1.1 INTRODUCTION

In today's world automation has been integrated in all areas. But there are some areas where technology has not become indispensable, one of them is weather monitoring.

A comfortable environment, favorable work conditions and suitable weather is needed by all human beings to live in and produce results with full efficiency. It is very difficult to perform with full capacity when the environmental conditions are not favorable. Be it homes, offices, factories, or outdoors, it is necessary to monitor the environment one lives in and be prepared for it. Hence, the idea of "WEATHER SENSORS INTEGRATED MOBILE CONTROLLED ROBOT" (WIMBOT) came into being. This system is an automated device to measure environmental parameters such as temperature, humidity, atmospheric pressure and physical parameters such as latitude, longitude and altitude. This arrangement is mounted on a portable ROBOT which makes it possible to use the device without human presence on the spot, it is wireless. This assembly is detachable, it can also be used as a permanent setup. All the data is sent via SMS (Short Message Service) through GSM module to a centralized server which shows us all the sorted data in an Excel file with graphical analysis.

The basic idea behind this project is to monitor the environmental conditions as per requirement, making it easier to adapt with the surrounding. This arrangement is mounted on a remote and mobile controlled ROBOT to move this assembly in inaccessible areas. This setup does not require 'Repeaters' to retransmit or amplify the signal, as GSM service is used.

1.2 HISTORY

Weather monitoring systems these days are mostly stationary and transmit data using LAN services, after some fixed distance (depending on the system), repeaters are needed to reamplify and reconstruct the data.

There is a stationary structure with all the sensors mounted on it and a lot of hardware is needed which mostly comprises of repeaters. To monitor the weather of different locations, this stationary system has to be erected, this consumes space and is not portable.

As the hardware increases, cost of the system increases proportionally, also systems become bulky. Multiple weather monitoring units have to setup at discrete distances. Maintenance cost increases, manpower requirement also increases accordingly. Faults are not spotted easily and data lost is not recovered. Data travels in a strict hierarchy e.g., first the data goes to district servers, then the state servers then it finally reaches the centralized server, this introduces some unwanted delay in the transmission of data.

Averaging weather and environmental data with maximum accuracy is required for civil engineering, these systems are not capable of doing that as they are not portable (fixed). For achieving this, the requirement of units in a small area increases. Many uses like these require portable systems.

There is no automatic data sorting mechanism in these systems. The collected data is needed to be entered and sorted manually as per requirement.

1.3 OBJECTIVES

1 To monitor various parameters such as temperature, relative humidity, pressure, obstacle distance, precise location.
2. Make complete setup including transmitter and receivers without the use of repeaters.
3. Gaining control over various systems such as testing chambers, greenhouses, farms, industries, laboratories by obtaining rough and approximate values of the above mentioned parameters.
4. Getting access to rough terrains without difficulty.
5. Automation in wireless transmission of the collected data to a main server.
6. Automatic maintenance of large amount of data in convenient text and excel files.
7. Ease of data acquisition and representation of collected data in a statistical form such as graphs, tables, charts etc.

1.4 ORGANIZATION

1.4.1 INTRODUCTION

In this chapter overall study of the project is discussed. The motivation and objectives of the project along with the general specifications are discussed.

1.4.2 LITERATURE SURVEY

In this chapter the general introduction to the Weather sensors Integrated Mobile Controlled Robot with an overview of history of the same is discussed.

1.4.3 DESIGN AND DRAWING

In this chapter all the design aspects are taken under consideration. The design and working of each block has been discussed. The specifications and description of all the blocks are given in short. The software aspect of the system is discussed shortly.

1.4.4 MANUFACTURING

In this chapter fabrication of PCBs and testing and trouble shoot condition of the system have been studied. The flowchart of PCB fabrication has been studied.

1.4.5 ADVANTAGES DISADVANTAGES AND APPLICATION

In this chapter, we mention various advantages, disadvantages and also the applications of the Weather sensors Integrated Mobile Controlled Robot.

1.4.6 RESULT AND DISCUSSION

In this chapter, overall results are taken into consideration. Working of the project is successfully done. Finally, results regarding the output of the project are gathered in this chapter.

1.4.7 CONCLUSION AND FUTURE SCOPE

After completion of the project some conclusions are obtained. Those are collectively discussed in this concluding chapter.

1.5 SUMMARY

In this chapter, the background of the project and its relevance with electronics has been discussed. Furthermore, the project that is undertaken through understanding of various electronic devices has been studied deeply. The objective set for dissertation work are:

- Selecting relevant sensors and communication modules.
- Assemble the entire system.
- To demonstrate the working successfully.

The organization of the report gives a brief about the formatting of the report and where to look for specific things throughout the report.

2.1 INTRODUCTION

The objective is to explain the perspective and method which has been used in the past projects and to observe how this project can be related with existing research and theory. This shows how the theory and concept have been implemented in order to solve the problem statement of our project. The understanding of theory is crucial as a guidance to start any project. The result of a project cannot be assessed if it's not compared to the theory. So, after practically implementing our project we will compare it to the theoretical results.

Various components required are studied and various types of one particular component are compared to choose the one which is the best fit for the application. This chapter covers the guidelines set for selecting the hardware and software for the project.

2.2 HARDWARE

2.2.1 ARDUINO DEVELOPMENT BOARD

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

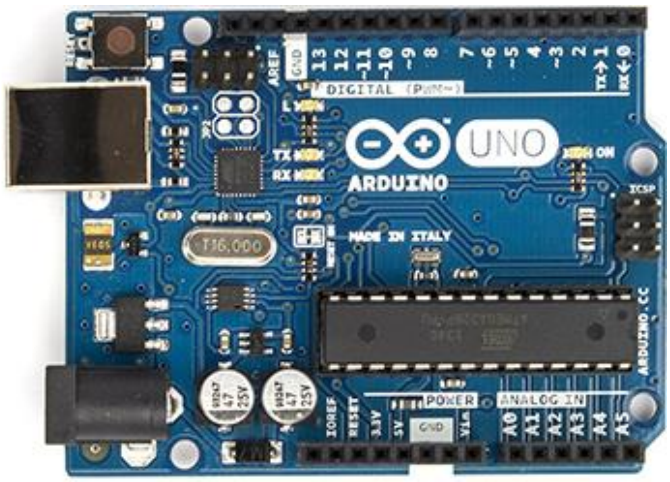


FIG-2.1-ARDUINO UNO BOARD

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter of the Uno board has a resistor pulling the 8U2 HWB line to ground.

