good user graphic interface plays its part in any project which lacks in projects with reference [6].
- The major problem of Design of an Event Based Surveillance System Using Advanced Technology [7] is the ineffective utilization memory of SD card or USB because once it overflows it will pose a problem for robot operation.
- In Vision Based Robotic System for Military Applications [8] the major drawback was the mismatch in distance and accuracy of the target detection.

2.4 Problem Formulation

The limitations of various projects, discussed in the literature survey, are taken into consideration while designing of the project. The short range IR sensor used for intruder detection purpose [6], is replaced with a comparatively high range Ultrasonic sensor (SR04) with a range up to 4 m. The controls used provided a poor GUI. The solution is provided in the project by giving the controls in the hands of the user i.e. through an Android application installed in the mobile phone.

2.5 Objectives of the project

The main objectives of our project are as follows:

i. To study literature survey.
ii. To study Arduino Uno and its various interfacings.

iii. To develop an android application using MIT app inventor.

iv. To design PCB using EAGLE.

v. To synchronize between various modules.

vi. To design the surveillance device

2.6 Methodology

This section explains the methodology we used in implementation of our project. The main phases of our project were:

i. Requirement Analysis

In this phase, we discussed the various modules to be used and the basic model of our project.

ii. Literature Survey

We studied the other similar projects that were implemented earlier. We tried to find out the gaps between them and their drawbacks, so that we can make a better design.

iii. Investigation of Possible Implementation Methods

The third phase that we underwent was to come up with as many possible methods for implementation of our project that we could. None of the ideas were immediately rejected. A seemingly unfeasible idea may not be able to stand alone but it needs to be considered because certain parts of it may be applicable to another idea. To narrow down our choices we needed to find out which ones were the most feasible. We established feasibility by performing simple calculations.

iv. PCB Designing

It was one of the most important phases of our project. In this, we designed the schematic and PCB layout. While designing the schematic the main problem that we faced was the shortage of digital pins in ATMEGA 328. To meet the insufficiency of pins we used two shift registers-one for controlling the four motors and other for controlling the relays.

v. Arduino UNO Coding

Arduino programming for bot motion control, data transmission and reception using wireless module and ultrasonic sensor interfacing.

vi. Android App Development

For this purpose we have used MIT app inventor. The Android application is designed to control movement of this surveillance robot which can be easily installed in hand held smart phones. The Smartphone is being interfaced to the bot by using Bluetooth module (HC-05) which is further interfaced with Arduino Uno board responsible for the bot movement control.

2.7 Summary

In this chapter related work has been mentioned. It basically describes the various technologies used by the others in making similar projects. It also mentions the shortcomings and the gaps in their study.

Chapter 3

COMPONENTS AND TOOLS USED

This chapter describes the various components that have been used in making the project. It also mentions the tools – EAGLE (For PCB Designing) and MIT app inventor (For Developing Android App) used for designing the project.

3.1 Components Used

3.1.1Capacitor

A capacitor (originally known as a condenser) is a passive two-terminal electrical component used to store energy electrostatically in an electric field. When there is a potential difference across the conductors (e.g., when a capacitor is attached across a battery), an electric field develops across the dielectric, causing positive charge +Q to collect on one plate and negative charge −Q to collect on the other plate.

Figure 3.1: Capacitor Symbols

3.1.2 Diodes

1N4007 is a member of 1N400x diodes. Diode is a rectifying device which conducts only if a certain threshold voltage or cut-in voltage is present in the forward direction (a state in which the diode is said to be forward-biased) and it behaves open circuited for the current flow from cathode to anode (a state in which diode is said to be reverse-biased).It comprises of diffused PN junction .

Figure 3.2: Diodes [12]

3.1.3 Voltage Regulator

The 7805 is a family of self- contained fixed voltage regulator integrated circuits. The 7805 is commonly used in electronic circuits to provide a regulated power supply. The 7805 line is positive voltage regulators as they produce a voltage that is positive w.r.to ground.

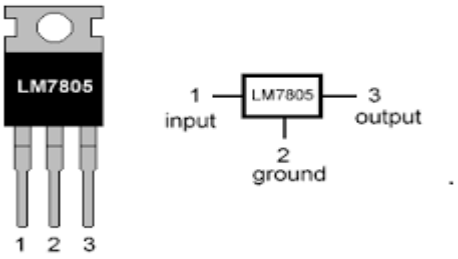

Figure 3.3: Voltage Regulator 7805 [13]

3.1.4 Step Down Transformer

A transformer is an electrical device that transfers energy between two or more circuits through electromagnetic induction.

A varying current in the transformer's primary winding creates a varying magnetic flux in the core and a varying magnetic field impinging on the secondary winding. This varying magnetic field at the secondary induces a varying electromotive force (emf) or voltage in the secondary winding. Making use of Faraday's Law in conjunction with high magnetic permeability core properties, transformers can thus be designed to efficiently change AC voltages from one voltage level to another within power networks.

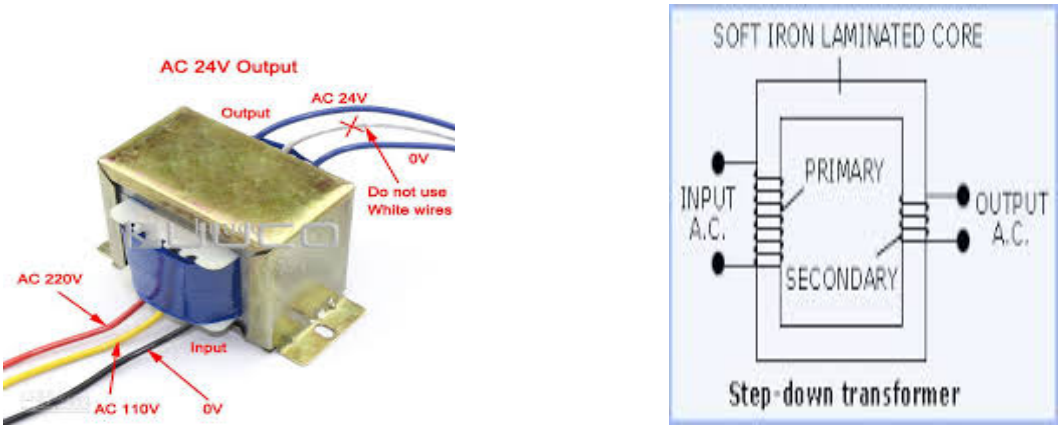

Figure 3.4: Step down transformer [14]

3.1.5 Infra-Red Sensor

An infrared sensor is an electronic instrument which is used to sense certain characteristics of its surroundings by either emitting and/or detecting infrared radiation. All objects which have a temperature greater than absolute zero (0 Kelvin) possess thermal energy and are sources of infrared radiation as a result. Sources of infrared radiation include blackbody radiators, tungsten lamps and silicon carbide. Infrared sensors typically use infrared lasers and LEDs with specific infrared wavelengths as sources.

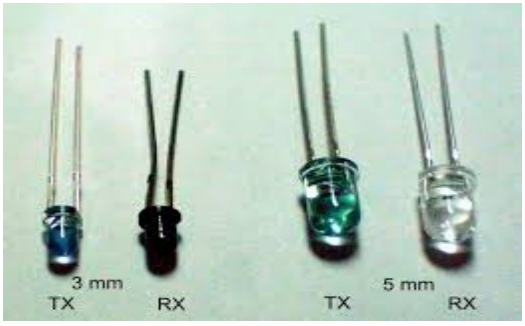

Figure 3.5: IR Sensor [15]

3.1.6 Ultrasonic Sensor

Ultrasonic sensors (also known as transceivers when they both send and receive, but more generally called transducers) work on a principle similar to radar or sonar, which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively. Active ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor, measuring the time interval between sending the signal and receiving the echo to determine the

distance to an object. Passive ultrasonic sensors are basically microphones that detect ultrasonic noise that is present under certain conditions.

Figure 3.6: Ultrasonic Sensor [16]

3.1.7 Shift Register 74LS164

These are 8-bit shift registers. Data at the serial inputs may be changed while the clock is high or low. Clocking occurs on the low to high level transition of the clock input. All inputs are diode clamped to minimise transmission line effects.

