DESIGN AND IMPLEMENTATION OF LONG RANGE SPY ROBOT

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CERTIFICATE OF APPROVAL

The project entitled as "**Design and Implementation of Long Range Spy Robot**" submitted by **Mohammad Rafiqul Hasan**, bearing Matric ID. **ET133041** and **Md. Rabiul Hasan**, bearing Matric ID. **ET133050** of session **Spring 2018**, to the Department of Electrical and Electronic Engineering, International Islamic University Chittagong, has been accepted as satisfactory in partial fulfilment of the requirements for the degree of Bachelor of Science in Engineering and approved for the examination held on **18 May 2018**.

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DECLARATION

It is hereby declared that this work has been done by us and no portion of the work contained in this project has been submitted elsewhere for the award of any degree or diploma.

____

Mohammad Rafiqul Hasan

____

Md. Rabiul Hasan

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Authors

ABSTRACT

With the sophisticated technological advancement nowadays robotics has become a hot field for research. Robots are now used by military forces for reducing risk of their causalities and to defeat their enemies. The major focus of this project is the use of robot in war, peace and as well as their impact on society. Here DTMF signals are used for robot control system. Night vision monitoring system has been added which will capture and transmit the information surrounding the robot to the operator. With this feature the robot can not only transmit real time videos with night vision capabilities but cannot also be identified by the enemies in war zone. A metal detector and GSM module has also been added which will inform us about any bomb underneath the robot vehicle and the location of the robot. The existing sensors in the robot are able to monitor the weather of the robots location.

In this paper, Mobile operated Long range spy Robot is a small robot designed for long range surveillance and inspection purpose.

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CHAPTER 1
INTRODUCTION

1.1 Introduction

Science has brought out wondering technologies to ease human life. Robotics is one of the branches of it which has made human life easier and lessened the workload. It has also enabled us to reduce the participation of human in risky works. Nowadays robots are being used for various purpose in industries, labs, Space and also in battlefield. People are sending robots to places where man can hardly go like in space, underwater, bomb surrounded areas. Wireless communication system has become one of the essential features for commercial products and a popular research topic within the last ten years. There are now more mobile phone subscriptions than wired-line subscriptions. Lately, one area of commercial interest has been low-cost, low-power, and short distance wireless communication used for personal wireless networks. Technology advancements are providing smaller and more cost effective devices for integrating computational processing, wireless communication, and a host of other functionalities.

This project's main functionality is to deal with tough situations where human beings cannot handle situations like darkness, entering narrow and small places and detecting hidden bombs etc. The system is controlled by using Dual Tone Multiple Frequency . Using night vision camera attached to robot situations around the system is observed according which the robot is instructed to move or do other functionalities. Besides with temperature sensor the surrounding weather can be understand, the gas sensor will allow the user to understand if there is any poisonous gas is present in that particular place , sound sensor will allow to detect any kind of noise, with the help of metal detector it can be determined if there are any kind of land mines, GPS module will show the location of the robot.

1.2 Motivation

With the vision to upgrade the relationship between men and robots this project is built. As the name suggests this Assistive Robot can be used for the purpose of assistance of soldiers on battlefield.

From some recent incidences like Holey Artisan Restaurant attack [1] in our country we have that attack two of our policemen were shot and 20 hostages were killed just because we took so long time to find out the location of the terrorists where with the help of this type of spy robots we could easily find out the location of the terrorists and perhaps we could save the civilian lives and the lives of the policemen too.

Another heart touching incidence happened when a small child named Zihad felled into a 600 feet deep pipe of Railway authority. Those accidents show us the lack of surveillance system of our country and limitation of human being in such kind of rescue operations. From those accidents we got our motivation to serve the nation by developing a manually controlled wireless night vision camera mounted robot which will also detect metal or any bomb hidden into the ground. Many conceptual implementation related to our project has also been used in US army and NASA in different operations.

1.3 Objectives

The project has been designed for developing a wireless surveillance robot for helping the soldiers during their operation, war or other situations where human life is at risk. The robot along with camera can wirelessly transmit real time video with camera controlling capabilities and also using a robotic arm anything can be picked or dropped within its limit. This kind of robot can be very useful for helping purpose in war fields. The project is also designed to search invisible metal stuffs from where people are not capable to reach and it is so designed to work in hostile environment where visible light will not be available. Basic objectives that our robot will be able to perform can be noted as follow:

i) To operate in jungles and other environments where human cannot enter during the night.

ii) To get video and Audio signal from remote area by night vision camera.

iii) To find out metal& smoke from remote area.

iv) To control by DTMF.

v) To save manpower.

1.4 Outline of the report

i. Chapter 1 “Introduction” shows the background, motivation and objectives of the project.

ii. Chapter 2 “Literature review” discusses about the history and literature importance of this project.

iii. Chapter 3 “Design Methodology” shows the implementation process of the device.
iv. Chapter 4 “Hardware Description” describes the hardware used in the projects.
v. Chapter 5 “Design Implementation and Analysis” shows the on field implementation of the system that has been designed before.
vi. Chapter 6 “Result and Discussion” shows the performance analysis of the device with proper output.
vii. Chapter 7 “conclusion” shows the limitation and future works in this field.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Nowadays there has been a lot of researches and inventions over unmanned robots. Human life is the most precious thing so nowadays for risky places many countries are using robots instead of human soldiers. Military robots are autonomous robots or remote-controlled mobile robots designed for military applications, from transport to search & rescue and attack. The use of robots in warfare, although traditionally a topic for science fiction, is being researched as a possible future means of fighting wars. Already several military robots have been developed by various armies. For the development of the research on this field many competition has been hosted.

2.1.1 Definition of Long Range Spy Robot

Literally the word robot comes from the slavic word ROBOTA which means labor. Basically a robot is generally an electromechanical machine that is able to perform tasks whether automatically or manually or in both mood. It is also defined as the industrial machine that replaces the human being to work in such condition which is hazardous and unsafe. Long Range Spy Robot can be defined as a machine that detects the mines in war all on its behalf and can be used spying on the enemies and can notify us about the surroundings and its location.

2.2 Present technology

Nowadays with the improvement of technology robots are used in military operations which are not completely automatic. They are actually controlled remotely. The robots or unmanned machines as they are termed, can be any moving object or a flying aero plane fitted with all necessary equipment like sensors, LIDARS (Laser based Communication RADARS), cameras etc. [2] Their operations can be from disposing bombs, to surveying enemy territories.

Generally there are 3 kinds of unmanned machines used in the military operations:

i. Unmanned Ground Vehicle (UGV): They are used for ground purposes. They can carry heavy load, move on uneven terrains and have various sensors and cameras fitted on them.

ii. Unmanned Aerial Vehicle (UAV): They are used to carry aerial weapons and are basically flying machines.

iii. Unmanned Underwater Vehicle (UUV): They are basically submarines or machines which can survey under water. [3]

2.3 Previous Works

Day by day use of unmanned robots in military is increasing. Many developed and developing countries are replacing soldiers with unmanned vehicle in dangerous places.

2.3.1 Radio Operated Robot :

Naskar S. in his present paper tried to explore how a radio frequency controlled robot can be used in defence and in real war field. The robot is radio operated, self-powered, and has back tracking facility, in case of loss of connection from the base station. Wireless cameras will send back real time video and audio inputs which can be seen on a remote monitor in the base station from where the robot is being controlled and action can be taken accordingly. The robot can be controlled from a base station by means of radio frequency. [4]

Advantage:

- His robot can be operated from long distance.

Limitations:

- This robot cannot operate properly at night mode.
- This robot has no weather monitoring system.

2.3.2 Spy Robot

Wai Mo Mo Khaing designed and implemented a similar robot shown in **Fig. 2.1** where a camera is mounted. [5]

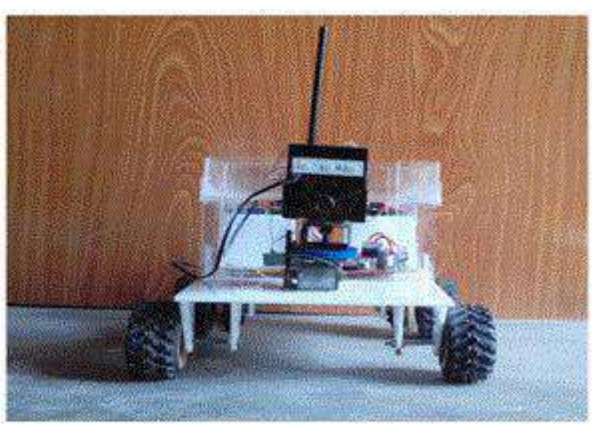


Fig. 2.1 Spy robot made by Wai Mo Mo Khaing and Kyaw Thiha [5]

Advantages:

- It has got better wheel system.

Limitations:

- No metal detector is installed.

2.3.3 Night Vision Spy Robot

Aaruni Jha made a project of spy robot in which night vision camera is attached so that it can operate even in night mode. [6]

Advantages:

- Capable of operating at night mood.

Limitations:

- There are no metal detector in this robot

2.3.4 War Field Helping Robot

Er Vansh Raheja in his project, developed a war field helping robot where a firefighting circuit is also implemented. [7]

Advantages:

- Firefighting circuit implemented.

Limitations:

- There are no metal detector in this robot.
- No weather monitoring system.

2.3.5 Mobile Operated Spy Robot

Dhiraj Singh Patel developed a combat Robot which is capable of multi-tasking and can be controlled by mobile phone [8].

Advantages:

- This can be controlled by mobile phone.

Limitations:

- No metal detector have been used .
- No weather monitoring system.

CHAPTER 3

DESIGN METHODOLOGY

3.1 Introduction

The project entitled “Long Range Spy Robot” is designed and implemented for the betterment of the service of our soldiers in defence. In this project we used DTMF to control the whole robot movement. We’ve also added a night vision camera which will send the real time video from the location. The robot is also capable of detecting landmine or any metal weapon beneath the robot within its range as we’ve connected a metal detector in it. We can also get the temperature of the robots place, we have set a gas sensor which allow us to detect if there are any kind of gas that could be harmful for human body, moreover the robot is capable of detecting noises more than 80DB. The additional ultrasonic sensor will allow us to avoid collision.

3.2 Stages

In the process of completing this project we’ve followed four steps. Which are

1. Planning.
2. Analysing.
3. Designing.
4. Design implementation.

3.2.1 Stage 1 - Planning

At first stage of starting the project we discussed about our project with our supervisor. After the idea being selected he said us to put a considerable name of the project so we came up with the name “Design and Implementation of Long Range Spy Robot” considering our objectives. After naming the project we budgeted our approximate cost on the project. Then we studied on the background work on this field and shockingly we found out that there are not many researches done in this field where in other countries (like America, Japan, China) are using this kind of technology in their defence work. Unfortunately our police and military are still compromising with the old technology that we had many years ago that is why we are still losing lives in war fields. It’s high time we updated our strategy of fighting. Robots can be replaced with soldiers where life is endangered.

Based on our research we found out that present technology that exists today has limitations too. So we pointed them out and planned to fulfil as much as the lacking we can.

3.2.2 Stage 2 - Analysing

After planning about the project we started analysing about some of the spy robots that has been made before. We downloaded some papers from IEEE page which helped us during analysing. We also saw many videos on YouTube on this kind of spy robots and robots that US army uses in their operations. We did our literature review section according to this analysis.