Summary:

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
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 bootloader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz
Length	68.6 mm
Width	53.4 mm
Weight	25 g

2.2.2 GSM MODULE

SIM800H is a complete Quad-band GSM/GPRS solution in a LGA type which can be embedded in the customer applications.

SIM800H support Quad-band 850/900/1800/1900MHz, it can transmit Voice, SMS and data information with low power consumption. With tiny size of 15.8*17.8*2.4 mm, it can fit into slim and compact demands of customer design. Bluetooth, FM and Embedded AT, it allows total cost savings and fast time-to-market for customer applications.

Short Part-Number	**SIM800H**
Full Part-Number	S2-105HG-XXXXX
Voice (07.07)	+
SMS (07.05)	+
GPRS Class	12 B
Hard Ware	
Chipset	MT6260D
Band Width	MT6260D
SIM-card	1
Package	LGA
Size	15.8 mm X 17.8mm
Audio Interfaces	2 analog + PCM
Supply Voltage	3.4V-4.4 V
Sleep Mode Current Consumption	1.16 mA
Temperature Range	-40 C/+85C
Soft Ware	
TCP/IP and UDP/IP	+
HTTP and FTP	+

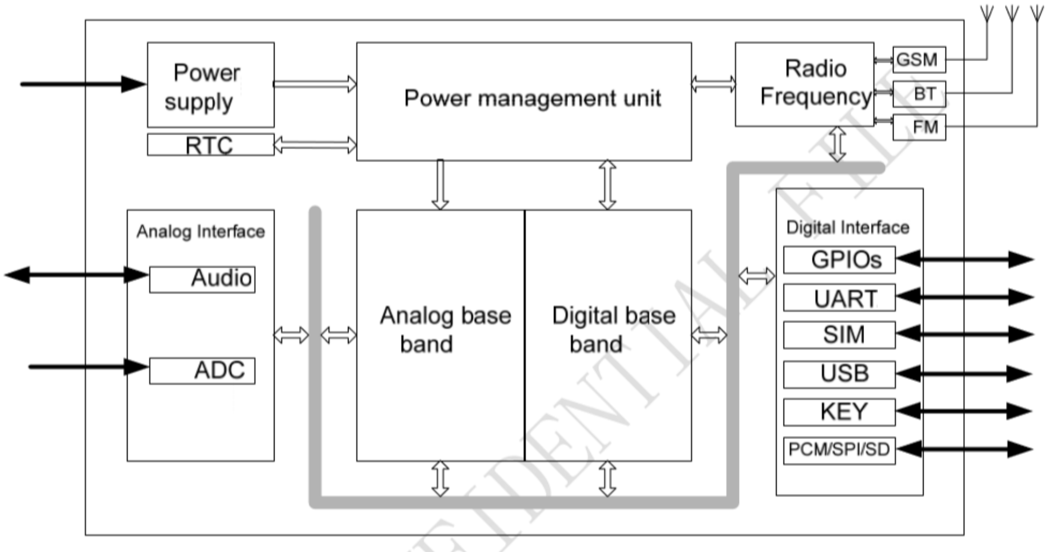


FIG-2.2-BLOCK DIAGRAM OF GSM MODULE

2.2.2.1 AT COMMANDS

AT stands for 'ATTENTION'. This commands are used to communicate between the GSM module and Microcontroller/Processor. They are used for various functions such as composing a message, sending a message, reading a message, making call, hang up the call, answering the call, deleting the call, holding a call etc. In our project we are mostly using these above mentioned commands from the array of over 200 commands (approximately) for achieving the desired output.

Get the current status of the mobile phone or GSM modem

- Establish a data connection or voice connection to a remote modem (ATD, ATA, etc.)
- Send and receive fax (ATD, ATA, AT+F*)
- Send (AT+CMGS, AT+CMSS)
- read (AT+CMGR, AT+CMGL)
- write (AT+CMGW)
- delete (AT+CMGD) SMS messages and obtain notifications of newly received SMS messages (AT+CNMI)

AT Commands for SMS

+CMGF - Message Format

AT+CMGF[=[<mode>]]	Selects the format of messages used with send, list, read and write commands. 0 - PDU mode 1 - text mode

+CMGR - Read Message

AT+CMGR=<index>	Execution command reports the message with location value **<index>** from **<memr>** message storage

+CMGL - List Messages

AT+CMGL[=<stat>]	Execution command reports the list of all the messages

Message Sending and Writing

+CMGS - Send Message

AT+CMGS=<length>	Execution command sends to the network a message. To send the message issue **Ctrl-Z** char (0x1A hex).

+CMGD - Delete Message

AT+CMGD=<index>	Execution command deletes from memory **<memr>** the message(s). 1- delete all read messages from storage, leaving unread messages 2- delete all read messages from storage and sent mobile originated messages, leaving unread messages and unsent mobile originated messages untouched 3- delete all read messages from storage, sent and unsent mobile originated messages, leaving unread messages untouched 4- Delete all messages

2.2.3 SMART TERRAIN ROBOT

2.2.3.1 Comparator

Sensors cannot itself provide output, which can solely be used as a reference to the controlling. Also every IR Receiver provides a different output even for the same conditions and is Analog in nature. Thus a fundamental signal conditioner is necessary to turn it into identifiable. This job is done using a comparator IC LM324. IC LM324 has 4 comparator in it, so it can compare 4 sensor outputs at a time.

2.2.3.2 Motor Driver

While driving the motor, motors draw large currents from the source, which is in Amperes. Thus connecting the loads directly to the control circuitry is totally impractical. In our Robot, we will be using L293D ICs for driving the motors. The schematic diagram of a common motor driver circuit is like above. Each Motor Drives as follows:

- When both i/p are HIGH-Motor Halts
- When both i/p are LOW-Motor Halts
- When i/p 1 is HIGH and i/p 2 is LOW-Motor moves in forward direction
- When i/p1 is LOW and i/p 2 is HIGH-Motor moves in reverse direction

2.2.3.3 Mobile Control

To control the robot using a Cell Phone, we're using the DTMF (Dual Tone Multiple Frequencies) tones to do so. These are the irritating tones we hear in a call when some keys are pressed mistakenly. Each keys on dial pad produces different frequencies and are distinct from each of them. The robot, is controlled by a mobile phone that makes call to the mobile phone attached to the robot in the course of the call, if any button is pressed control corresponding to the button pressed is heard at the other end of the call. This tone is called dual tone multi frequency tone (DTMF) IC HT9170 receives this DTMF tone with the help of phone stacked in the Robot.