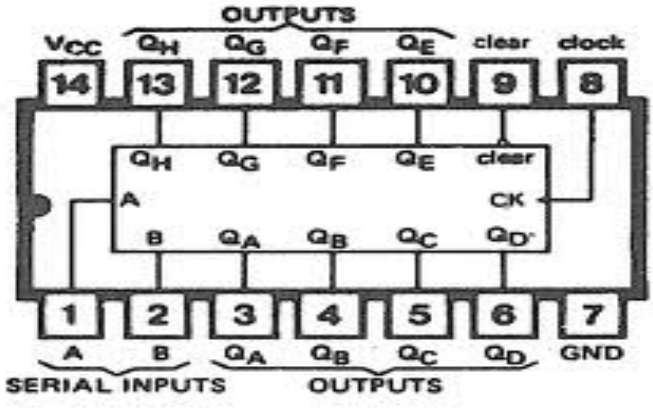

Figure 3.1.7: Shift Register 74LS164 [17]

3.1.8 Current Driver L293D

The L293 and L293D are quadruple high-current half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications.

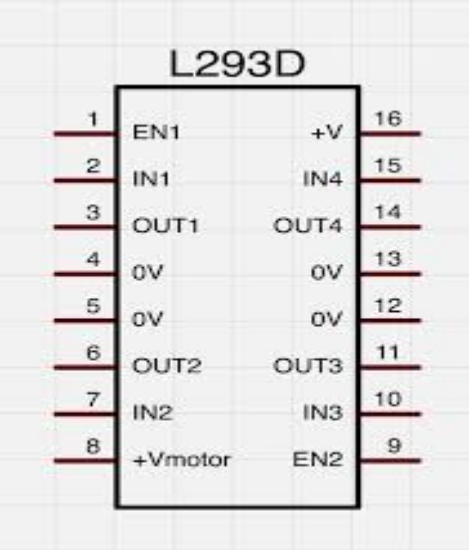

Figure3.8: Current Driver L293D [18]

3.1.9 ATmega 328

The high-performance Atmel 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1KB EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator.

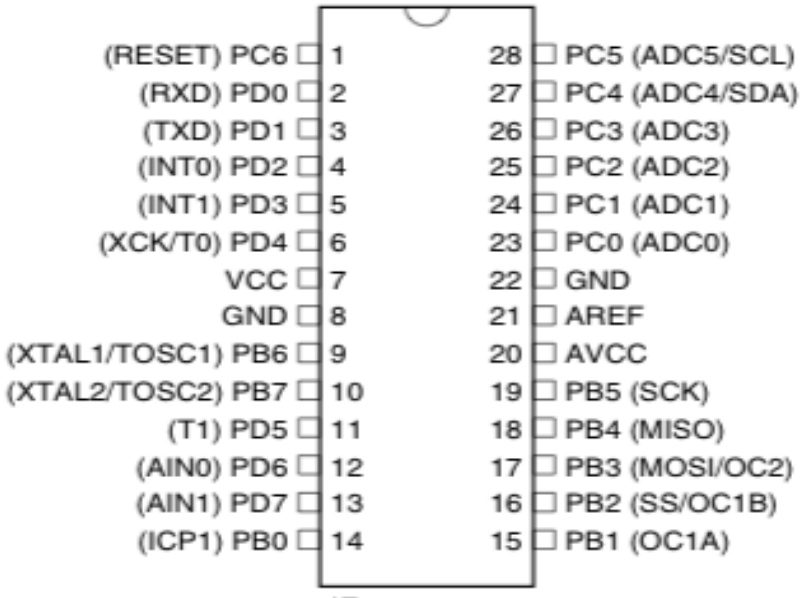

Figure 3.9: Pin Diagram of ATmega328 [19]

3.2 Tools Used

3.2.1 EAGLE

EAGLE stands for Easily Applicable Graphical Layout Editor. It is software used to design an electronic schematic and layout of a printed circuit board. It consists of a schematics editor, a PCB editor and an auto router module. Schematic provides the functional flow and the graphical representation of an electronic circuit. Schematic mainly consists of Electrical connections (nets), Junctions, Integrated circuits symbols, discrete components like Resistors, I/O connectors, Power &ground symbols. PCB layout: To start laying out the printed circuit board, open the schematics in Eagles schematic editor and click on the board button. Once you have created a board for a schematic, you should always have both files open when working with either the schematic or the circuit board layout.

3.2.2 MIT Application Inventor2

App Inventor 2 for **Android** is an open-source web application originally provided by Google, and now maintained by the Massachusetts Institute of Technology (MIT). It allows newcomers to computer programming to create software applications for the Android operating system (OS). It uses a graphical interface, which allows users to drag-and-drop visual objects to create an application that can run on Android devices.

App Inventor includes:

- A designer, in which a program's components are specified. This includes visible components, such as buttons and images, which are placed on simulated screen, and non-visible components, such as sensors and web connections.
- A blocks editor**,** in which the program's logic is created.
- A compiler based on the KAWA language framework
- An app for real-time debugging on a connected Android device.

3.3 Summary

This chapter gives the overview about various components that have been used in the project. Also it mentions the various tools required for designing the PCB and Android Application.

Chapter 4

SYSTEM ARCHITECTURE

The architecture describes the inter-relationship among different modules or functional units of the project. It describes the outlook of the project and the functional blocks of the system.

4.1 Project Description

The following are the important points regarding our project:

i. The main aim of this surveillance system is to detect intrusion.
ii. The system has two basic functional units- Android application and the Arduino Uno (controller- ATmega328).
iii. Android application is installed in the handheld Android phone and Arduino is placed on the bot, responsible for intruder detection.
iv. The sensor used for intruder detection is ultrasonic sensor. It is placed on the bot itself and its movement is controlled using two motors -- horizontal motion control and vertical motion control motors, which are placed so as to make a U-joint for solid 180 degree angle rotation of the sensor.
v. The Android application has two basic controls for the bot movement control-
    - Manual Control: In this mode, the bot movement is controlled manually and the control panel is provided for the forward, backward, left, right and stop controls. This mode is used to make the intruder detection bot reach the place from where it has to start detecting the intrusion. Ultrasonic sensor remains deactivated in this mode.
    - Automatic Control: This is the line/edge follower mode. Two IR sensors have been placed on the front and back of the chasis for the purpose of edge/line detection. The ultrasonic sensor is connected to the vertical motor which rotates it by an angle of 180 degrees. In this mode intruder detection is activated and the status is checked periodically by Arduino at the output pin of the sensor. For this purpose both the horizontal and vertical motors are enabled. As soon as the intruder is detected, the

message is sent to the phone numbers that have been entered by the user. The user / operator can take the necessary action.