Then we analysed the hardware's operation and their specifications that we are using. Study on suitable programming language and different platforms are important to ensure that the programming language is sufficient to build the proposed system and how to integrate different modules with different platforms into a meaningful system to provide useful information to the user. We also analysed the previous works in our university on this field. There was a work similar to us but they had many limitations which we tried to solve in our project.

We also analysed about some incidences that happened in recent times where application of this robot could be proven beneficial. Like in the incidence of Holey Artisan Restaurant where this type of robot could be proven handy.

3.2.3 Stage 3 - Design

The main project constructing process starts from this stage. Here the entire system will be theoretically designed which will be implemented in the implementation chapter.

3.2.3.1 Block Diagram

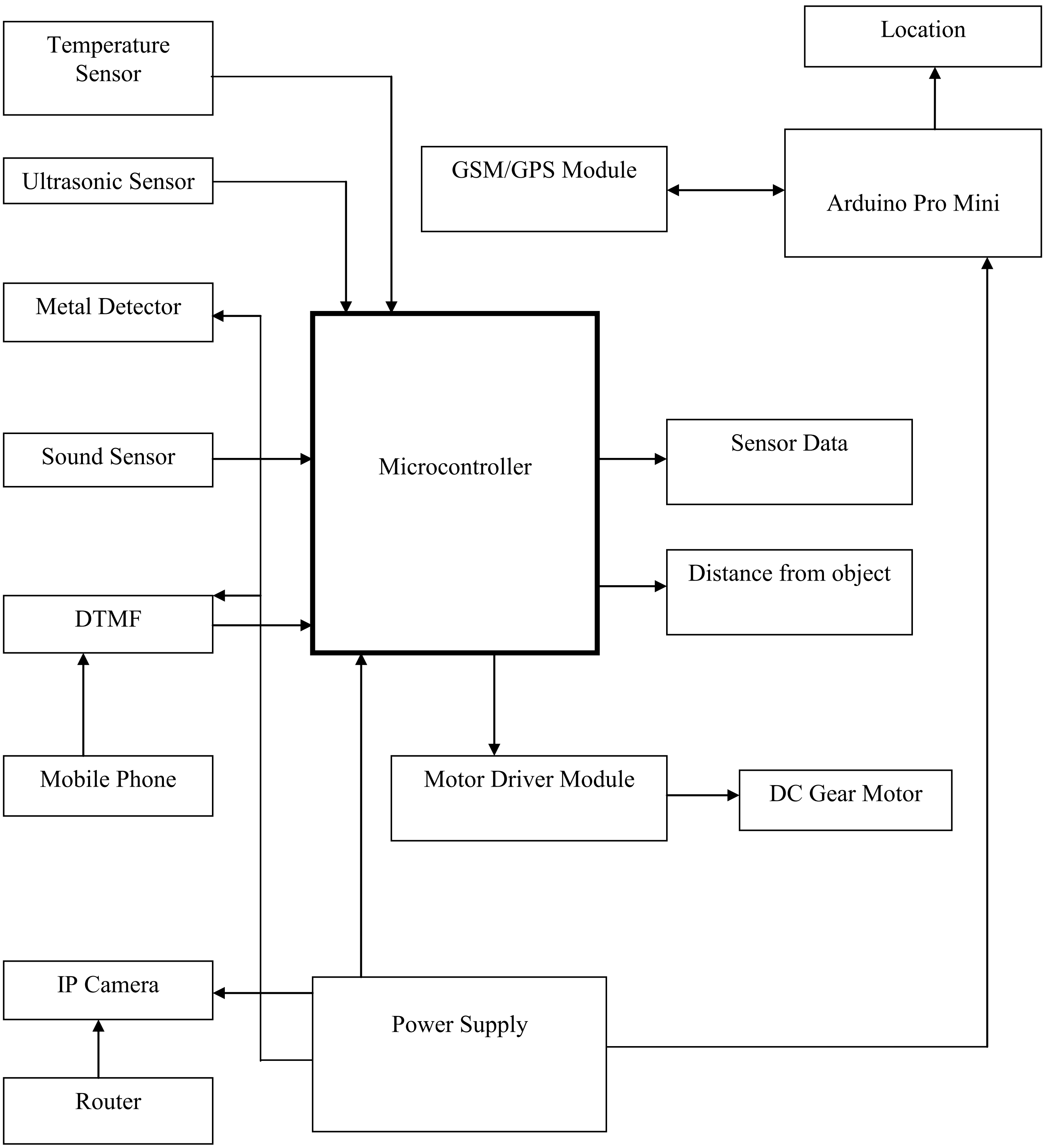


Fig. 3.1 Block diagram of the entire system and subsystem

Fig. 3.1 shows the block diagram representation of the entire robot system is depicted from where its operating procedure can be described. Here will be an DTMF decoder circuit with a mobile phone which will be connected to the motor driver IC when we call to the existing mobile phone the DTMF will allow us to move the wheels .

A subsystem is the gas sensor, sound sensor and the temperature sensor which will show the data in the display , if there is any object in front of the robot ultrasonic sensor will measure the distance and give us the distance in LCD , GPS module will allow us locate the real location of the robot and it will be shown via LCD .

Another subsystem block is the metal detector block which will allow us to detect if there is any kind of land mine beneath the robot , if there are any metals the burger will make sound .

And the last subsystem in the diagram is the wireless video transmitter module which will capture videos and sounds around the robot and its internal transmitter will transmit them to the receiving monitor section. At the receiving monitor section the movement of the camera head is also controlled.

3.2.3.2 Base structure

Fig. 3.2 shows the base structure of the robot chassis or body.

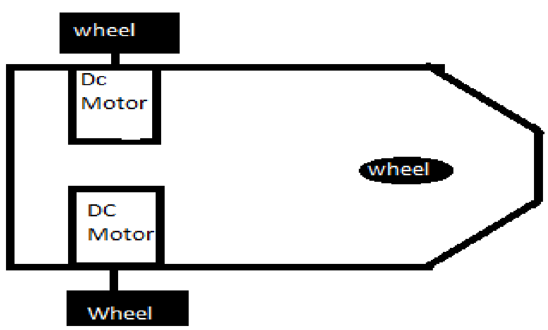


Fig. 3.2 Base structure

3.2.3.3 System Context Diagram

Fig. 3.3 is the system context diagram that the operating of the robot.

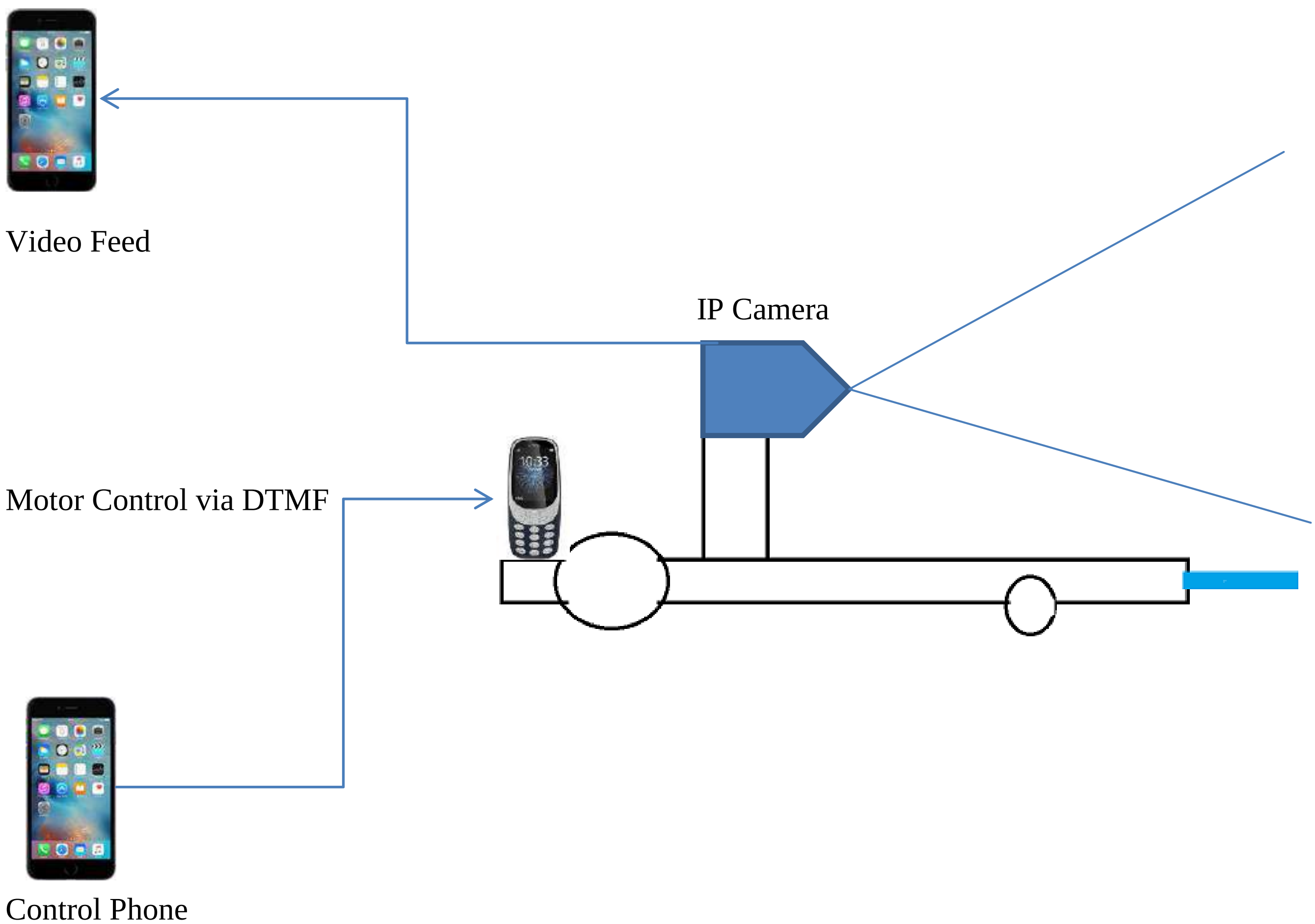


Fig. 3.3 System Context Diagram

3.2.4 Stage 4 - Design implementation

After the completion of all the designs and measurements we started implementing the theoretical designs where all hardware are implemented and functionality is checked. First of all, the base of the robot is built and the wheels are attached.

Secondly, dc gear motors are connected to the wheels and motor driver is connected to the DTMF decoder and motor. Then other subsystems are connected and simulated one by one which will be discussed in the later Hardware implementation section.

Finally, after all the hardware works been done final testing has been performed and results are noted.