Digit	TOE	INH	ESt	Q_4	Q_3	Q_2	Q_1
ANY	L	X	H	Z	Z	Z	Z
1	H	X	H	0	0	0	1
2	H	X	H	0	0	1	0
3	H	X	H	0	0	1	1
4	H	X	H	0	1	0	0
5	H	X	H	0	1	0	1
6	H	X	H	0	1	1	0
7	H	X	H	0	1	1	1
8	H	X	H	1	0	0	0
9	H	X	H	1	0	0	1
0	H	X	H	1	0	1	0

Table 1. Functional Decode Table

L=LOGIC LOW, H=LOGIC HIGH, Z=HIGH IMPEDANCE X = DON‘T CARE

DTMF signalling is used for telephone signalling over the line in the voice frequency band to the call switching centre. The version of DTMF used for telephone dealing is known as touch tone.

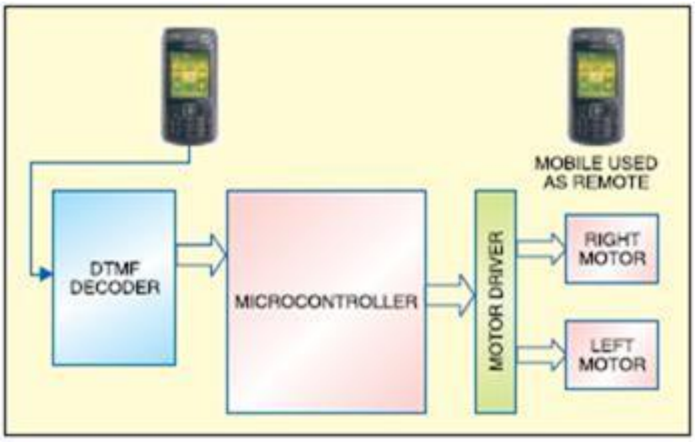


FIG-2.3-MOBILE CONTROL

DTMF assigns a specific frequency (consisting of two separate tones) to each key that it can easily be identified by the electronic circuit. The signal generated by the DTMF encoder is the direct algebraic submission, in real time of the amplitudes of two sine (cosines) waves of different frequencies, i.e. pressing 5 will send a tone made by adding 1336Hz and 770Hz to the other end of the mobile.

2.2.3.4 Microcontroller

A microcontroller is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Program memory in the form of NOR flash or OTP ROM is also often included on chip, as well as a typically small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications.

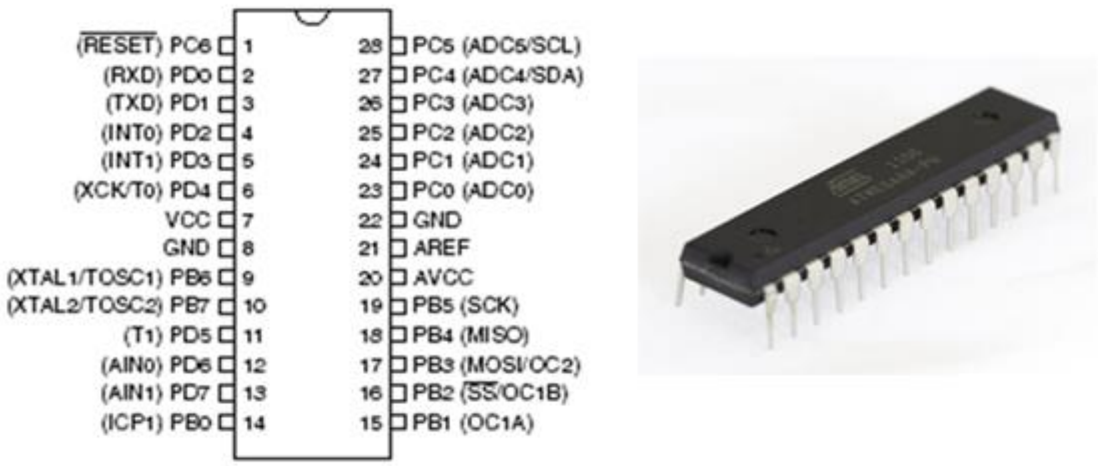


FIG-2.4-MICROCONTROLLER

The microcontroller we will be using is Atmega 8. It is a 28 pin Microcontroller in Dual-in-line Package, it has following key parameters.

Parameter	Value
• Flash	8 kB
• Pin Count	28
• Max. Operating freq	16 MHz
• CPU	8-bit AVR
• Max I/O Pins	23

The Atmega 8 IC has taken inputs from all the sensor modules, also from the cell phone and the manual joystick and the mode switch input is also given to it. Motor Drivers are also connected to the same IC. So as per the mode selected and as per the program burned inside the flash memory of Atmega 8 the operation of the robot is done.

- **Voltage Regulator**

A fixed voltage regulator, IC7805 will regulate any unstable voltage in the range of 7 volts to 30 V to a constant regulated voltage of 5V. It provides both Line and load regulation to the circuit. Also it has over voltage protection and thermal shutdown in it.

- **Motor Connector**

These High Current Carrying screw connectors are used to connect the motors to the circuit. It makes it convenient to attach the motor to the circuit.

- **Battery**

We will be using a Lead acid battery of 12V, 1.2AH supply rating, and a lead acid battery requires less time to charge and also lasts long. Also it has a longer lifetime than other battery types. It is cheaper than Li-ion battery and also easily available.

- **DC Motor**

The working principle behind any DC motor is the attraction and repulsion of magnets. The simplest motors use electromagnets on the shaft, with permanent magnets in the case of the motor that attract and repel the electromagnets. The reason for using electromagnets is so that it is possible to flip their magnetic field (their north and south poles).