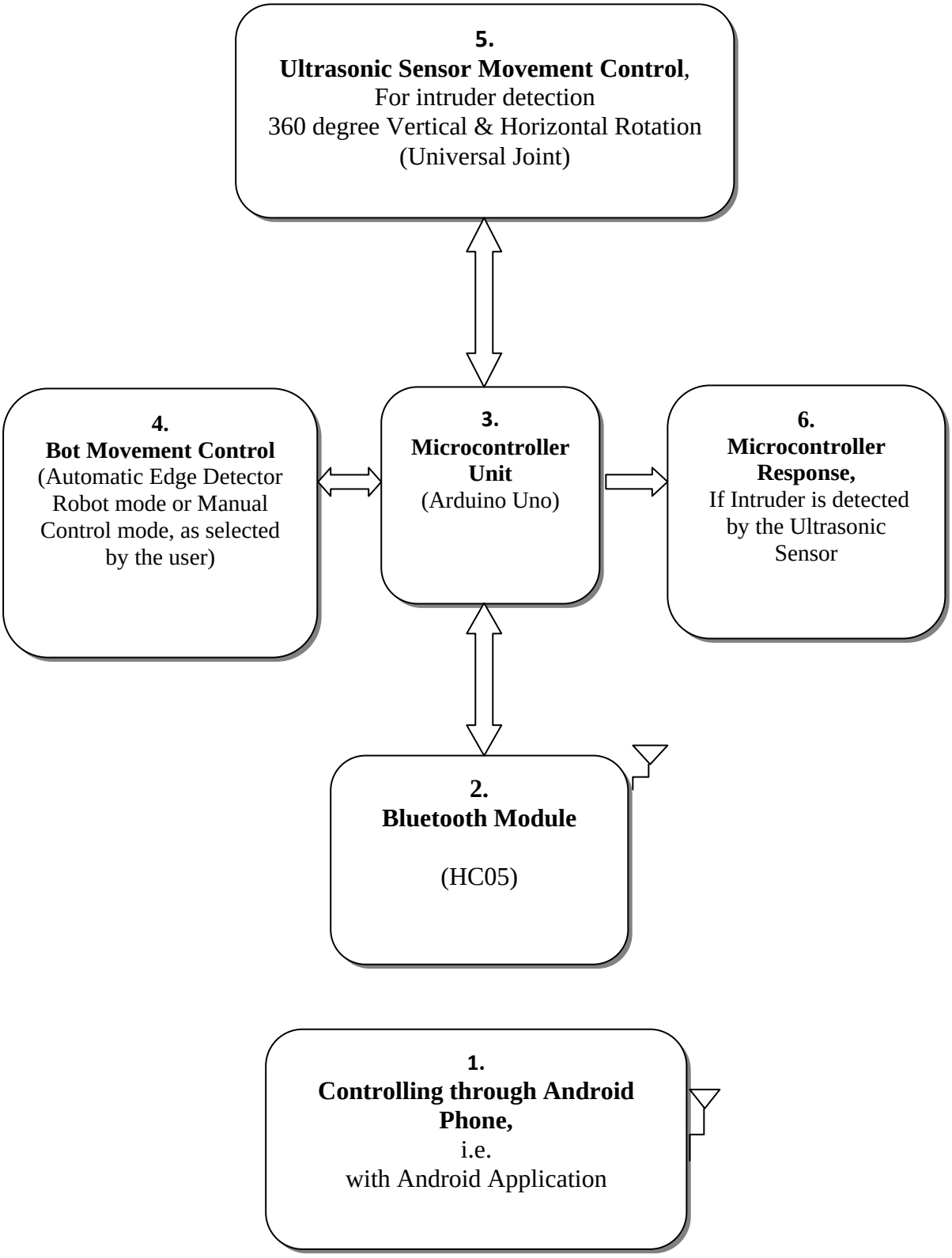

Figure 4.1: Block Diagram of the Project

4.2 Functional blocks of the Project

The inter-relationship among different modules or functional units of the project comprises its architecture. The step by step control transfer from one module to another and the corresponding functioning of the system design is as shown in the figure below:

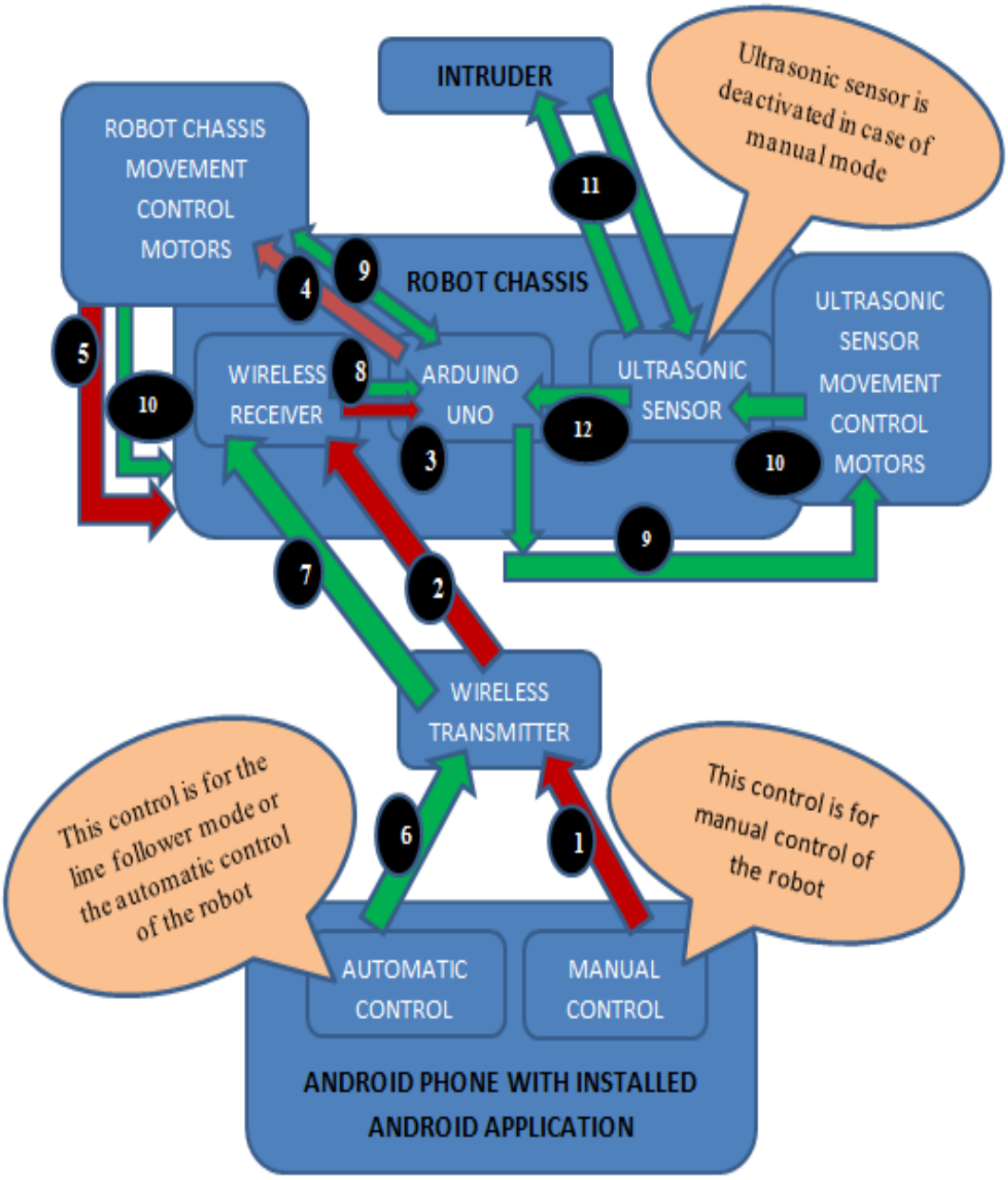

Figure 4.2: Architecture of the Project

4.3 Summary

This chapter mentions the generalised model of the project. The architecture describes the inter-relationship among different modules or functional units of the project.

Chapter 5

SYSTEM DESIGN AND ANALYSIS

This chapter mentions the internal description of the project. It describes the workflow and step by step implementation of the project. It also mentions the specifications of the system.

5.1 Flowchart of the Project

A flowchart is a diagram that represents an algorithm, workflow or process, showing the steps as boxes of various kinds, and their order by connecting them with arrows. This diagrammatic representation illustrates a solution model to a given problem. The flowchart of the project is as shown below:

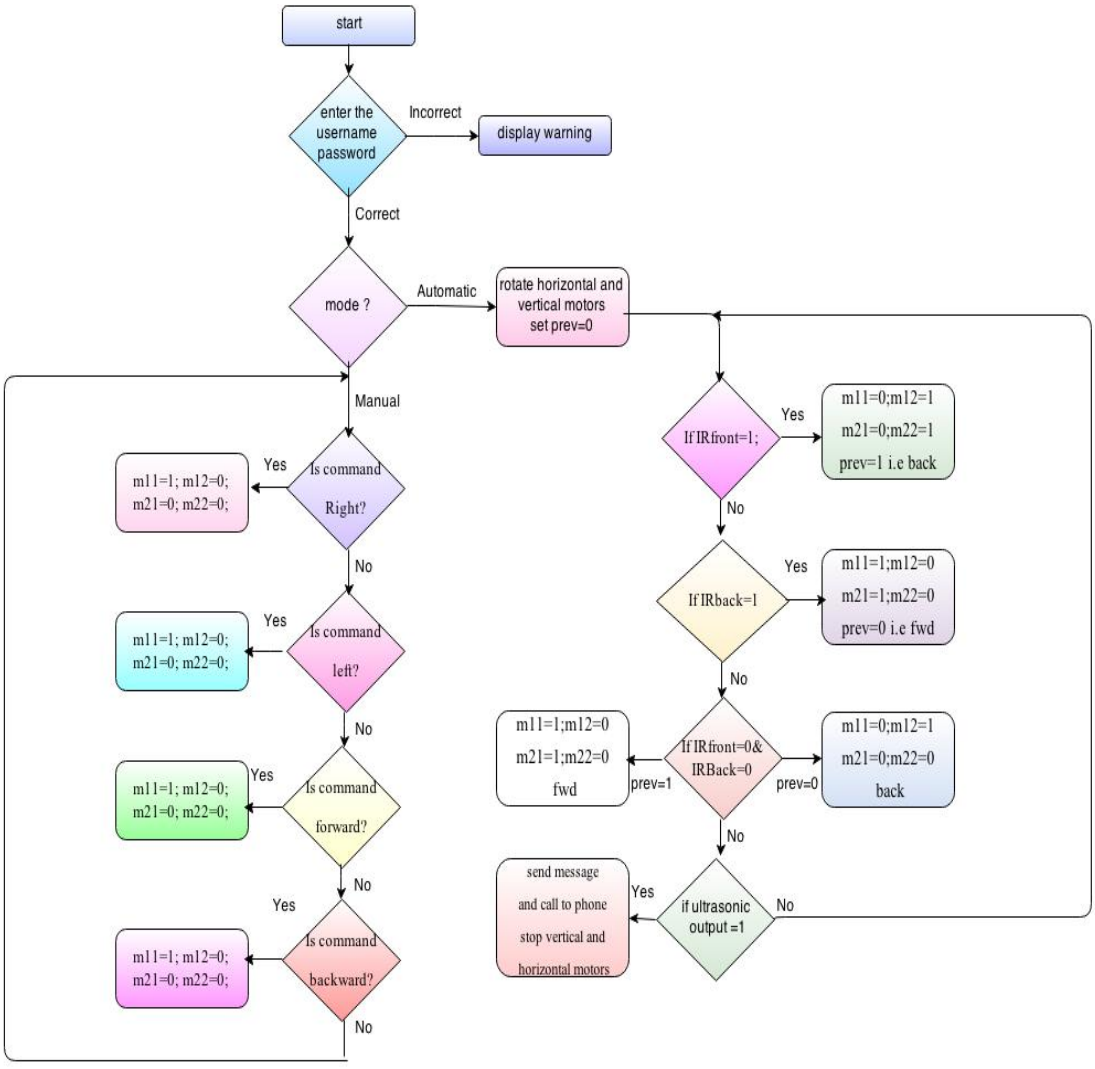

Figure 5.1: Flowchart of the Project

5.2 Algorithm of the Project

An algorithm is a step-by-step procedure for calculations. The algorithm of the project is as shown

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Algorithm Used

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i) Start

ii) Read the mode received from the bluetooth

iii) Repeat the following if mode = automatic

a. Read input from IR sensor

b. If front IR output = 1

Then move the robot backwards

Set previous state =1;

If back IR output = 1

Then move the robot forwards

Set previous state =0;

If front IR output = 0 and back IR output=0

Then if (previous state =1)

Then move the robot backwards

Else Move the robot forward.

c. Read ultrasonic output

d. If ultrasonic output =1

Then stop the motors

Send bluetooth intruder detected

e.If mode = automatic

Jump to step (iii)

Else

Jump to step (iv)

iv) Repeat the following step if mode = manual

a. Read input from bluetooth as bt output

b. If bt output = backward

Then move the robot backwards

If bt output = left

Then move the robot left

If bt output = right

Then move the robot right

If mode = automatic

Jump to step (iii)

else

Jump to step (iv)

Stop

5.3 Specifications of the system

The main specifications of the project have been mentioned in the table given below. The specifications of the system describe the operating voltage range, Clock Speed, response time, ultrasonic sensor range and memory specifications.

Table 5.1: Specifications of Project

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (limits)	6-20V
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (Atmega328) of which 0.5 KB used by boot loader
SRAM	2 KB (Atmega328)
EEPROM	1 KB (Atmega328)
Ultrasonic Sensor Range	4 m
Response Time	55 seconds
Clock Speed	16 MHz

5.4 Summary

In this chapter the system architecture is described. The inter-relationship among different modules or functional units of the project comprises its architecture. The step by step control transfer from one module to another and the corresponding functioning of the system design have been mentioned.

Chapter 6

RESULTS AND DISCUSSIONS

6.1 Interfacings Used and Testing of the Project

6.1.1 Motor Interfacing and Testing

Motors portray their jobs according to the input received from the IR sensors and the server which was performed on Proteus in the manner shown:

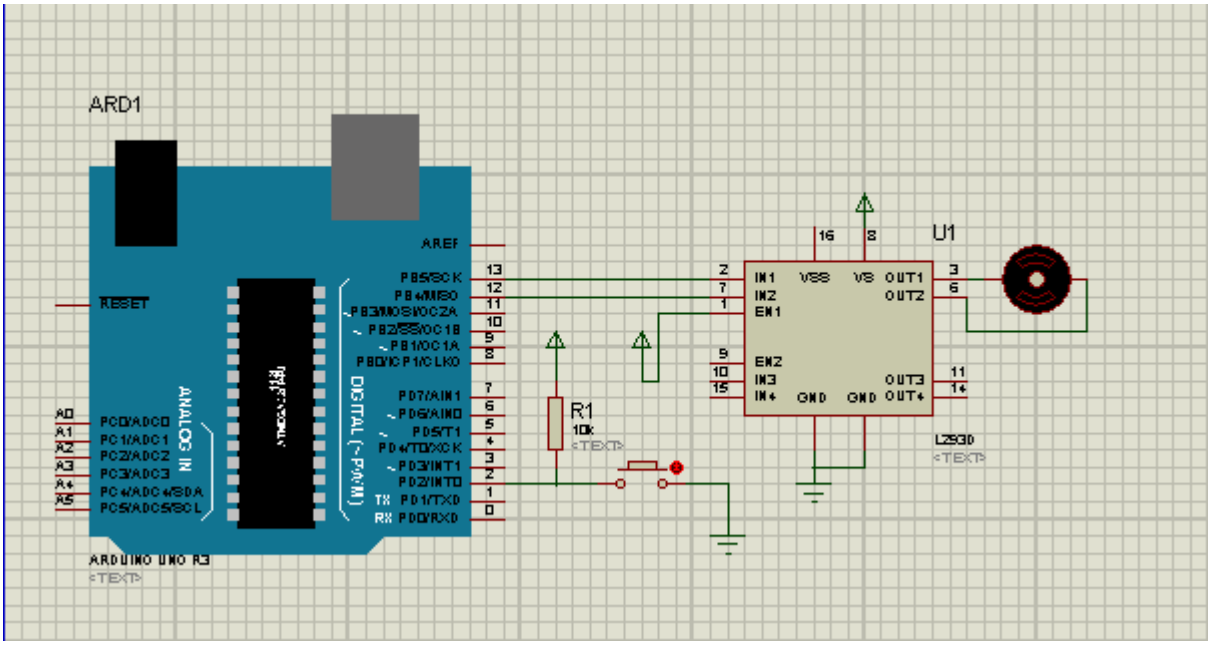

Figure 6.1: Interfacing Arduino with Motors

Code: Testing of Motors

```
int m1 = 13;

int m2 = 12;

int sw = 2;                    // the setup routine runs once when you press reset:

void setup() {                 // initialize the digital pin as an output.

    pinMode(m1, OUTPUT);

   pinMode(m2, OUTPUT);
```

```
        pinMode(sw, INPUT);
}
void loop() {
        if(digitalRead(sw)==HIGH)
                {
                 digitalWrite(m1, HIGH);
                digitalWrite(m2, LOW);
                }
        else
                {
                  digitalWrite(m1, LOW);
                digitalWrite(m2, HIGH);
                }
}
```

6.1.2 IR Sensor Interfacing and Testing

Real time system like IR sensor where the interaction with the atmosphere is required is not possible to simulate on Proteus but as its output would be digital so can be substituted by switches as shown above

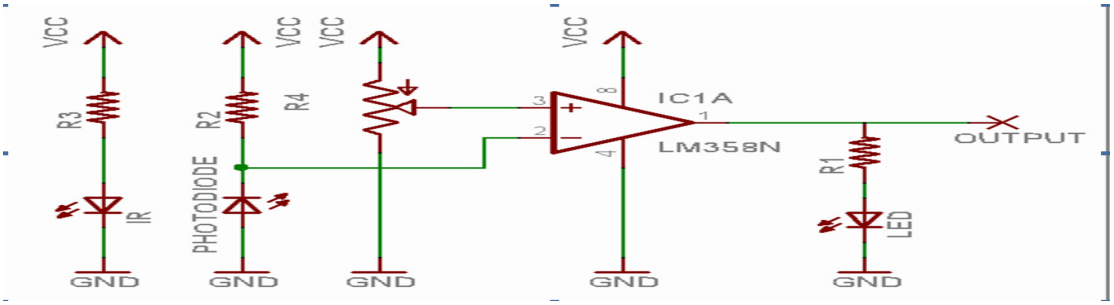

Figure 6.2: Design and Simulation of IR Sensor

6.1.3 Interfacing with Relays

Relays will be used to heat the element when any intrusion will be detected.