CHAPTER 4

HARDWARE DESCRIPTION

4.1 Introduction

In this chapter the description of hardware have been included, The development of this project is based on several types of device. These devices are:

1) DTMF
2) PIC16F73 Microcontroller
3) GPS/GSM Module
4) Arduino Pro Mini
5) Metal Detector
6) Ultrasonic Sensor
7) Temperature Sensor
8) Sound Sensor
9) Gas Sensor MQ2
10) IP camera
11) LCD Display
12) DC Gear Motor
13) Motor Driver Module L298
14) DTMF Receiver IC MT8870
15) Crystal Oscillator
16) Voltage Regulator
17) Rechargeable Battery

4.2 DTMF

DTMF (Dual Tone Multi Frequency) better known as touch-tone is a system of signal tones used in telecommunication. Applications include voice mail, help desks, telephone banking, etc. There are twelve DTMF signals shown in **Fig. 4.1** each of which are made up of two tones from the following selection: 697 Hz, 770 Hz, 852 Hz, 941 Hz, 1209 Hz, 1336 Hz, and 1477 Hz. The tones are divide into two groups (low and high), and each DTMF signal uses one from each group. This prevents many harmonics from being misinterpreted as a part of signal.

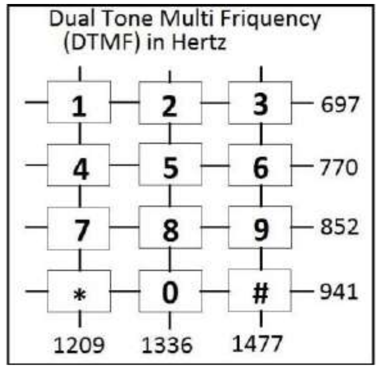


Fig. 4.1: DTMF Technology [16]

DTMF is the generic name for pushbutton telephone signalling equivalent to the Bell System's Touch Tone®. Dual-Tone Multi-Frequency (DTMF) signalling is quickly replacing dial-pulse signalling in telephone networks worldwide. In addition to telephone call signalling, DTMF is becoming popular in interactive control applications, such as telephone banking or electronic mail systems, in which the user can select options from a menu by sending DTMF signals from a telephone. To generate (encode) a DTMF signal, the ADSP-2100 adds together two sinusoids, each created by software. For DTMF decoding, theADSP-2100looks for the presence of two sinusoids in the frequency domain using modified Goertzel algorithms. This chapter shows how to generate and decode DTMF signals in both single channel and multi-channel environments. Realizable hardwires briefly mentioned. DTMF signals are interfaced to the analog world via codec (coder/decoder) chips or linear analog-to-digital (A/D) converters and digital-to analog (D/A) converters. Codec chips contain all the necessary A/D, D/A, sampling and filtering circuitry for a bidirectional analog/digital interface. These codes with on-chip filtering are sometimes called codec/filter combo chips, or combo chips for short. They are referred to as codes in this chapter. The codec channel used in this example is band limited to pass only frequencies between 200Hz and 3400Hz. The codec also incorporates commanding (audio compressing/expanding) circuitry for either of the two commanding standards (A-law and m-255 law). These two standards are explained in Chapter 2, Pulse Code Modulation. Commanding is the process of logarithmically compressing a signal at the source and expanding it at the destination to maintain a high end-to-end dynamic range while reducing the dynamic range requirement within the communication channel. Alternatively, a DTMF keypad could be used for digit entry. In either case, the resultant DTMF tones are generated mathematically and added together. The values are logarithmically compressed and passed to the codec chip for conversion to analog signals. Multi-channel DTMF signal generation is performed by simply timemultiplexing the processor among the channels. On the receiving end, the ADSP-2100 reads the logarithmically compressed, digital data from the codec's 8-bit parallel data bus, logarithmically expands it to its 16-bit linear format, performs a Goertzel algorithm — a fast DFT (discrete Fourier transform) calculation — for each tone to detect, IC MT8870DE which is a touch tone decoder IC. It decodes the input DTMF to 5 digital outputs. The M-8870 DTMF (Dual Tone Multi Frequency) decoder IC uses a digital counting technique to determine the frequencies of the limited tones and to verify that they correspond to standard DTMF frequencies. The DTMF tone is a form of one way communication between the dialer and the telephone exchange. The whole communication consists of the touch tone initiator and the DTMF (Dual Tone Multi Frequency) decoder circuit identifies the dial tone from the telephone line and decodes the key pressed on the remote telephone. Here for the detection of DTMF signalling, we are using the tone decoder or detector. The decoded bits can be interfaced to a computer or microcontroller for further application (For example, Remote control of car, robot using a telephone network, Cell Phone controlled home appliances, Mobile phone controlled robot, etc.). Caller generates a dial tone consisting of two frequencies. It is transmitted via the telephone line (communication media).Telephone exchange consists of a DTMF decoder, which decodes the frequencies in to digital code. DTMF keypad is placed out on a 4 cross 4 matrices, in which each row represents low frequency, each column represents high frequency, with DTMF, each key passed on a phone generates two tones of the specific frequencies one tone is generated from a high frequency tones and low frequency tone. These tones are converted to digital form using DTMF decoder circuit. These codes are the address of the destination which is read and preceded by the computer that connects the caller to the destination. The DTMF decoder circuit used in many electronics projects for better connectivity to control the applications

4.3 PIC 16F73 Microcontroller

PIC (usually pronounced as "pick") is a family of microcontrollers made by Microchip Technology, derived from the PIC1650. originally developed by General Instrument's Microelectronics Division. The name PIC initially referred to Peripheral Interface Controller, then it was corrected as Programmable Intelligent Computer.

4.3.1 Description

This powerful (200 nanosecond instruction execution) yet easy-to-program (only 35 single word instructions) CMOS FLASH based 8-bit microcontroller packs shown in **Fig. 4.2** Microchip's powerful PIC architecture into 28-pin package and is upwards compatible with the PIC16C5X, PIC12CXXX and PIC16C7X devices. The PIC16F73 features 5 channels of 8-bit Analog-to-Digital (A/D) converter with 2 additional timers, 2 capture/compare/PWM functions and the synchronous serial port can be configured as either 3-wire Serial Peripheral Interface (SPI™) or the 2-wire Inter-Integrated Circuit (I²C™) bus and a Universal Asynchronous Receiver Transmitter (USART). All of these features make it ideal for more advanced level A/D applications in automotive, industrial, appliances and consumer applications.

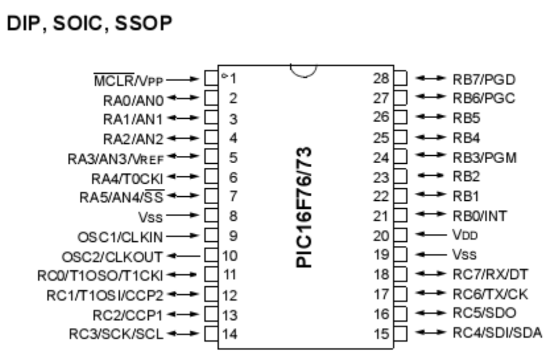


Fig. 4.2 Pin diagram of PIC16F73 Microcontroller IC [17]

4.3.2 Key feature

Table 4.1 shows the key feature of PIC16F73 microcontroller IC.

Table 4.1 Key feature of PIC16F73 microcontroller IC

Key Features	PIC16F73
Operating Frequency	DC - 20 MHz
RESETS (and Delays)	POR, BOR (PWRT, OST)
FLASH Program Memory (14-bit words)	4K
Data Memory (bytes)	192
Interrupts	11
I/O Ports	Ports A,B,C
Timers	3
Capture/Compare/PWM Modules	2
Serial Communications	SSP, USART
Parallel Communications	—
8-bit Analog-to-Digital Module	5 Input Channels
Instruction Set	35 Instructions
Packaging	28-pin DIP 28-pin SOIC 28-pin SSOP 28-pin MLF

4.3.3 Pin Description

Table 4.2 shows the pin description of PIC16F73 microcontroller IC.

Table 4.2 Pin description of PIC16F73 Microcontroller IC

Pin Number	Pin Name	Description
1	MCLR/Vpp	Master clear (reset) input or programming voltage input. This PIN is an active low reset to be the device
2	RAO/ANO	PORTC Is a bi-direction I/O Port
		RA0 can also be analog input 0
3	RA1/AN1	RA1 can also be analog input 1
4	RA2/AN2	RA2 can also be analog input 2
5	RA3/AN3Vref	RA3 can also be analog input 3 or analog reference voltage
6	RA4/TOCKI	RA4 can also be the clock input to the Timer0 module output is open drain type
7	RA5/SS/AN5	RA5 can also be analog input 4 or the slave select for the synchronous serials port

8	Vss	Ground reference for logic and i/o pins
9	OSC1/CLKIN	Oscillator crystal input/external clock source
10	OSC2/CLKOUT	Oscillator crystal input
11	RCO/T1OSO/T1CKT	PORTC Is a bi-direction I/O Port
		RC0 can also be the timer1 oscillator output or timer 1 clock input
12	RC1/T1OSI	RC1 can also be the timer1 oscillator input
13	RC2/CCP1	RC2 can also be the capture1 input/compare1 output/pwm1 output
14	RC3/SCK/SCL	RC3 can also be the synchronous serials clock input/output for both SPI and I2C modes
15	RC4/SDI/SDA	RC4can also be the SPI data in (SPI mode) or date I/O (I2C mode)
16	RC5/SDO	RC5 can also be the SPI date out(SPI mode)
17	RC6	RC6 can also be the SPI date out(SPI mode)
18	RC7	RC7 can also be the SPI date out(SPI mode)
19	Vss	Ground reference for logic and i/o pins
20	Vdd	Positive supply for logic and i/o pins
21	RB0/INT	PORTB can be software program for weak pull on al input
		RBO can also be the external interrupt pin
22	RB1	Interrupt on change pin
23	RB2	Interrupt on change pin
24	RB3	Interrupt on change pin
25	RB4	Interrupt on change pin
26	RB5	Interrupt on change pin
27	RB6	Interrupt on change pin. Serial programming clock
28	RB7	Interrupt on change pin. Serial programming data

4.4 GPS/GSM Module

Fig. 4.3 GSM/GPRS module [18]

The SIM800L module shown in **Fig. 4.3** supports quad-band GSM/GPRS network, available for GPRS and SMS message data remote transmission. The SIM800L communicates with microcontroller via UART port, supports command including 3GPP TS 27.007, 27.005 and SIMCOM enhanced AT Commands. It also has built-in level translation, so it can work with microcontroller of higher voltage than 2.8V default. Besides, the board also supports A-GPS technique which is called mobile positioning and gets position by mobile network. This features make it can also be a tracker module.

Features:

- Quad-band 850/900/1800/1900MHz
- GPRS multi-slot class12 connectivity: max. 85.6kbps(down-load/up-load)
- GPRS mobile station class B
- Controlled by AT Command (3GPP TS 27.007, 27.005 and SIMCOM enhanced AT Commands)
- Supports Real Time Clock
- Supply voltage range 3.4V ~ 4.4V
- Supports A-GPS
- Supports 3.0V to 5.0V logic level
- Low power consumption, 1mA in sleep mode

- Compact size 23mm x 35mm x 5.6mm
- Micro SIM Card

4.5 Arduino Pro Mini

The Pro Mini is not physically compatible with Arduino shields (it could be still hard-wire up to any Arduino shield).The Pro Mini in **Fig. 4.4** uses the same ATmega328 and also has same 14 digital i/o pins,6 analog pins as in Uno. Though it differs from Uno by some hardware changes such as, Size-Pro mini is just 1.3x0.70" and it is about 1/6th the size of the Arduino Uno, Operating voltage-Pro mini has only one regulator on board either 3.3V or 5V unlike Uno which has both 5V and 3.3V and the Clock Speed is 8MHz from 3.3v model which is half the speed of Uno. As said before, there are two versions of Pro mini(3.3v and 5v).So how to know the difference between this two will be worth mentioning. There is a voltage regulator on the Pro mini(red box shown in the image) which makes the difference i.e. If the label of that regulator is given as KB33 mean it is 3.3v model and KB50 means 5v model. Also you can measure the voltage between the Vcc and Gnd pin which determines the model.