So the electromagnet is attracted to one of the permanent magnets. As soon as it reaches the permanent magnet, its north and south poles flip so that it is repelled from that magnet and attracted to the other permanent magnet.

2.2.4 GPS MODULE:

Features

•Support EASY self-generated orbit prediction

•Support SBAS ranging (WAAS, EGNOS, GAGAN, MSAS)

•Support EPO orbit prediction

•Serial interfaces UART, SPI / I²C

•Digital I/O EINT0 input GPIO Pulse-per-second (PPS)

•Protocols NMEA, PMTK

•SIM28 EVB KIT with USB V2.0 full speed interface

•Receiver type 22 tracking/66 acquisition-channel GPS receiver
GPS L1, C/A Code

•Sensitivity
Tracking:-165 dBm
Reacquisition: -160 dBm
Cold starts: -147 dBm

•Accuracy
Automatic Position: 2.5m CEP
EPO 30days DATA: 1.99m
Speed: 0.1m/s

•Operation temperature:-40°C~+85 °C

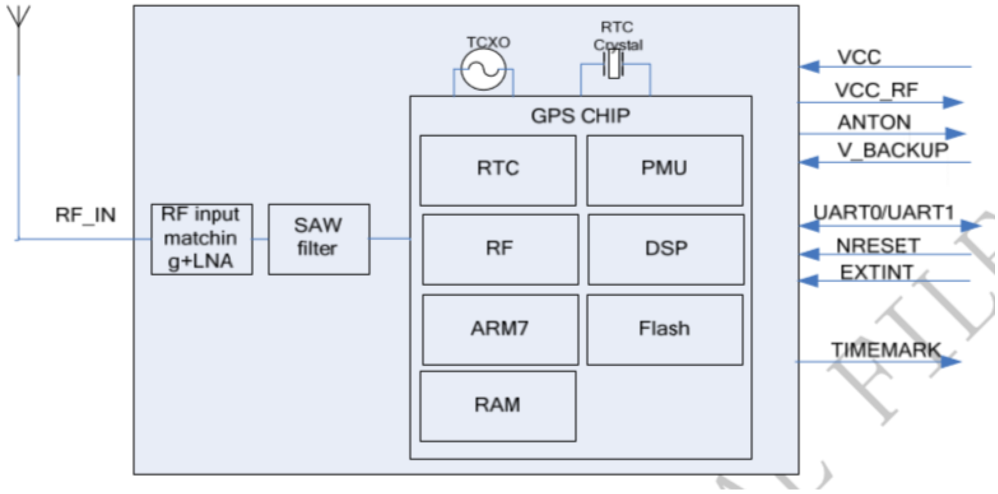


FIG-2.5-BLOCK DIAGRAM OF GPS MODULE

2.2.4.1 NMEA COMMANDS

NMEA Output Messages

Message	Description
GGA	Time, position and fix type data
GLL	Latitude, longitude, UTC time of position fix and status
GSA	GPS receiver operating mode, satellites used in the position solution, and DOP values
GSV	Number of GPS satellites in view satellite ID numbers, elevation, azimuth, & SNR values
MSS	Signal-to-noise ratio, signal strength, frequency, and bit rate from a radio-beacon receiver
RMC	Time, date, position, course and speed data
VTG	Course and speed information relative to the ground
ZDA	PPS timing message (synchronized to PPS)

A full description of the listed NMEA messages are provided in the following sections.

GGA —Global Positioning System Fixed Data: - Table contains the values for the following example:

$GPGGA,002153.000,3342.6618,N,11751.3858,W,1,10,1.2,27.0,M,34.2,M,,0000*5E

GGA Data Format

Name	Example	Unit	Description
Message ID	$GPGGA		GGA protocol header
UTC Time	002153.000		hhmmss.sss
Latitude	3342.6618		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	11751.3858		dddmm.mmmm
E/W Indicator	W		E=east or W=west
Position Fix Indicator	1		See Table 1-4
Satellites Used	10		Range 0 to 12
HDOP	1.2		Horizontal Dilution of Precision
MSL Altitude	27.0	meters	
Units	M	meters	
Geoid Separation	-34.2	meters	Geoid-to-ellipsoid separation. Ellipsoid altitude = MSL Altitude + Geoid Separation.
Units	M	meters	
Age of Diff. Corr.		sec	Null fields when DGPS is not used
Diff. Ref. Station ID	0000		
Checksum	*5 E		
<CR> <LF>			End of message termination

2.2.5 SENSORS

A **sensor** is a device that detects events or changes in quantities and provides a corresponding output, generally as an electrical or optical signal; for example, a thermocouple converts temperature to an output voltage. But a mercury-in-glass thermometer is also a sensor; it converts the measured temperature into expansion and contraction of a liquid which can be read on a calibrated glass tube.

In this project Meteorological sensors like humidity, rain, air purity etc. sensors will be used:

2.2.5.1 Temperature and Humidity sensor:

Humidity is the presence of water in air. Humidity measurement in industries is critical because it may affect the business cost of the product and the health and safety of the personnel. Hence, **humidity sensing** is very important, especially in the control systems for industrial processes and human comfort.

The sensor used in this project is DHT11 temperature and humidity sensor. DHT11 digital temperature and humidity sensor is a composite Sensor contains a calibrated. Digital signal output of the temperature and humidity. Application of a dedicated digital modules collection technology and the temperature and humidity sensing technology, to ensure that the product has high reliability and excellent long-term stability. The sensor includes a resistive sense of wet components and an NTC temperature measurement devices, and connected with a high-performance 8-bit microcontroller.

FIG-2.6-DHT-11 (TEMPERATURE AND HUMIDITY SENSOR)

PINS:

1. VDD power supply 3.5-5.5V DC
2. DATA serial data, a single bus
3. NC, empty pin
4. GND ground, the negative power

- Data format:

The 8bit humidity integer data + 8bit the Humidity decimal data +8 bit temperature integer data + 8bit fractional temperature data +8 bit parity bit.

- Parity bit data definition

"8bit humidity integer data + 8bit humidity decimal data +8 bit temperature integer data + 8bit temperature fractional data" 8bit checksum is equal to the results of the last eight.