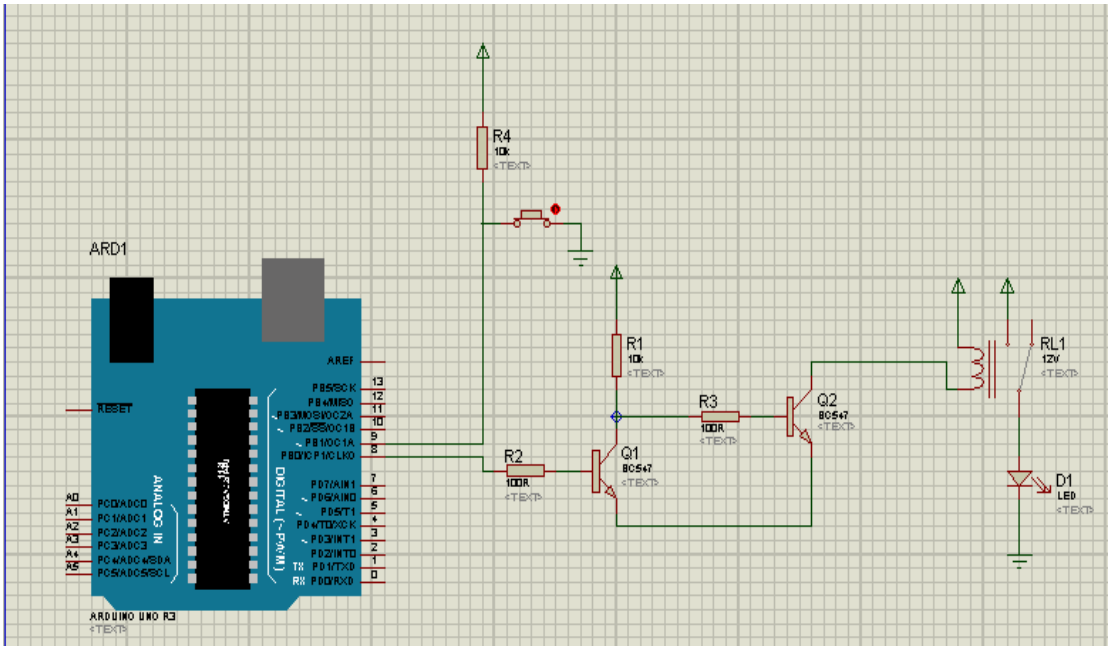

Figure 6.3: Interfacing Arduino with Relays

Code: Testing of Relays

```
int led1 = 8;
int sw = 9;                // the setup routine runs once when you press reset:
void setup() {             // initialize the digital pin as an output.
      pinMode(led1, OUTPUT);
       pinMode(sw, INPUT);
}                          // the loop routine runs over and over again forever:
void loop() {
       if(digitalRead(sw)==HIGH)
```

{

digitalWrite(led1, HIGH); // turn the LED1 on (HIGH is the voltage level)

}

else

{

digitalWrite(led1, LOW); // turn the LED1 OFF(HIGH is the voltage level)

}

}

6.1.4 Interfacing with Ultrasonic Sensor

Similar to IR sensor ultrasonic sensor also cannot be simulated on Proteus so was tested on PCB itself.

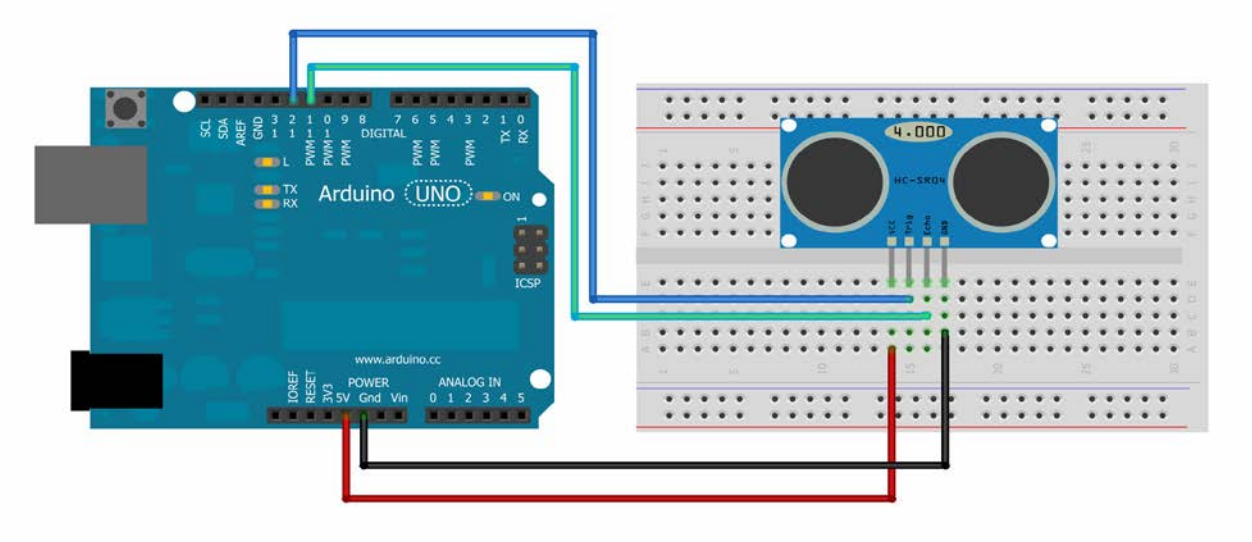

Figure 6.4: Interfacing Arduino with Ultrasonic Sensor [16]

6.1.5 Interfacing Bluetooth with Arduino

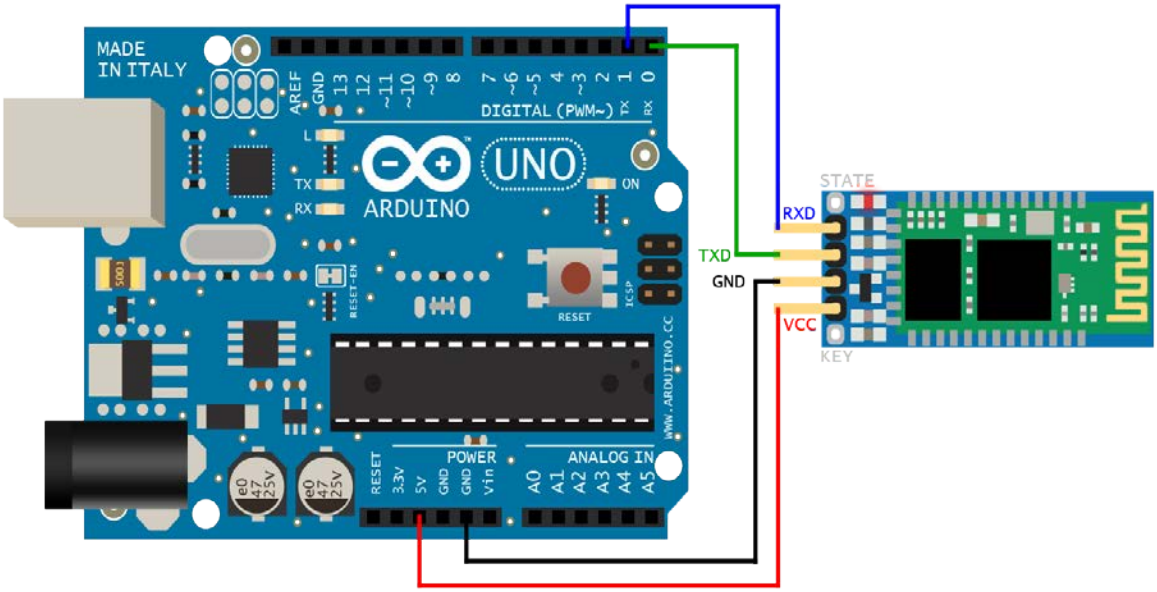

Figure 6.5: Circuit Diagram for Interfacing Bluetooth with Arduino [17]