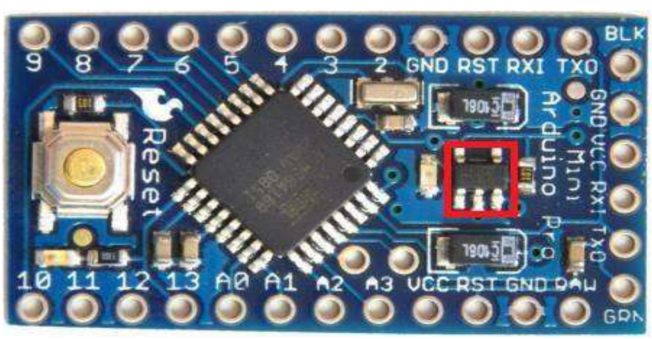


Fig. 4.4 Arduino Pro mini [19]

4.5.1 Specification

i. Microcontroller - ATmega328

ii. Operating Voltage - 3.3V or 5V (depending on model)

iii. Input Voltage - 3.35 -12 V (3.3V model) or 5 - 12 V (5V model)

iv. Digital I/O Pins - 14 (of which 6 provide PWM output)

v. Analog Input Pins - 6

vi. DC Current per I/O Pin - 40 mA

vii. Flash Memory - 32 kB (of which 0.5 kB used by bootloader)

viii. SRAM - 2 kB

ix. EEPROM - 1 kB

x. Clock Speed - 8 MHz (3.3V model) or 16 MHz (5V model)

4.5.2 Arduino Pro Mini Pinouts

Fig. 4.5 shows Arduino Pro mini pinouts.

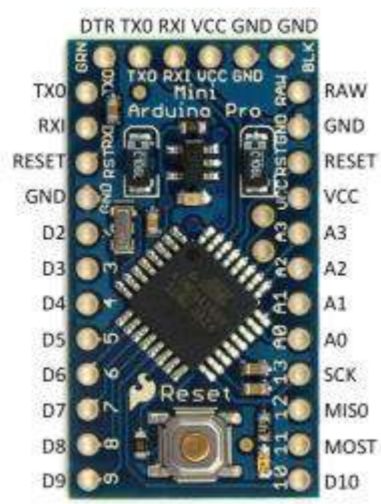


Fig. 4.5 Arduino Pro mini pinouts [19]

i. RAW: For supplying a raw (regulated) voltage to the board

ii. VCC: The regulated 3.3 or 5 volt supply

iii. GND: Ground pins

iv. RX: Used to receive TTL serial data

v. TX: Used to transmit TTL serial data

vi. Digital I/O pins(2 and 3): These pins can also be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value

vii. Digital I/O pins(3, 5, 6, 9, 10, and 11): They can also be configured to provide 8-bit PWM output

viii. Digital I/O pins(10, 11, 12 and 13): They can also be configured as SPI pins-10 - (SS), 11 - (MOSI), 12 - (MISO) and 13 - (SCK)

ix. Analog input pins: A0 to A7 in which A4 and A5 can also be used as IIC pins where A4 - (SDA) and A5 – (SCL).

x. Reset: The microcontroller can be reset by bringing this pin low.

4.6 Metal Detector

A metal detector shown in **Fig. 4.6** is an electronic instrument which detects the presence of metal nearby. Metal detectors are useful for finding metal inclusions hidden within objects, or metal objects buried underground. They often consist of a handheld unit with a sensor probe which can be swept over the ground or other objects. If the sensor comes near a piece of metal this is indicated by a changing tone in earphones, or a needle moving on an indicator. Usually the device gives some indication of distance; the closer the metal is, the higher the tone in the earphone or the higher the needle goes. Another common type are stationary "walk through" metal detectors used for security screening at access points in prisons, courthouses, and airports to detect concealed metal weapons on a person's body

Fig. 4.6 Metal Detector Module [14]

4.7 Ultrasonic Sensor:

The Ultrasonic Sensor shown in **Fig. 4.7** sends out a high-frequency sound pulse and then times how long it takes for the echo of the sound to reflect back. The sensor has 2 openings on its front. One opening transmits ultrasonic waves, (like a tiny speaker), the other receives them, (like a tiny microphone). The speed of sound is approximately 341 meters (1100 feet) per second in air. The ultrasonic sensor uses this information along with the time difference between sending and receiving the sound pulse to determine the distance to an object. It uses the following mathematical equation ,

Distance = Time x Speed of Sound/2

Time = the time between when an ultrasonic wave is transmitted and when it is received

You divide this number by 2 because the sound wave has to travel to the object and back.

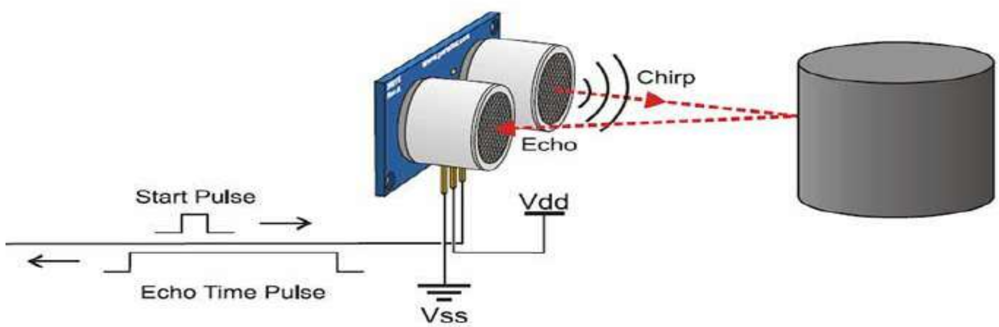


Fig. 4.7 Ultrasonic sensor working [13]

4.8 Temperature Sensor (LM 35):

The LM35 shown in **Fig. 4.8** is one kind of commonly used temperature sensor that can be used to measure temperature with an electrical o/p comparative to the temperature (in °C). It can measure temperature more correctly compare with a thermistor. This sensor generates a high output voltage than thermocouples and may not need that the output voltage is amplified. The LM35 has an output voltage that is proportional to the Celsius temperature. The scale factor is .01V/°C.

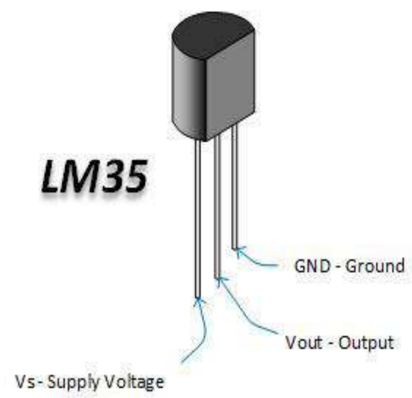


Fig. 4.8 Temperature Sensor LM35 [10]

The LM35 does not need any exterior calibration and maintains an exactness of +/-0.4°C at room temperature and +/-0.8°C over a range of 0°C to +100°C.One more significant characteristic of this sensor is that it draws just 60 micro amps from its supply and acquires a low self-heating capacity. The LM35 temperature sensor available in many different packages like T0-46 metal can transistor-like package, TO-92 plastic transistor-like package, 8-lead surface mount SO-8 small outline package.

4.9 Sound Sensor

There are several types of sound sensors (microphones) like dynamic microphone, condenser microphone, ribbon microphone, carbon microphone etc. Our microphone is dynamic and uses induction coil positioned in the magnetic field of a permanent magnet attached to the diaphragm.

4.9.1 Description

The sound sensor module shown in **Fig. 4.9** provides an easy way to detect sound and is generally used for detecting sound intensity. This module can be used for security, switch, and monitoring applications. Its accuracy can be easily adjusted for the convenience of usage. It uses a microphone which supplies the input to an amplifier, peak detector and buffer. When the sensor detects a sound, it processes an output signal voltage which is sent to a microcontroller then performs necessary processing.

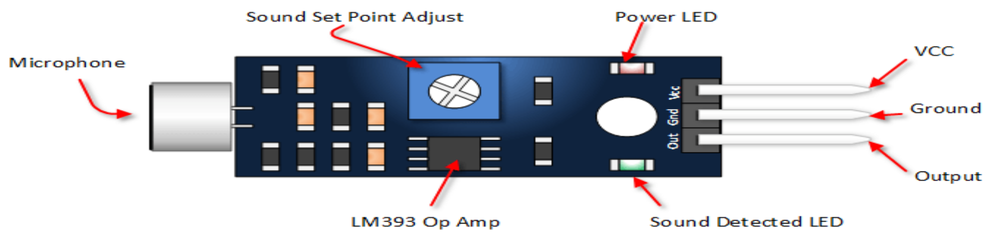


Fig. 4.9 Digital Sound Sensor [11]

4.9.2 Specifications:

The specifications of sound sensor are given below

i. Operating voltage 3.3V-5V
ii. Output model: digital switch outputs (0 and 1, high or low level)

4.10 Gas Sensor MQ-2

The used Gas sensor is MQ-2 it has been described below.

4.10.1 Description

The MQ-2 Gas Sensor module detects gas leakage in home and industry. The MQ series of gas sensors use a small heater inside with an electrochemical sensor. They are sensitive to a range of gasses and are used indoors at room temperature. The output is an analog signal and can be read with an analog input of the Arduino. **Fig. 4.10** & **Fig. 4.11** show MQ2 gas sensor module & pinout respectively.

Fig. 4.10 Gas Sensor module [12]

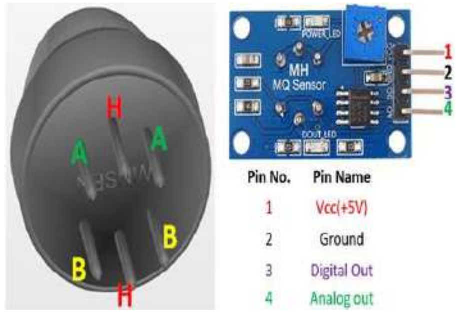


Fig. 4.11 Gas Sensor Pin out [12]

4.10.2 Features

1. Wide detecting scope
2. High sensitivity and fast response
3.Long life and stable
4. Simple drive circuit

Due to its fast response time and high sensitivity, measurements can be taken as soon as possible. The sensor sensitivity can be adjusted by using the potentiometer.

4.11 IP Camera

An Internet Protocol Camera, commonly referred to as an IP camera, is a digital video camera much like a webcam, which transmits and receives data over a network or the internet. Unlike an ordinary webcam it is a standalone unit with its own IP address that requires nothing more than a network connection in order to transfer images. The IP camera connects to a network in exactly the same way as any other standard network device such as a laptop, tablet or printer. IP cameras capture images in much the same way as a digital camera, and compress the files to transmit over the network. IP cameras may be used with a wired network connected via ethernet cable to a broadband modem or router, or wirelessly via a Wi-Fi router. The images captured by an IP camera may be viewed from anywhere in the world via the internet, whether via pc, laptop or mobile phone. In many cases, as well as being able to view video footage and listen to audio streaming, the camera may also be controlled remotely. **Fig. 4.12** shows the IP camera that is used in this project.