Example 1: 40 data is received:

0011 0101 0000 0000 0001 1000 0000 0000 0100 1101

High humidity 8 Low humidity 8 High temp. 8 Low temp. 8 Parity bit

Calculate：

0011 0101+0000 0000+0001 1000+0000 0000= 0100 1101

Received data is correct：

Humidity：0011 0101=35H=53%RH

Temperature：0001 1000=18H=24℃

- Data Timing Diagram

User host (MCU) to send a signal, DHT11 converted from low-power mode to high-speed mode, until the host began to signal the end of the DHT11 send a response signal to send 40bit data, and trigger a letter collection. The signal is sent as shown.

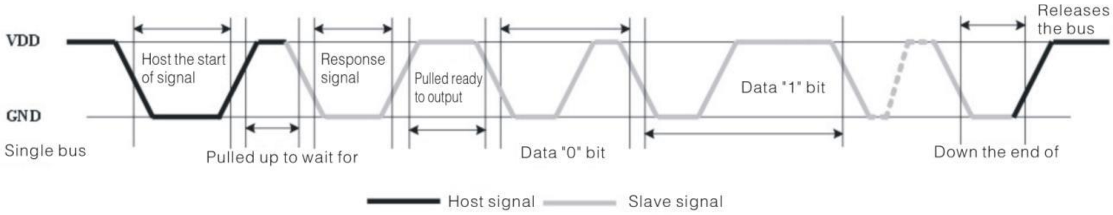


FIG-2.7-DATA TIMING DIAGRAM OF DHT-11

2.2.5.2 Ultrasonic Sensors:

Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules includes ultrasonic transmitters, receiver and control circuit. The basic principle of work:

(1) Using IO trigger for at least 10us high level signal,

(2) The Module automatically sends eight 40 kHz and detect IF there is a pulse signal back.

(3) IF the signal back, through high level, time of high output IO duration is the time from sending ultrasonic to returning.

FIG-2.8-HC-SR04 (ULTRASONIC SENSOR)

Test distance = (high level time×velocity of sound (340M/S) / 2

Electric Parameter

- Working Frequency -40Hz
- Max Range- 4m
- Min Range- 2cm
- Measuring Angle- 15 degree
- Trigger Input Signal- 10uS TTL pulse

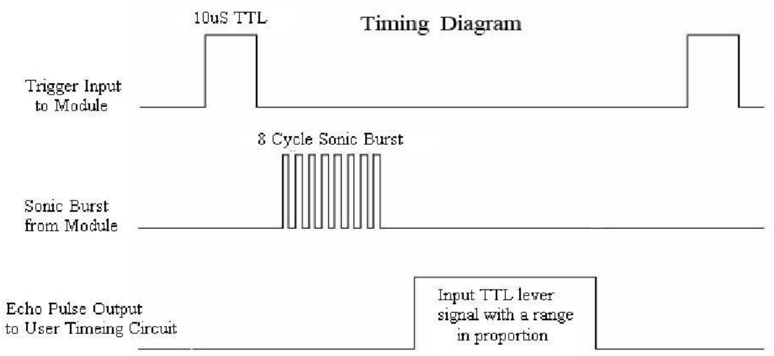


FIG-2.9-DATA TIMING DIAGRAM OF HC-SR04

2.2.5.3 BMP 085 (PRESSURE AND ALTITUDE SENSOR)

The BMP085 is designed to be connected directly to a microcontroller of a mobile device via the I^2C bus. The pressure and temperature data has to be compensated by the calibration data of the E^2PROM of the BMP085.

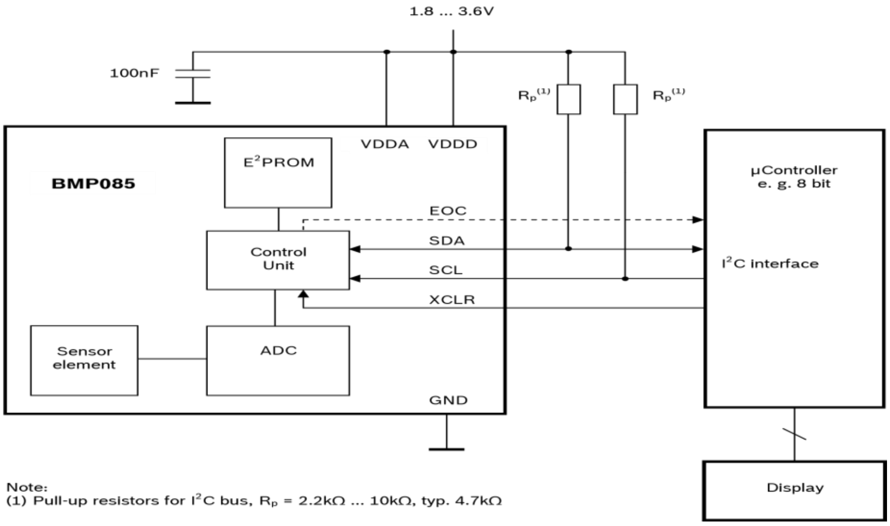
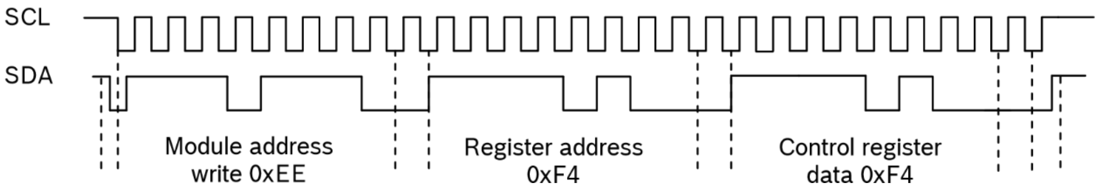


FIG-2.10-BMP-085 (PRESSURE SENSOR)

- General function and application schematics: The BMP085 consists of a piezo-resistive sensor, an analog to digital converter and a control unit with E^2PROM and a serial I^2C interface. The BMP085 delivers the uncompensated value of pressure and temperature. The E^2PROM has stored 176 bit of individual calibration data. This is used to compensate offset, temperature dependence and other parameters of the sensor.
- UP = pressure data (16 to 19 bit)
- UT = temperature data (16 bit)
- Typical application circuit:
- Measurement of pressure