Code: Testing of Bluetooth

```
int Ready=13;
int M11=5;
int M12=6;
int M21=7;
int M22=8;

String state;
void setup()
{
   // sets the pins as outputs:
   pinMode(Ready, OUTPUT);
   digitalWrite(Ready, LOW);
   pinMode(M11, OUTPUT);
   digitalWrite(M11, LOW);
   pinMode(M12, OUTPUT);
    pinMode(M21, OUTPUT);
```

```
  digitalWrite(M21, LOW);
  pinMode(M22, OUTPUT);
  digitalWrite(M22, LOW);
  Serial.begin(9600); // Default connection rate for my BT module
 //  Serial.println("ON");    //For Bluetooth Transmission
}

void loop()
{
 digitalWrite(Ready, HIGH);
  if(Serial.available() > 0)      //Reception
  {
    state = Serial.readStringUntil('\n');
  }
  if(state == "backward")     //backward
  {
     backward();
   }

   if(state == "forward")     //off
  {
     forward();
  }

   if(state == "right")     //Off
  {
    right();
  }
   if(state == "left")     //Off
  {
    left();
  }
  if(state == "stop")     //Off
  {
```

```
    stops();
   }
}
void backward()
{
        digitalWrite(M11, LOW);              //0101
        digitalWrite(M12, HIGH);
        digitalWrite(M21, LOW);
        digitalWrite(M22, HIGH);
}

void forward()
{
         digitalWrite(M11, HIGH);              //1010
        digitalWrite(M12, LOW);
        digitalWrite(M21, HIGH);
        digitalWrite(M22, LOW);
}
void left()
{
       digitalWrite(M11, HIGH);              //1000
        digitalWrite(M12, LOW);
        digitalWrite(M21, LOW);
        digitalWrite(M22, LOW);
        }
void right()
{
        digitalWrite(M11, LOW);              //1000
        digitalWrite(M12, LOW);
        digitalWrite(M21, HIGH);
        digitalWrite(M22, LOW);
      //   Serial.println("right");
}
void stops()
```

```
{
        digitalWrite(M11, LOW);              //1000
        digitalWrite(M12, LOW);
        digitalWrite(M21, LOW);
        digitalWrite(M22, LOW);
    //  Serial.println("stop");
}
```

6.2 Schematics of the Project

6.2.1 Power Supply Section

The power supply section provides a 5V DC output. The bridge rectifier section converts the 12V sinusoidal ac output of 12-0-12 V transformer to 12 V pulsating DC. The capacitor removes its ripples and smoothens the 12 V pulsating DC which is fed to the input of 7805 voltage regulator. 7805 gives a constant 5 V DC as the output which is the power supply for the whole circuit.

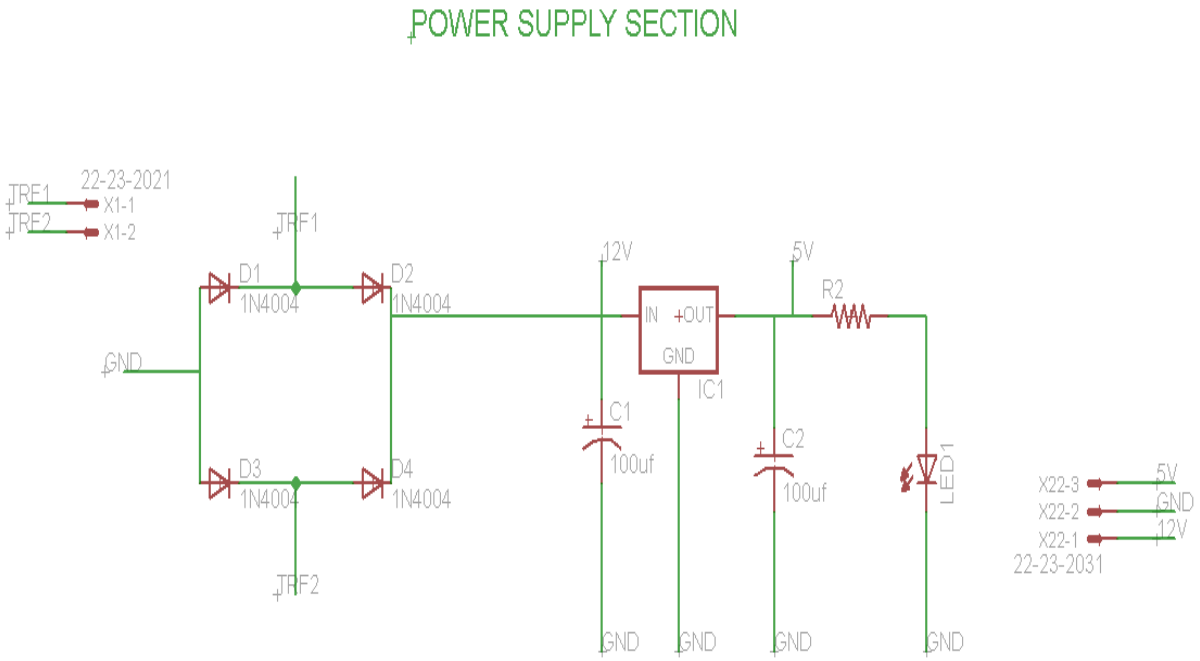

Figure 6.6: Circuit Diagram for Power Supply

6.2.2 Shift Register (for Motor Control) and Current Driver Section

This motor driver circuit is used to complete the current and voltage requirements of the 12 V DC motors. Arduino Uno is incapable of driving the motor (300rpm, 12V). So, current driver L293D is used as an intermediate between the controller and the motors. It has two channels. No load current (per channel) = 60 mA and full load current (per channel) = 1.2 A.

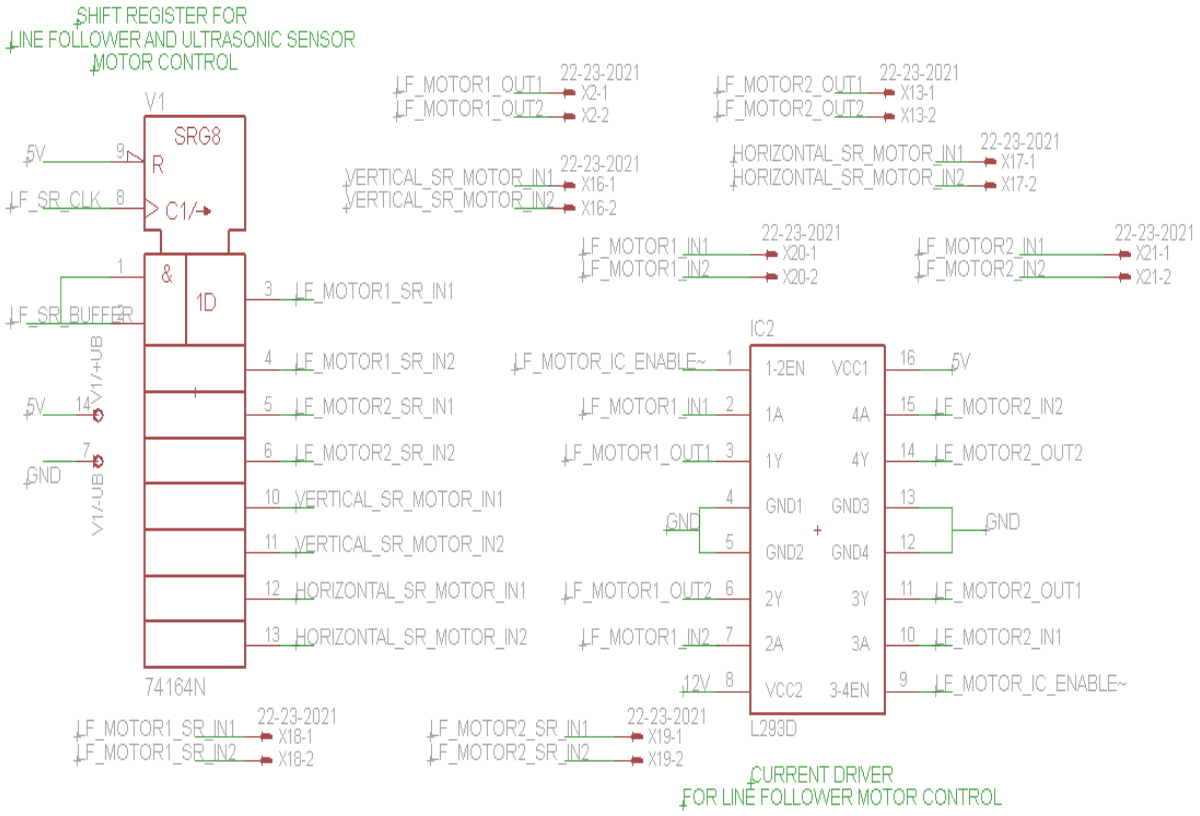

Figure 6.7: Circuit Diagram for Current Driver

6.2.3 Ultra Sonic Sensor Motion Control

Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function. It is used for the detection of intruder.