Fig. 4.12: 360 degree rotating IP camera[15]

4.12 LCD Display

Liquid Crystal Display shown in **Fig. 4.13** also called as LCD is very helpful in providing user interface as well as for debugging purpose. A liquid crystal display (LCD) is a flat panel display that uses the light modulating properties of liquid crystals (LCs). LCD Modules can present textual information to user. LCD panels typically use thinly-coated metallic conductive pathways on a glass substrate to form the cell circuitry to operate the panel. It is usually not possible to use soldering techniques to directly connect the panel to a separate copper-etched circuit board. Instead, interfacing is accomplished using either adhesive plastic ribbon with conductive traces glued to the edges of the LCD panel, or with an elastomeric connector which is a strip of rubber or silicone with alternating layers of conductive and insulating pathways, pressed between contact pads on the LCD and mating contact pads on a circuit board.

Fig. 4.13 Liquid Crystal Display [20]

4.13 DC Gear Motor

Geared DC motors shown in **Fig. 4.14** can be defined as an extension of DC motor which already had its Insight details demystified here. A geared DC Motor has a gear assembly attached to the motor. The speed of motor is counted in terms of rotations of the shaft per minute and is termed as RPM .The gear assembly helps in increasing the torque and reducing the speed. Using the correct combination of gears in a gear motor, its speed can be reduced to any desirable figure. This concept where gears reduce the speed of the vehicle but increase its torque is known as gear reduction. This Insight will explore all the minor and major details that make the gear head and hence the working of geared DC motor.

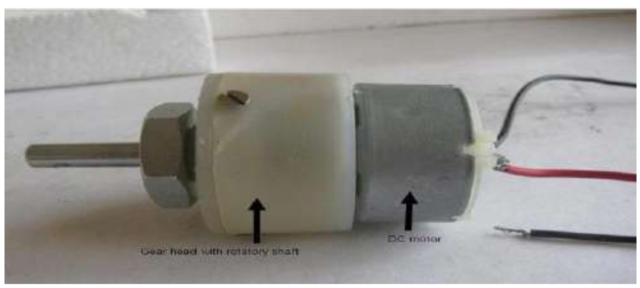


Fig. 4.14 DC Gear Motor [9]

A small motor (ac induction, permanent magnet dc, or brushless dc) designed specifically with an integral (not separable) gear reducer (gearhead). The end shield on the drive end of the motor is designed to provide a dual function. The side facing the motor provides the armature/rotor bearing support and a sealing provision through which the integral rotor or armature shaft pinion passes. The other side of the end shield provides multiple bearing supports for the gearing itself, and a sealing and fastening provision for the gear housing. This construction provides many benefits for a user and eliminates the guesswork of sizing a motor and gear reducer on your own.

i. Using the right sized motor and gear head combination for an application helps to prolong gear motor life and allows for optimum power management and power utilization. Traditionally, design engineers oversized motors and gearheads to add “safety factors” — Bodine “factory matched” gear motors consistently deliver rated performance.

ii. Quieter operation due to integral castings and integral pinion, ground or hobbed on the armature or rotor shaft. Fewer parts requiring assembly resulting in "near perfect" alignment of the rotor, pinion and gear train.

iii. Minimum risk of lubricant leakage, because of "O-ring" and lip seal construction. The design can be more compact and the lubrication can be controlled better (for various mounting configurations).

iv. Gear motors eliminate the need for motor/gear head couplings and eliminate any potential bearing alignment problems, common when a motor and gear head are bolted together by an end-user (separable gear heads). Misalignment can result in bearing failure due to fretting corrosion.

v. Separable motor and gearhead solutions make more sense in larger integral horsepower (>1 HP) applications. For example, when a 100-pound motor is mounted to a 500-pound gear head.

4.14 Motor Driver Module L298

The L298N is a dual H-Bridge motor driver which allows speed and direction control of two DC motors at the same time. The module can drive DC motors that have voltages between 5 and 35V, with a peak current up to 2A. **Fig.** 4.15 , **Fig.** 4.16 show motor driver module and working principle respectively.

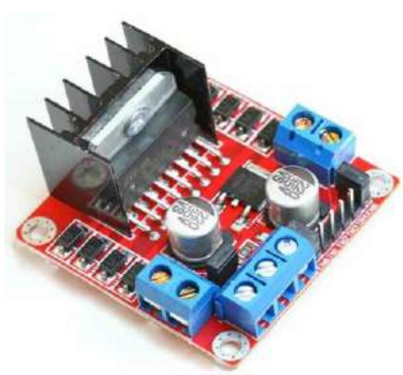


Fig. 4.15 Motor Driver Module [21]

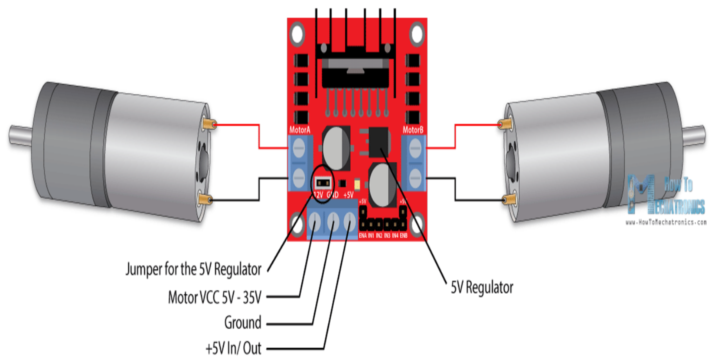


Fig. 4.16 Motor Driver Module working [21]

The module has two screw terminal blocks for the motor A and B, and another screw terminal block for the Ground pin, the VCC for motor and a 5V pin which can either be an input or output. Figure 4.14 & 4.15 show motor driver module and its connection with motor.

4.15 DTMF Decoder (IC MT8870)

The MT8870 is a complete DTMF receiver integrating both the bandsplit filter and digital decoder functions. The filter section uses switched capacitor techniques for high and low group filters; the decoder uses digital counting techniques to detect and decode all 16 DTMF tone-pairs into a 4-bit code. This circuit detects the dial tone from a telephone line and decodes the keypad pressed on the remote telephone. The dial tone we heard when we pick up the phone set is call Dual Tone Multi-Frequency, DTMF in short. The name was given because the tone that we heard over the phone is actually make up of two distinct frequency tone, hence the name dual tone. The DTMF tone is a form of one way communication between the dialer and the telephone exchange. A complete communication consists of the tone generator and the tone decoder. These digital bits can be interface to a computer or microcontroller for further application e.g. remote control, phone line transfer operation, LEDs etc.

4.16 Crystal Oscillator

A crystal oscillator shown in **Fig. 4.17** is an electronic oscillator circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a precise frequency. This frequency is often used to keep track of time, as in quartz wristwatches, to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies for radio transmitters and receivers. The most common type of piezoelectric resonator used is the quartz crystal, so oscillator circuits incorporating them became known as crystal oscillators, but other piezoelectric materials including polycrystalline ceramics are used in similar circuits. A crystal oscillator, particularly one made of quartz crystal, works by being distorted by an electric field when voltage is applied to an electrode near or on the crystal. This property is known as electrostriction or inverse piezoelectricity. When the field is removed, the quartz - which oscillates in a precise frequency - generates an electric field as it returns to its previous shape, and this can generate a voltage. The result is that a quartz crystal behaves like an RLC circuit.

Fig. 4.17: Crystal Oscillator [22]

4.17 Voltage Regulator

A voltage regulator IC shown in **Fig. 4.18** is used to convert the voltage from an upper level to lower level. AC voltages are subject to spikes and dips from occurrences such as lighting .Power supplies that use them as input will also have these surges. The role of an IC (or integrated circuit) voltage regulator is to help controlling these variations in the voltage. A voltage regulator generates a fixed output voltage of a pre-set magnitude that remains constant regardless of changes to its input voltage or load condition.

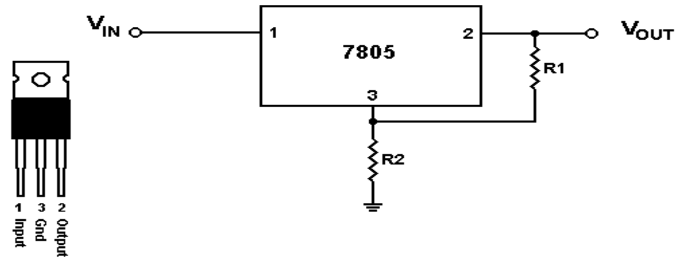


Fig. 4.18: Voltage Regulator IC [23]

4.18 Rechargeable Battery

A rechargeable battery, storage battery, secondary cell shown in **Fig. 4.19** is a type of electrical battery which can be charged, discharged into a load, and recharged many times, as opposed to a disposable or primary battery, which is supplied fully charged and discarded after use. It is composed of one or more electrochemical cells. Rechargeable batteries are produced in many different shapes and sizes, ranging from button cells to megawatt systems connected to stabilize an electrical distribution network. Several different combinations of electrode materials and electrolytes are used, including lead–acid, nickel–cadmium (NiCd), nickel–metal hydride (NiMH), lithium-ion (Li-ion), and lithium-ion polymer(Li-ion polymer).

Fig. 4.19: Rechargeable Battery [24]

CHAPTER 5

SYSTEM DEVELOPMENT AND ANALYSIS

5.1 Introduction

This chapter is all about implementing the theoretical concepts into reality. Here the entire system is assembled and its performance is analysed. The system of long range spy robot is more simple than other robots.

5.2 System Architecture

The system architecture shown in **Fig. 5.1** refers to the entire system with all their subsystems and their process of proceeding where application block indicates all the facilities that the operator is provided with. In the architecture the robot is controlled via DTMF which allow us to control the robot from a remote location . Here microcontroller is the brain of the entire system and subsystems which coordinates between all the subsystems. If the metal detector sense any metal the buzzer over the metal detector makes sound or it keep on looking for metal. The existing sound detector on the robot will detect if there is any sound over 80dB and a message Noise Detected will appear on the display. Obstacle sensor will detect how long distance the obstacle is situated. Temperature sensor will sense the room temperature and show it on display. If there is any Gas the gas sensor will detect its intensity on the display. The whole Situation will be observed through mobile phone via IP Camera.

One of the other subsystems work almost individually that is it does not interface with other microcontroller. And the last subsystem block uses a GSM system to communicate with the operator and send its real time location.