S ACKS ACKS ACKS P

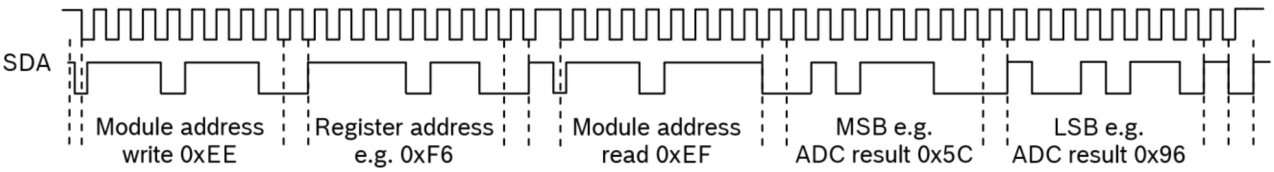
FIG-2.11-DATA TIMING DIAGRAM OF BMP-085

Control registers values for different internal oversampling setting (osrs):

Measurement	Control register value (register address 0xF4)	Max. conversion time [ms]
Temperature	0x2E	4.5
Pressure (osrs = 0)	0x34	4.5

Instead of waiting for the maximum conversion time, the output pin EOC (end of conversion) can be used to check if the conversion is finished (logic 1) or still running (logic 0). After the conversion is finished BMP085 switches automatically in standby mode. Read A/D conversion result or E^2PROM data.

Timing diagram read 16 bit A/D conversion result:



S ACKS Restart ACKS ACKM NACKM P

FIG-2.12-DATA TIMING DIAGRAM OF 16 BIT ADC OUTPUT

2.2.6 SD CARD

We are using SD card to save data as a backup on robot only. Because we are using SMS service so there is some chances of data loss. s\So we need backup. For that we save the whole data as txt file on SD card.

The SD/ micro SD communication is based on an advanced 9 and 8-pin interface (SD: 9pin micro SD: 8pin)) designed to operate in at maximum operating frequency of 208MHz and 2.7V ~ 3.6V voltage range with 2 Type signalling (1.8V & 3.3V)*. More detail information's on the interface, and mechanical description is defined as a part of this specification. High Speed mode Limited on this Specification.

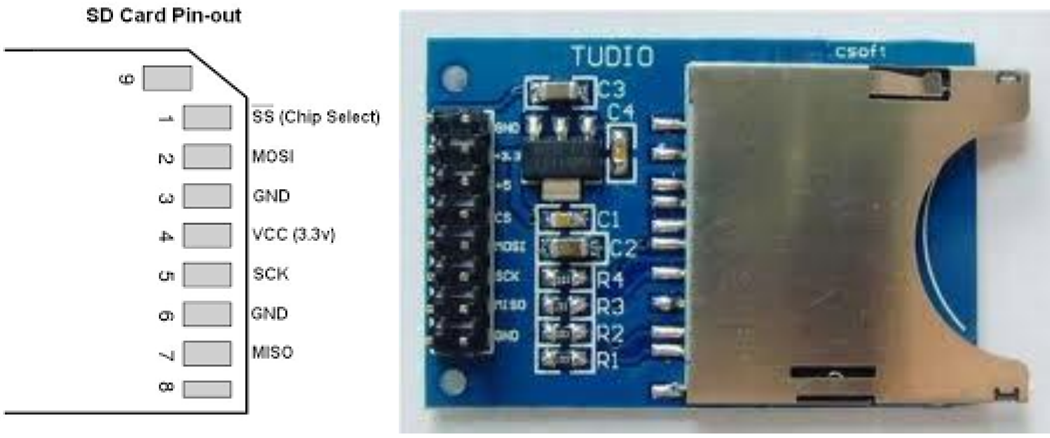


Fig-2.13-SD CARD

System Features

- Compliant with SD Memory Card Specifications PHYSICAL LAYER SPECIFICATION Version 3.00 - Based on SD Memory Card Specification 3.0 compatible Test Device.
- Bus speed only support up to High Speed Mode (3.3V signalling, frequency up to 50MHz)
- Targeted for portable and stationary applications
- Memory capacity:

Standard Capacity SD Memory Card (SDSC): Up to and including 2 GB

High Capacity SD Memory Card (SDHC): More than 2GB and up to and including 32GB)

Extended Capacity SD Memory Card (SDXC): More than 32GB and up to and including 2TB

High Voltage SD Memory Card – Operating voltage range: 2.7-3.6 V

- Designed for read-only and read/write cards.
- Bus Speed Mode

Default mode: Variable clock rate 0 - 25 MHz, up to 12.5 MB/sec interface speed

High-Speed mode: Variable clock rate 0 - 50 MHz, up to 25 MB/sec interface speed.

2.3 SOFTWARE

2.3.1 ARDUINO

Arduino is an open-source computer hardware and software company, project and user community that designs and manufactures kits for building digital devices and interactive objects that can sense and control the physical world.

The project is based on a family of microcontroller board designs, using various 8-bit Atmel AVR microcontrollers or 32-bit Atmel ARM processors. These systems provide sets of digital and analog I/O pins that can be interfaced to various extension boards and other circuits. The boards feature serial communications interfaces, including USB on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino platform provides an integrated development environment(IDE) based on the Processing project, which includes support for C and C++ programming languages.

FIG-2.14-ARDUINO SOFTWARE

Processing is an open source programming language and integrated development environment (IDE) built for the electronic arts, new media art, and visual design communities with the purpose of teaching the fundamentals of computer programming in a visual context, and to serve as the foundation for electronic sketchbooks. The project was initiated in 2001 by Casey Reas and Benjamin Fry, both formerly of the Aesthetics and Computation Group at the MIT Media Lab. One of the stated aims of Processing is to act as a tool to get non-programmers started with programming, through the instant gratification of visual feedback. The language builds on the Java language, but uses a simplified syntax and graphics programming model.

Arduino programs are written in C or C++. The Arduino IDE comes with a software library called "Wiring" from the original Wiring project, which makes many common input/output operations much easier. Users only need define two functions to make a runnable cyclic executive program:

- setup(): a function run once at the start of a program that can initialize settings
- loop(): a function called repeatedly until the board powers off

The Arduino IDE uses the GNU tool chain and AVR Lib to compile programs, and uses avrdude to upload programs to the board.