There is an arrangement done, using two motors, for the horizontal and vertical movement of the sensor. This motor driver circuit is used for the driving of these two motors.

The current driver L293D is used for driving the motors

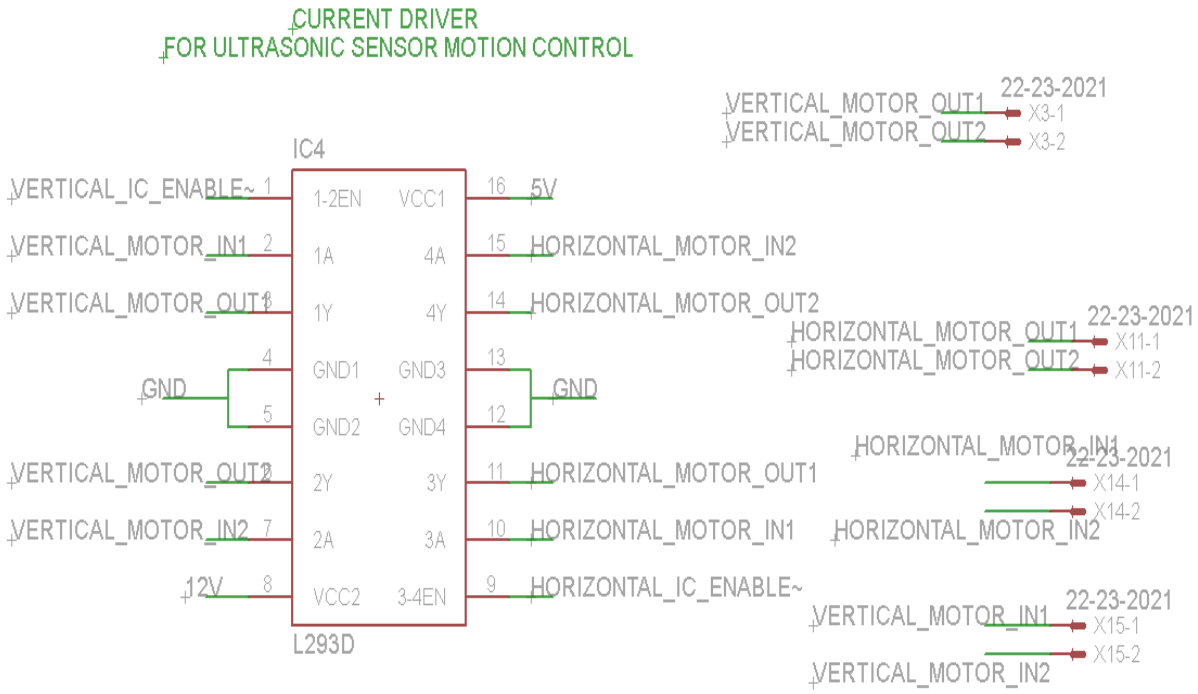

Figure 6.8: Circuit Diagram for Control over the Direction of Ultrasonic sensor

6.2.4 Controller section

This is the section which defines all the connections of the ATmega328, pin-mapped as Arduino, with the various components used.

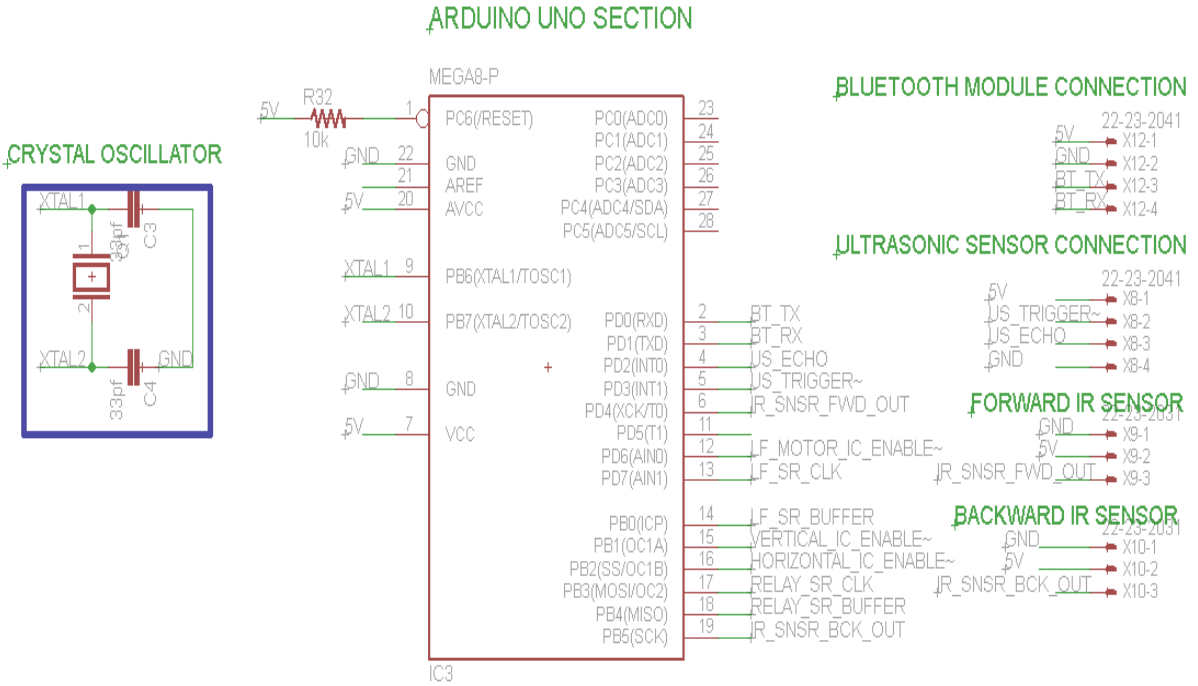

Figure 6.9: Circuit Diagram for Controller Section

6.3 Complete Circuit Diagram

The complete circuit diagram with all the modules and components interfaced for fulfilling the requisites of this project is shown below. The entire embedded system consists of two parts, one is android application and the other one is an electronic controlling circuitry. In the first part the android device is used for communicating with the controlling circuit through Bluetooth module. The android application can be made using app inventor and installed in Smart phones. On the other hand the electronic circuitry consists of a microcontroller (ATmega328), a Bluetooth module (HC-05) and an ultrasonic sensor. The android device sends a command which is received by the receiver of the Bluetooth module and forwards it through its USART serial interface to the microcontroller. After receiving the command, the microcontroller performs the necessary action.