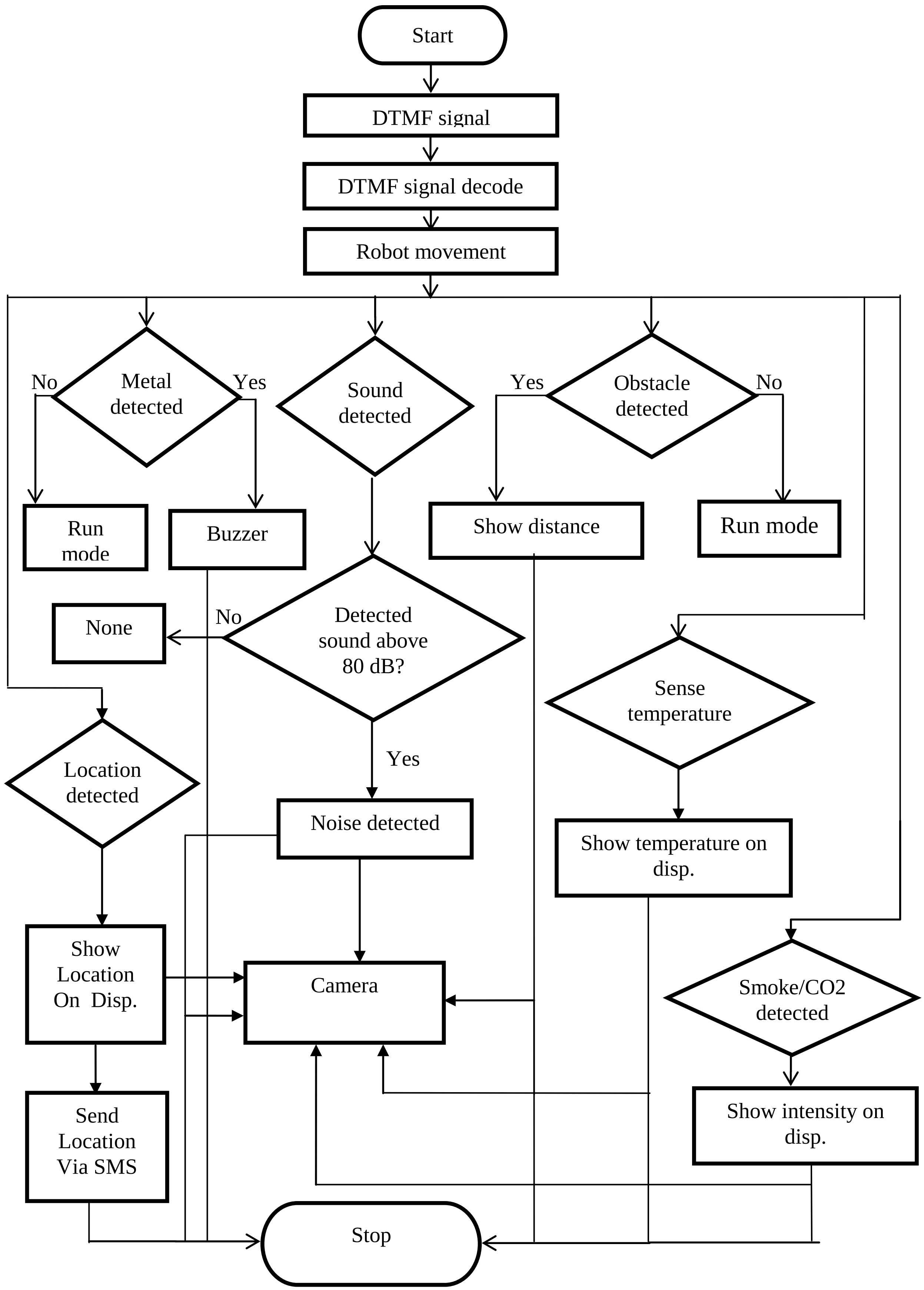


Fig. 5.1 System Architecture

5.3 DTMF Circuit

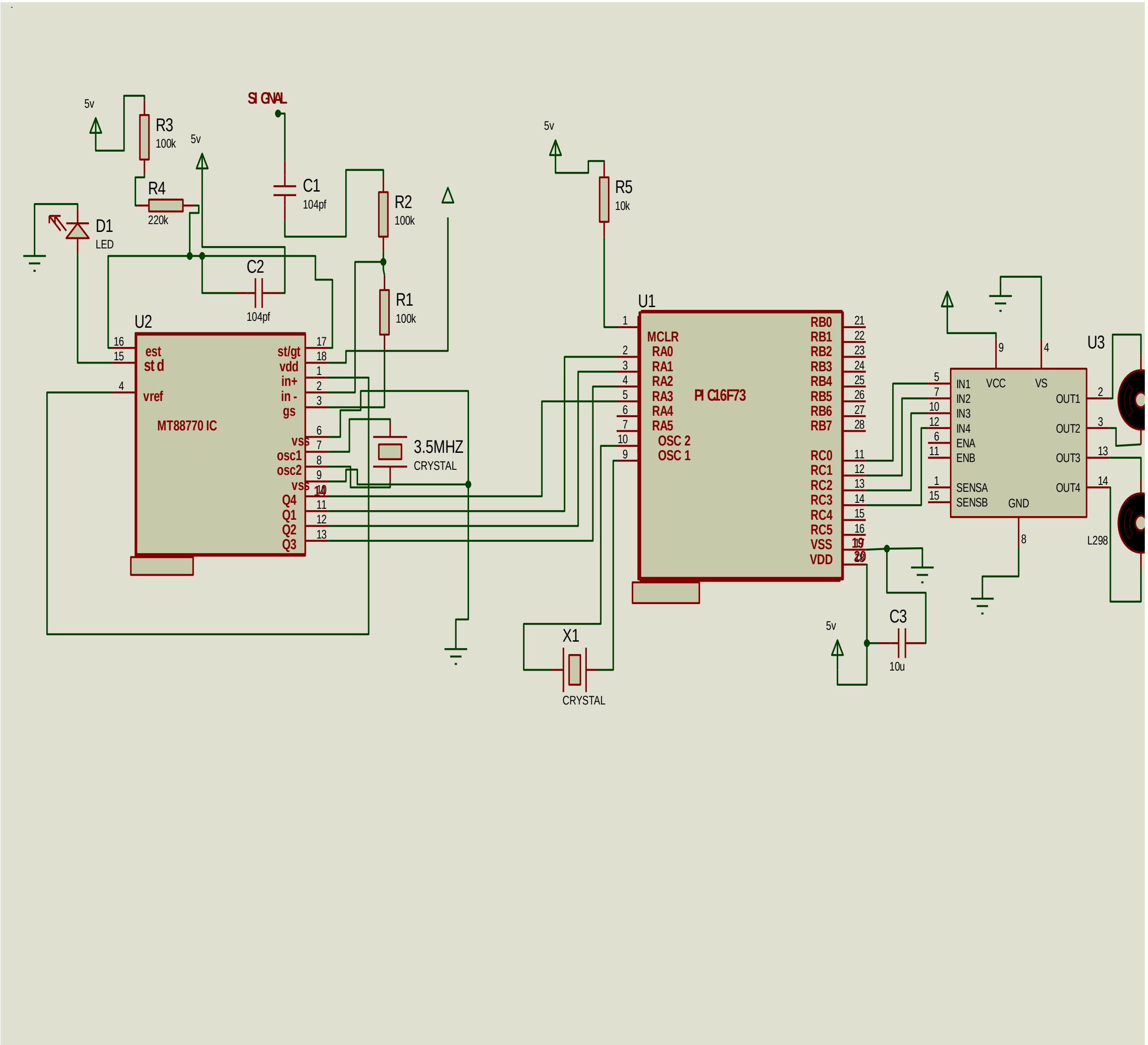


Fig. 5.2 DTMF Circuit

The **Fig. 5.2** shows the DTMF circuit of the project, this figure shows interfacing between DTMF decoder IC (MT8870) with microprocessor to the motor driver which helps to move the robot.

5.4 Location Tracker

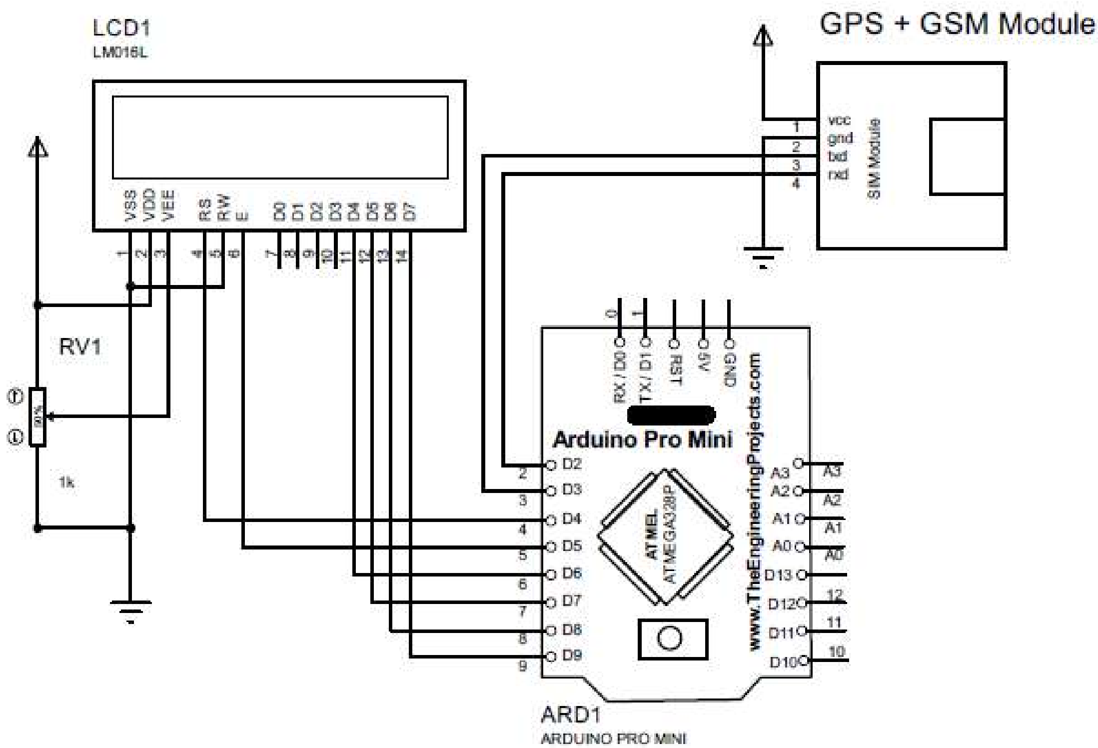


Fig. 5.3: Location tracker circuit diagram

The above figure(**Fig. 5.3**) shows that the interfacing between arduino pro mini with sim800L and LCD display which gives the exact location of the Long Range Spy Robot, with this feature the operator can find location of the robot.

5.5 Distance Measurement

The following figure (**Fig. 5.4**) is the distance measurement circuit implemented on the robot, where the microprocessor (PIC16F73) interfaced with the ultrasonic sensor and show the object distance in the LCD. The circuit implemented so that the robot can be operated in low visibility.