As the Arduino platform uses Atmel microcontrollers, Atmel's development environment, AVR Studio or the newer Atmel Studio, may also be used to develop software for the Arduino.

2.3.2 PLX-DAQ (PARALLAX)

The objective is to use this macro in order to feed data direct from Arduino to Excel. Essentially, the macro enables Excel to work just like any other terminal programme but has the advantage of producing direct input into where you really want it, and it can give you live graphs as well as a data file. I'm sure you can get pretty sophisticated with the Excel commands, but this start might be all you need.

WHAT IS PLX?

It has taken me about two years to work out that PLX_DAQ is just a terminal interface for Excel. All the things you do with the data are what you do with Excel. I got PLX-DAQ because of the ability to make graphs on the fly but this is not some mystical ability of PLXDAQ, all that is happening is that PLX-DAQ expedites normal Excel procedures. There is no difference between the making of my old Excel graph and PLX-DAQ except that manually entering one line of data each day is not nearly as spectacular as PLX-DAQ receiving a line of data each second automatically from Arduino.

The vital feature to note is that the material sent from Arduino is a mixture of data and Excel commands. The Excel commands do not preclude the use of other terminal programmes.

Only three Excel commands are used in this exercise – LABEL, DATA, and TIME

LABEL signifies that the following material is just a label

DATA signifies that the following is DATA

TIME is the command to get the PC time and write it in the first cell. Note that this is a local call, the time does not come from Arduino.

The sheet header, if required, is written when the reset is pressed. The line is in the setup section.

Serial.println ("LABEL, Time, InTemp, OutTemp, diff, DrainTemp");

Which labels the first five columns.

At the appropriate position in the loop, are the following commands:

Serial. Print ("DATA, TIME,"); Serial. Print (InTemp); Serial.print (“, “);

This tells Excel to put the PC time in the first column and fill the next four with numeric data. This data is the same floats were sent to any other terminal programme, and a maximum of 26 items will be accepted. Note that, in an exercise like this, you can get by with only one line of code to use PLX-DAQ – the time stamp. Indeed, there could be occasions when you don’t actually need that either. Note that the section in the PLX help file is called Control Directives, as are the commands. There is a lot of extra stuff but you can ignore their admonishions about carriage returns, it clearly does not apply to Arduino, just use Serial.println for the last in the normal manner. If you are a bit short of confidence, you can do a test run using the serial monitor. It is quite readable.

EXCEL

Download and install the macro in the normal manner. The installation includes a desktop folder with two shortcuts inside. Note that the help file is pretty comprehensive, even though it does not refer to Arduino. The objective is to get the right material into Excel, regardless of where it originated. Your job is simply get Arduino to talk the same language…..

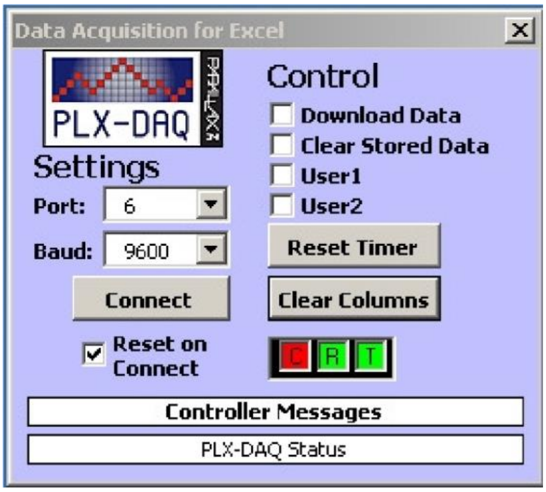


FIG-2.15-PLX-DAQ

This is used to make the connection and start Excel. The connection is made via the USB cable in the normal manner, and the port is the same as that used by the Arduino IDE. The baud rate must match that in the Serial, begin command in the Arduino programme.

2.3.3 EAGLE

EAGLE (for: Easily Applicable Graphical Layout Editor,) by CadSoft Computer is a flexible, expandable and scriptable EDA application with schematic capture editor, PCB layout editor, auto-router and CAM and BOM tools developed by CadSoft Computer GmbH, Germany, since 1988.

EAGLE is popular among smaller design houses and in academia for its favourable licensing terms and rich availability of component libraries on the web. Hobbyists are attracted by the availability of freeware licenses.

EAGLE was developed in 1988 as a 16-bit application for Microsoft DOS, with support for OS/2 and Windows added later on. Starting with version 4.0, EAGLE was converted to 32-bit. EAGLE version 4.0 also dropped support for DOS and OS/2, but was among the first professional electronic CAD tools available for Linux. A 32-bit DPMI version of EAGLE 4.0 running under DOS was available on special request in order to help support existing customers, but was not released commercially.

Starting with version 4.13, EAGLE became available for Mac OS X, with versions before 5.0.0 still requiring X11. Version 5.0.0 officially dropped support for Windows 9x and Windows NT 3.x/4.x. EAGLE 6.0.0 no longer supports Mac OS X on the Power PC platform (only on Intel Macs), and the minimum requirements have been changed to Mac OS X 10.6, Linux 2.6 and Windows XP.

On 24 September 2009 Premier Farnell announced the acquisition of CadSoft Computer GmbH, developer of EAGLE. EAGLE contains a schematic editor, for designing circuit diagrams. Parts can be placed on many sheets and connected together through ports. The PCB layout editor allows back annotation to the schematic and auto-routing to automatically connect traces based on the connections defined in the schematic. EAGLE saves Gerber and PostScript layout files and Excellon and Sieb & Meyer drill files. These standard files are accepted by many PCB fabrication companies.

2.4 SCOPE OF THE PROJECT

Technically, the scope of work had been divided to 3 levels. The levels are beginning level, intermediate level, finishing level.

2.4.1 Beginning Level

In the beginning level, the research and Development had been done. It consists of activities of gathering the information about project from multiple sources such as internet, journals and research papers, books and so on. In this state the massive analysis about the project.

2.4.2 Intermediate Level

At this level, design and drawing and basic layout were made. The software development and designing interface had been done to integrate software and hardware. A basic idea of the all the tasks to be performed, in a particular order was put in place. An algorithm and flowchart was made. All the basic components were put for manufacturing and codes were implemented.