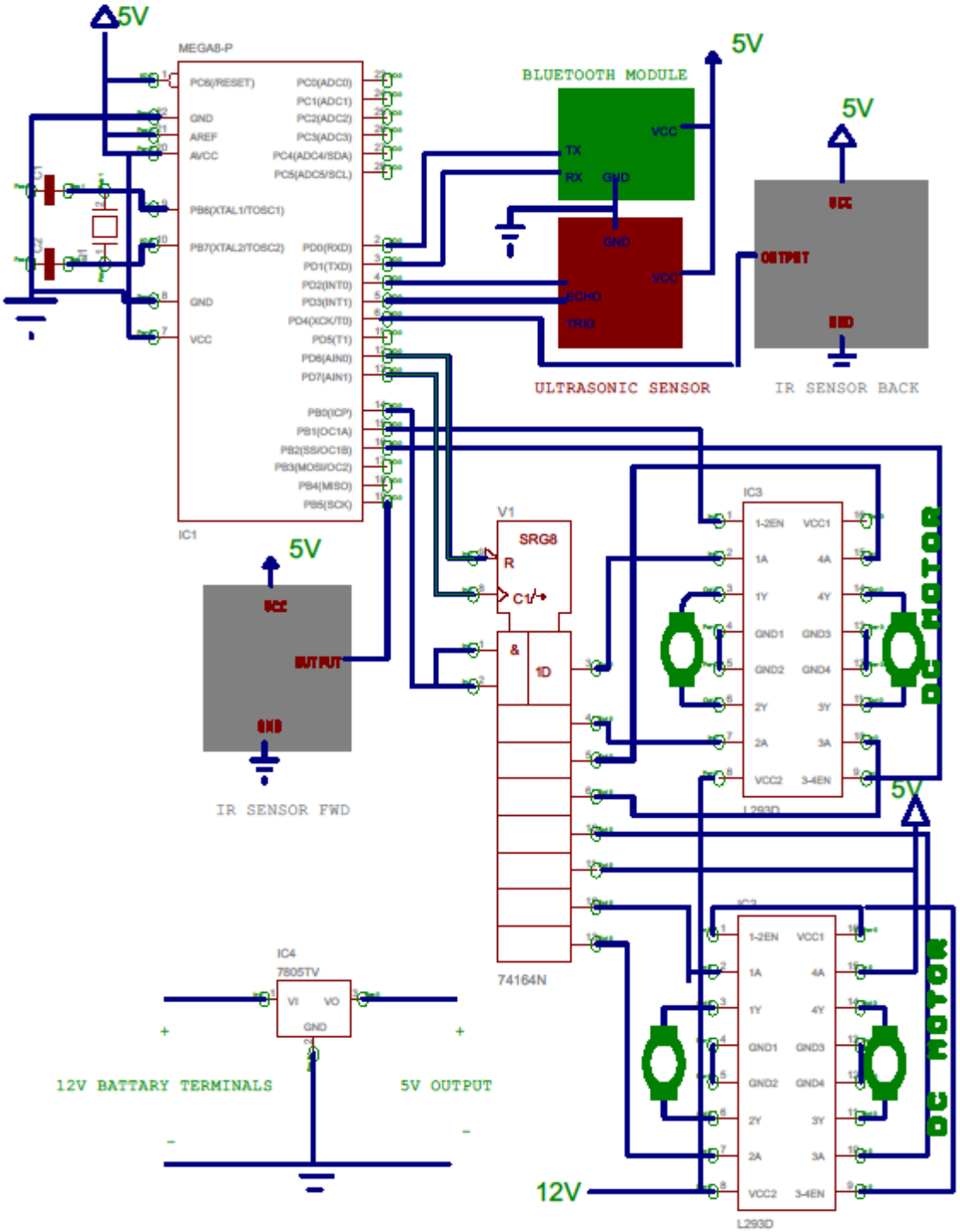

Figure 6.10: Complete Circuit Diagram of the Project

6.4 Android Application Simulation

For the development of android application, MIT app inventor has been used. It uses a graphical interface, which allows users to drag-and-drop visual objects to create an application that can run on Android devices. The main screens of our project have been shown in the snapshots shown below:

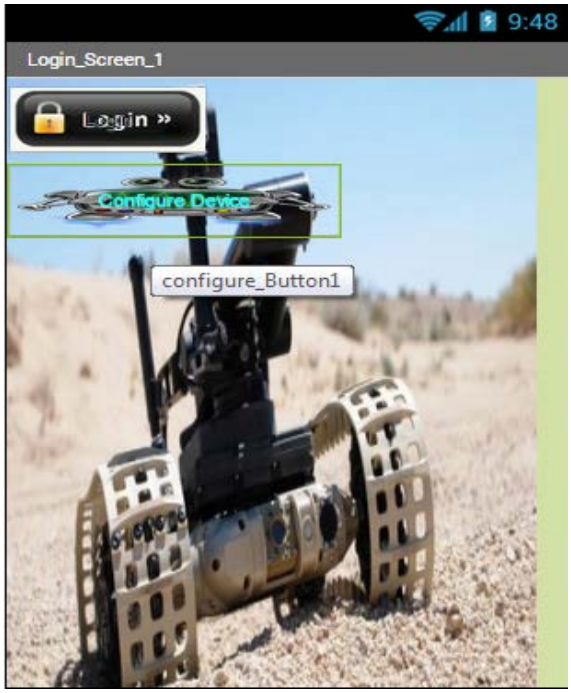

Figure 6.11: Login Screen

Figure 6.12: Cinfigure Screen

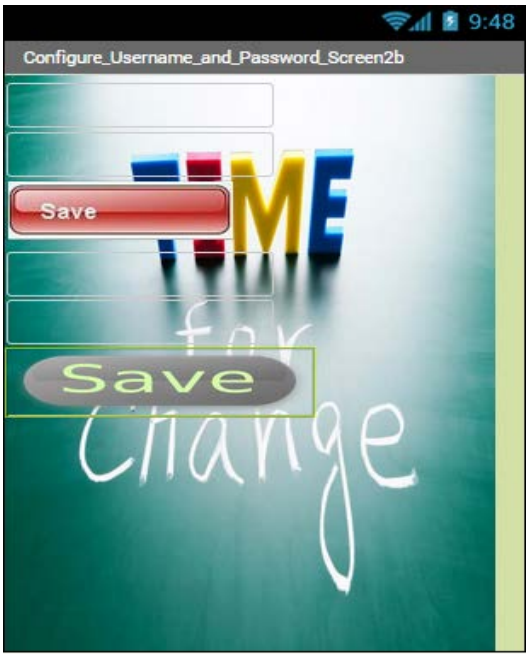

Figure 6.13: username &password screen

Figure 6.14: Configure phone no. screen

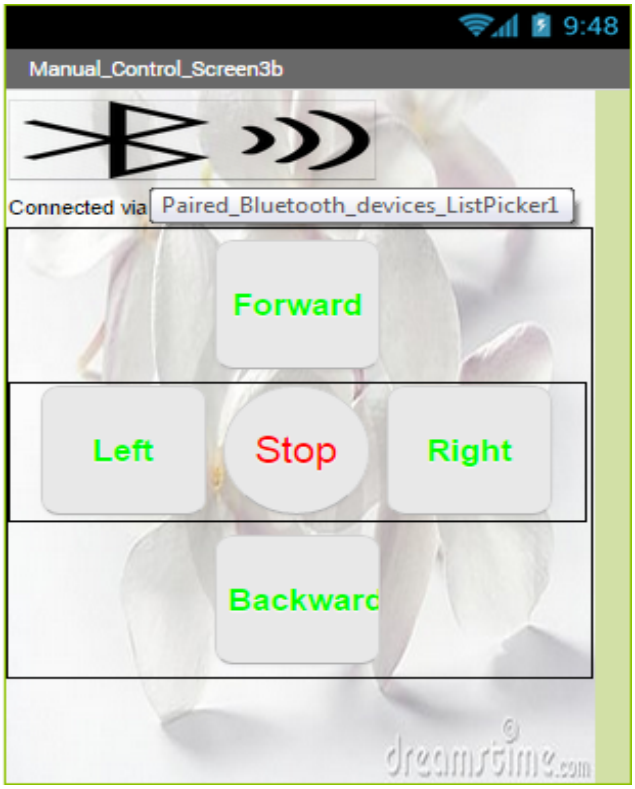

Figure 6.18: Manual Control Screen

6.5 Summary

Chapter 7

CONCLUSION AND FUTURE SCOPE

This chapter contains the conclusion of the entire project and also specifies its future scope. The conclusions mention the results that were supposed to be achieved from the project. It also tells about the limitations of the project that can be removed or minimized by future modifications.

7.1 Conclusion

The central idea which motivated the design of project is to provide an autonomous bot for the surveillance operations, required by the defence services of a country. The designed bot since being exposed to harsh and dangerous environments, should be robust, remotely controlled (wireless tech can serve this purpose), automatic (in terms of detecting any intrusion in its vicinity), reliable, easy to configure and operate, highly responsive and fast to signal the intruder detection. The project's chassis is made up of Aluminium Frame for robust design and light weight along with its protective corrosion layer. It has Arduino Uno as control unit with ATmega328 as CPU which is fast and highly responsive. An Android Application provides a good GUI which is easy to configure and operate. An intrusion is detected by using ultrasonic sensor which is capable of detecting any intrusion in a radius of 4m and alert is signalled through call or SMS to the desired number to server by the remote cell phone connected to the device via Bluetooth Module wirelessly within a range of 10m and it takes 55 seconds to alert the operator/server about the intrusion.

7.2 Future Scope

The concern about the human life will remain a main issue in the future, which in turn leads to the requirement of precise, power efficient, agile, small size and quick surveillance systems. It can be made power efficient by using the power management devices such as Texas instrument's UCC 28910, BQ29700 etc. which has the capability to convert the heat at sink to electrical energy. MSP430F2330 can be used as the CPU which works on 1.3V and 1μA current at considerably reducing power consumption and a much better speed. Solar energy can also be a great substitute for providing independent long time power to the system. A camera can be introduced for

real time recording, monitoring and inspection of the area under surveillance. The use of GSM provides a long distance wireless communication but it is not so reliable in the remote area where no network coverage is available so RF communication could be a better choice.

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