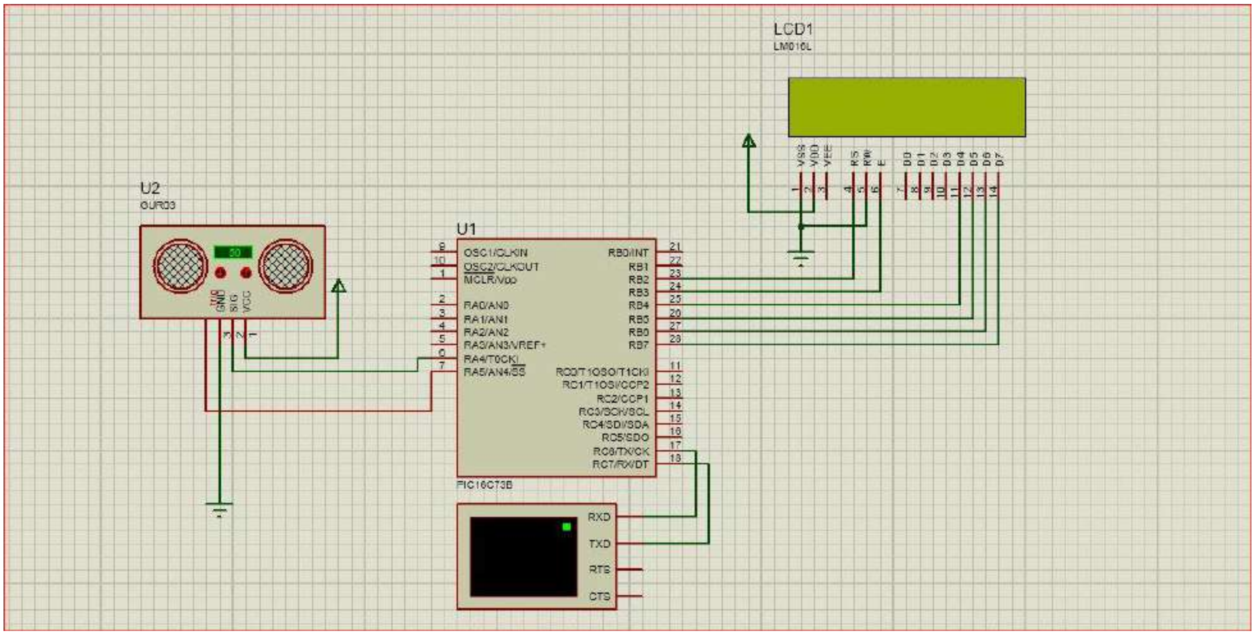


Fig. 5.4 Distance measurement circuit Diagram

5.6 Weather Monitoring System

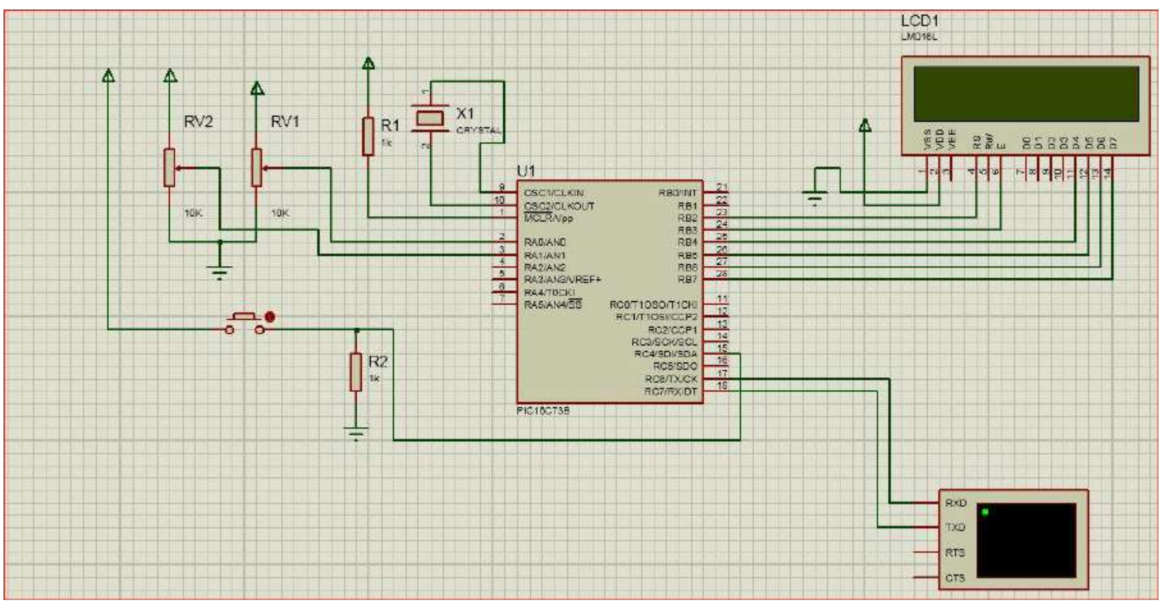


Fig. 5.5 Weather Monitoring System

The **Fig. 5.5** shows that the weather monitoring system by which the operator can learn about the entire weather situation of a particular place. In this circuit the microprocessor interfaced with Temperature sensor, gas sensor and sound sensor and the data shows in the display.

5.7 Working of the Entire system

In the robot initially it when it is switched on in different sections of the base it awaits for the signal from the Mobile. Initial starts up of the robot vehicle energizes up the metal detector's coil which produces a magnetic field around it. When this magnetic field is cut by any metallic conductor then it makes a sound which can be detected via the mic of the IP Camera.

At the same time the DTMF decoder receives a signal from the mobile phone. The DTMF decoder circuit will send the data to microprocessor for further processing the microprocessor will process the motor driver circuit and will help to move the robot.

The existing sensors in the Long Range Spy Robot will sent the data to a microprocessor, the microprocessor initializes farther steps which was programmed and uploaded before . The robot will show the data received from the sensor on the display setup over the robot.

By activating the camera and monitoring system live view is seen and according to which the robot vehicle is driven.

CHAPTER 6

RESULT AND DISCUSSION

6.1 Introduction

Our project worked perfectly during our experimental operation though sometime it behaves slow error due to wave distortion via different noise signal. We have tested some experiments to determine the working capacity and efficiency of the robot. We have been able to view the things accurately that are currently happening in the surrounding area. Our design has not caused any sort of disturbances. The robot worked smoothly according to the command we sent from the remote section unit. We have shown the view of the area around the robot by night vision camera. By keeping the circuit easy and simple, most users will be able to use it easily. Thus we should be able to manipulate its path when necessary, to create the robot safely.

Here we have experimented some tests to find the metal detector circuit's working and accuracy. Our metal detector worked perfectly within its range. The GPS showed accurate location. We have also observed the camera performance and working condition at night mood and it worked pretty much accurately.

6.2 Metal Detector testing

Metal detector is tested in different range and it worked appropriately when any metal was beneath the robot. The output range is noted below in Table 6.1

Table 6.1: Metal Detector Range of detection

SL No	Distance from metal detector (Inch)	Status
1	0.5	Worked instantaneously
2	1	Worked instantaneously
3	1.5	Worked a bit slowly
4	2	Did not work

6.3 Control with DTMF module

DTMF takes the input from the given signal. By this signal we control our robot. Here given the experimental operation in Table 6.2

Table 6.2 Robot controlling signal

SL.NO.	DTMF signal	Status
1	2	Robot moves forward
2	5	Robot stops
3	1	Robot moves backward
4	6	Robot moves right
5	4	Robot moves left

6.4 Camera Performance

Fig. 6.1 The Camera captured image

6.5 Ultrasonic Sensor testing

Ultrasonic sensor was tested in different ranges and it gave approximate value of distances shown in **Fig. 6.2**.

Fig. 6.2 Distance shown by ultrasonic sensor

6.6 Temperature , Gas and Sound sensor testing

Temperature sensor, Gas sensor and Sound sensor were tested in interval of time and they gave approximate value of weather system shown in **Fig. 6.3**.

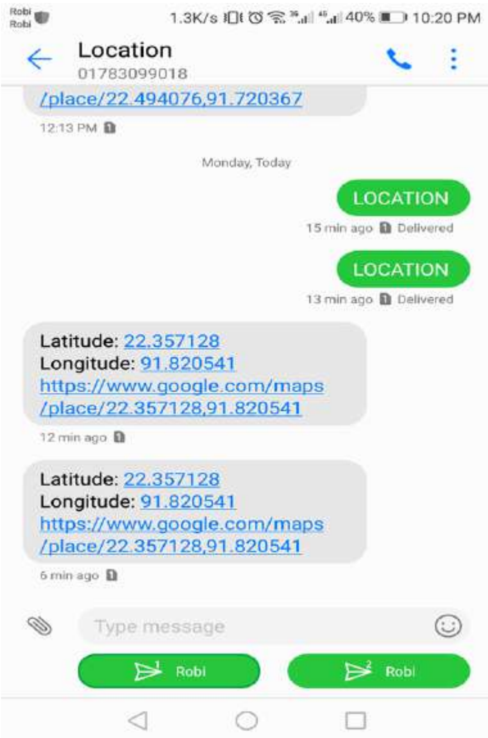
(a)

(b)

Fig. 6.3 Weather Monitoring System

6.7 GPS Tracker

The exact location of the robot with latitude and longitude through SMS given by the GPS tracker is shown in **Fig. 6.4** , **Fig. 6.5** respectively.



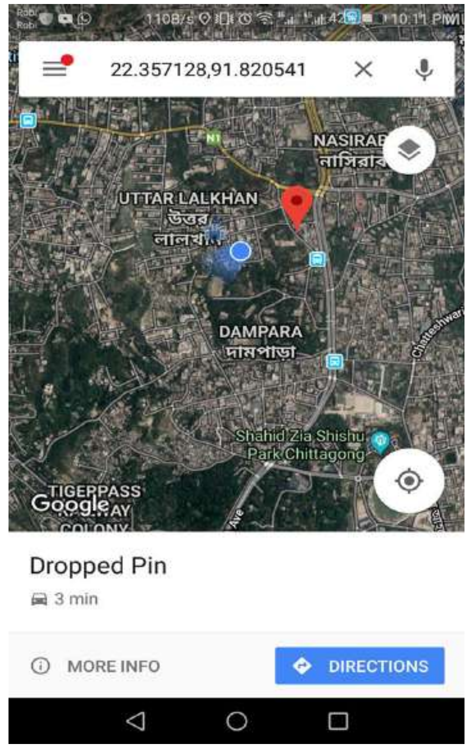


Fig. 6.4 "LOCATION" message sent to robot

Fig. 6.5 Robot's position

6.8 Entire System Prototype

Fig. 6.6 shows the prototypic photograph of the Robot.

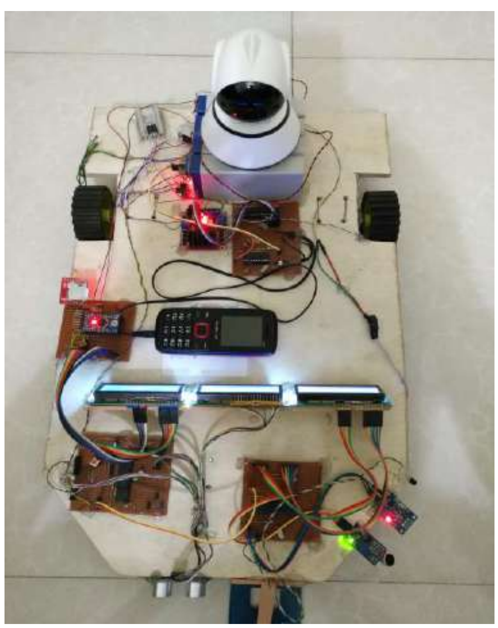


Fig. 6.6 Prototypic photograph of the Robot

6.9 Discussions

In this project we have developed a multitasking spy robot which performed pretty smoothly in our test run. The spy robot is such designed that it can be used for various purposes like long range surveillance, war field spying etc. It can also cater to the need of bomb disposal unit if needed. With some advancement in this project it can be made more efficient and multipurpose robot. Our battalion can make full use of it in the Warfield which is a crying need for today.

CHAPTER 7

CONCLUSION

7.1 Conclusion

A robot is a reprogrammable, multifunctional manipulator designed to move material, parts, tools or specialized devices through variable programmed motions for the performance of a variety tasks. Here we have designed such a multi-tasking robot reducing the drawbacks of the previous works which will provide short distance surveillance to our soldiers in hostage situations.

Conventionally, spy robots are implemented with nominal camera which provides lacking in terms of night mood. For this reason we have added a night vision camera in this project which enables our robot to capture images at dark and wirelessly transmit them to the monitor. Moreover a metal detector is added too which will provide the soldiers information about the dangers and situations in the hostage situation.

7.2 Limitation

i. The robot required GSM network.
ii. The robot cannot detect the metals situated more than 20mm.
iii. It needs two persons to control both camera and the robot .
iv. It requires charge after the battery drained.

7.3 Future Work

The system that we have designed and implemented is a prototype of a long range spy robot, which should be as compact, fast and accurate as possible. It is only being developed to ensure that the design is feasible, not impractical and can be implemented on a much larger scale in a more efficient way. Our robot is not a very manoeuvrable machine right now that is it may not provide the efficiency to cope with the unexpected surface or it may not have the capability to manoeuvre into small places, which is very important requirement of an spy robot. But in future it can be used to design such a robot, which will be not only compact but also fast and accurate.

7.3.1 Compact Design

Compact design reduces weight in robot vehicle resulting much faster operation and thus increases the accuracy and efficiency. Therefore the robot can be enhanced to be of much smaller size for the purpose of a faster and accurate operation. Besides compact sized robot get extra facilities in case of entering into smaller spaces. And for not being spotted in term of spying, compact structure is much beneficial.

7.3.2 Quick Movement

Being an spy robot with metal detector, it can be used as a bomb disposal robot where it will require very fast movement. This is required as the bomb disposal squad might also have very little time in checking out the bomb and then defusing it. Therefore a fast robot is necessary.

7.4 Future Augmentation

i. There no conveyer belt type wheel is implemented which will cause a bit of problem in complex roads, this problem can easily be solved with a conveyer type wheel using in it.

ii. This mechanism can be used in UAV (Unmanned Air Vehicles) or drone.

iii. Here an ordinary CCTV camera is used. In future a complex IC camera can be designed with much view angle.

7.5 Application of Military and LAW Enforcement

Military usage of remotely controlled vehicles dates back to the first half of 20th century. Soviet red Army used remotely controlled tele tanks during 1930s in the winter war and early stages of world war 2.There were also remotely controlled cutters and experimental remotely controlled planed in the Red Army.

Remote controlled vehicles are used in law enforcement anti-military engagement for some of the same reasons. The exposures of hazards are mitigated to the person who operates the vehicles from a location of relative safety. Remote controlled vehicles are used by many Police Department bomb squads to defuse and detonate explosives.

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APPENDIX

Program code for controlling the robot(DTMF)

```
unsigned int a,b,i,t;
float percent,voltage,voltage1,a,e,q,v;
char text[16];
char text1[16];
char b;
void main()
{
 adcon1=0;
 trisa.f1=1;
 porta.f1=1;
 trisa.f2=1;
 porta.f2=1;
 trisa.f0=1;
 porta.f0=1;
 trisa.f3=1;
 porta.f3=1;
 trisc=0;
 portc=0;
 while(1)
 {
 for(b=0; b<1; b++)
 {
     }
  a=adc_read(0);
  b=a*5;
  voltage1=(float)b/256;
  i=adc_read(1);
  a=i*5;
  a=(float)a/256;
  q=adc_read(2);
  e=q*5;
  e=(float)e/256;
   v=adc_read(3);
  v=v*5;
  v=(float)v/256;
   floattostr(v,text1);
   floattostr(a,text1);
  floattostr(voltage1,text);
  floattostr(e,text1);
  delay_ms(200);

  if(voltage1>=4)
  {
  portc=0b00001010;
  }
 if(a>=4)
  {
  portc=0b00000101;
 }
 if(e>=4)
  {
```

```
 portc=0b00001000;
 }
 if(v>=4)
  {
 portc=0b00000010;
 }
 if(voltage1>=4 && e>=4)
  {
 portc=0b00000000;
 }
 if(voltage1>=4 && a>=4)
  {
 portc=0b10000000;
 }
 else if(voltage1<=4 && a<=4 && e<=4 && v<=4)
 {
 portc=0b00000000;
 }
  delay_ms(300);
 }
}
```

Program for distance measurement

```
Xtal 20
Declare LCD_RSPin PORTB.2
Declare LCD_ENPin PORTB.3
Declare LCD_DTPin PORTB.4
Declare LCD_Interface  4
Declare LCD_Lines 4
Declare Hserial_Baud = 115200
Declare Hserial_RCSTA = %10010000
Declare Hserial_TXSTA = %00100100
Declare Hserial_Clear = On
All_Digital = true

Symbol trig = PORTC.2
Symbol echo = PORTC.1
Input echo : Output trig
Clear PORTC

Dim sonar_read As Word
Dim distance As Float
Clear : Cls

main:
GoSub check_sonar
GoSub check_distance
GoTo main

check_sonar:
PulsOut trig, 10, High
sonar_read = PulsIn echo, 1
DelayMS 10
 distance = (sonar_read * 0.028) / 2
Print At 1,1, "Distance:", Dec1 distance, "In"
  Return
```

Program for weather monitoring system

```
sbit LCD_RS at RB2_bit;
sbit LCD_EN at RB3_bit;
sbit LCD_D4 at RB4_bit;
sbit LCD_D5 at RB5_bit;
sbit LCD_D6 at RB6_bit;
sbit LCD_D7 at RB7_bit;
sbit LCD_RS_Direction at TRISB2_bit;
sbit LCD_EN_Direction at TRISB3_bit;
sbit LCD_D4_Direction at TRISB4_bit;
sbit LCD_D5_Direction at TRISB5_bit;
sbit LCD_D6_Direction at TRISB6_bit;
sbit LCD_D7_Direction at TRISB7_bit;

#define sound RC4_bit
char smoke, tmp, rxd, x = 0;
char r_status[7];
#define temp (tmp * 0.0196) * 100
}
void interrupt (){
  if (PIR1.RCIF) {
    PIR1.RCIF = 0;

  }
}

void print_dec(char x, char y, char value){
  char digit[4];
  digit[0] = value / 100 + 48;
  digit[1] = (value % 100) / 10 + 48;
  digit[2] = value % 10 + 48;
  digit[3] = 0;
  lcd_out(x,y, digit);
  newline();
}
```

Program for Location Tracking system (arduino pro mini)

```
#include <LiquidCrystal.h>
#include <SoftwareSerial.h>

SoftwareSerial serial(2,3);
LiquidCrystal lcd(4, 5, 6, 7, 8, 9);

char rxd, cp = 0, cp2 = 0, x = 0;
char longi[10];
char lati[10];
int timer = 0;

char number[] = "01835050306";

void setup() {
  Serial.begin(9600);
  serial.begin(9600);
  lcd.begin(16, 2);
  lcd.clear();
  delay(2000);
  GSM_init();
}

void loop() {
  lcd.setCursor(0,0);
  lcd.print("La: ");
  lcd.print(lati);
  lcd.setCursor(0,1);
  lcd.print("Lo: ");
  lcd.print(longi);

  SMS_read();
  if(timer == 0) Get_Location();
  timer++;
  if(timer == 10000) timer = 0;
}

void Get_Location(){
  memset(longi, 0, sizeof(longi));
  memset(lati, 0, sizeof(lati));
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("Finding Location");
  lcd.setCursor(0,1);
  lcd.print("Please wait...");
  Serial.println("Finding Location");

  serial.println("AT+CIPGSMLOC=1,1");
  receive_loc();

  lcd.clear();
  Serial.println("Location Read OK.");
}

void receive_loc(){
  while(!serial.available());
```

```
  while(serial.available()){
    rxd = serial.read();

    if(cp == 0 && rxd == 'L') cp = 1;
    if(cp == 1 && rxd == 'O') cp = 2;
    if(cp == 2 && rxd == 'C') cp = 3;
    if(cp == 3 && rxd == ':') cp = 4;

    if(cp == 4 && rxd == ',') cp = 5;
    if(cp == 5 && rxd != ',') cp = 6;

    if(cp == 6){
      if(rxd != ','){
        longi[x] = rxd;
        x++;
      }
      else {
        cp = 7;
        x = 0;
      }
    }

    if(cp == 7 && rxd == ',') cp = 8;
    if(cp == 8 && rxd != ',') cp = 9;

    if(cp == 9){
      if(rxd != ','){
        lati[x] = rxd;
        x++;
      }
      else {
        cp = 0;
        x = 0;
      }
    }
  }
  Serial.println(lati);
  Serial.println(longi);
  if(lati[0] == 0 || longi[0] == 0) Get_Location();
}

void SMS_read(){
  if(serial.available()){
    rxd = serial.read();
    if(cp2 == 0 && rxd == '+') cp2 = 1;
    if(cp2 == 1 && rxd == 'C') cp2 = 2;
    if(cp2 == 2 && rxd == 'M') cp2 = 3;
    if(cp2 == 3 && rxd == 'T') cp2 = 4;

    if(cp2 == 4 && rxd == 13) cp2 = 5;
    if(cp2 == 5 && rxd == 10) cp2 = 6;
    if(cp2 == 6 && rxd != 10) cp2 = 7;

    if(cp2 == 7 && rxd == 'L') cp2 = 8;
    if(cp2 == 8 && rxd == 'O') cp2 = 9;
    if(cp2 == 9 && rxd == 'C') cp2 = 10;
    if(cp2 == 10 && rxd == 'A') {
       cp2 = 0;
       send_SMS();
```

```
    }
  }
}

void send_SMS(){
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("Sending SMS..");

  serial.print("AT+CMGF=1\r\n");
  delay(1000);
  serial.print("AT+CMGS=\"");
  serial.print(number);
  serial.print("\"\r\n");
  delay(1000);
  serial.print("Latitude: ");
  serial.println(lati);
  serial.print("Longitude: ");
  serial.println(longi);
  serial.write(0x1A);
  serial.print("\r\n");
  delay(3000);

  lcd.clear();
}

void GSM_init(){
  lcd.clear();
  lcd.print("GSM Init...");
  Serial.println("GSM Init...");
  delay(10000);

  serial.println("AT");
  delay(1000);
  serial.println("AT+CMGF=1");
  delay(1000);
  serial.println("AT+CNMI=1,2,0,0,0");
  delay(1000);
  serial.println("AT+SAPBR=1,1");
  delay(3000);

  Serial.println("GSM Init OK.");
  lcd.clear();
  lcd.print("GSM Init OK.")
```