2.4.3 Finishing Level

At the finishing level, the development of hardware had been done. Then the integration between hardware and software had been done and also performance testing and troubleshooting had been done to ensure that the system is working well without errors. Finally, we are able to complete the wireless data transmitting robot.

2.5 APPLICATIONS

Local EPA and fire rescue HAZMA Tresponse, fire weather, mobile air traffic control support, NBC detection support, or any situation requiring a highly mobile, easily deployable general weather station.

2.6 SUMMARY

In this chapter, hardware has been explained in detail along with software. Literature survey of each and every component has been explained along with the levels in which we did the project.

3.1 INTRODUCTION

In this chapter we elaborate on the block diagram and its description of the proposed device. The function and working of each component used in the making of the device is explained in this chapter.

3.2BLOCK DIAGRAM

3.2.1 SMART TERRAIN ROBOT

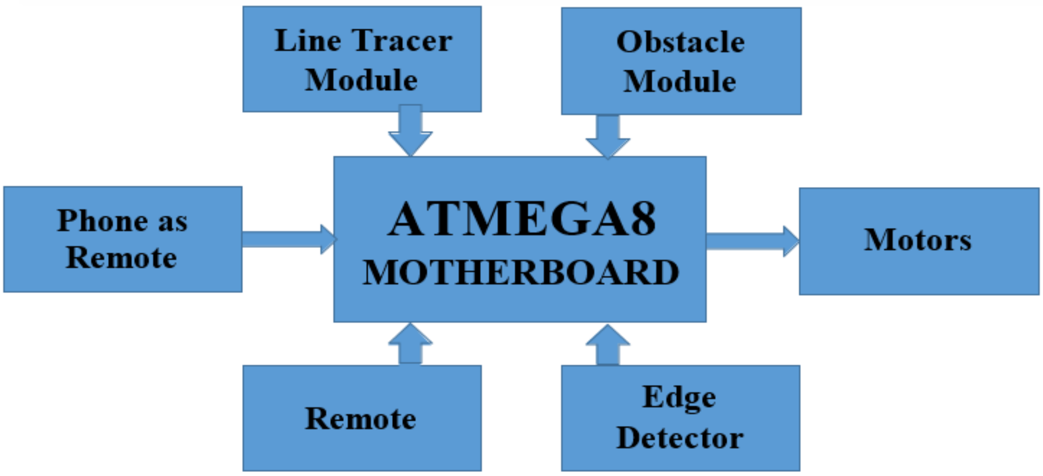


FIG-3.1- BLOCK DIAGRAM OF SMART TERRAIN ROBOT

3.2.2 TRANSMITTER

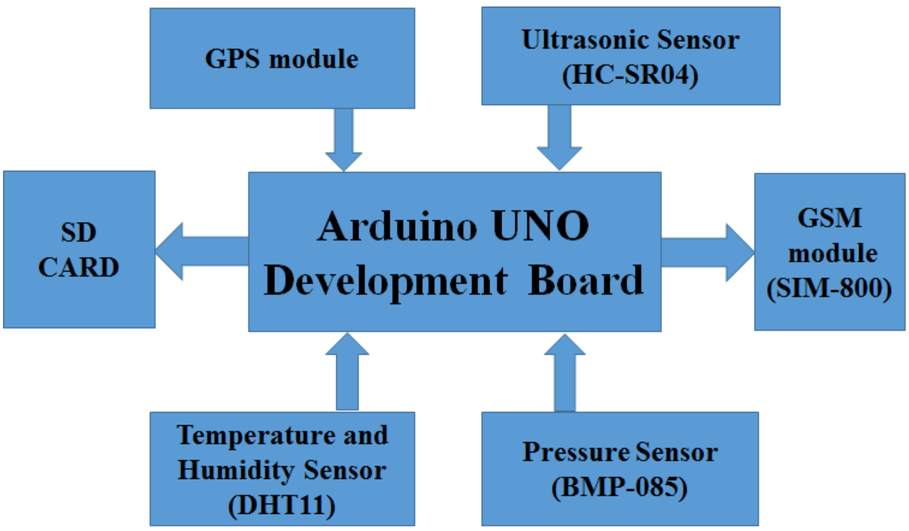


FIG-3.2- BLOCK DIAGRAM OF TRANSMITTER

3.2.3 RECEIVER

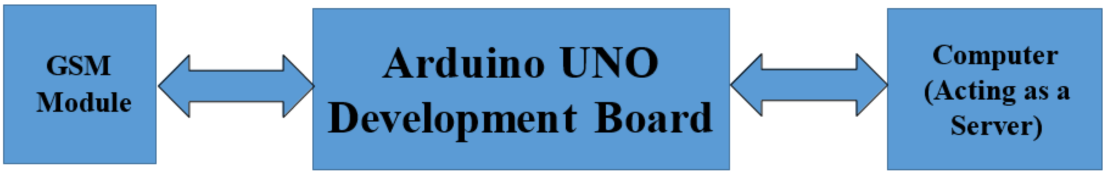


FIG-3.3- BLOCK DIAGRAM OF RECEIVER

3.3 BLOCK DIAGRAM DESCRIPTION

In this section we are going to emphasize on detailed overview of each of the block in the diagram. The project consists of three parts:

1. GSM module transmitter
2. Smart terrain robot
3. Central server (Receiver)

The transmitter section collects weather information through meteorological sensors interfaced with it. This data is transmitted to a receiver through text messages using a GSM module.

3.3.1 SMART TERRAIN ROBOT

This part of the project makes the whole system portable. This smart terrain robot can be used in manual mode (wired) or auto mode (wireless). The smart terrain robot is a five in one integrated system performing functions such as:

1. Line tracing
2. Edge detection
3. Obstacle avoiding
4. Mobile controlled
5. Remote controlled

Smart terrain robot consists of IR sensors, manual remote and 3.5 mm phone jack (for mobile control). IR sensors are used for the purpose of line tracing, obstacle avoider and edge detection.

3.3.1.1 LINE TRACING

Line tracing uses IR sensor. IR sensor gives high response to black surface and low to white surface. Therefore, line tracer IR module is used to trace a white line on black surface. So this gives low output and is received on the motherboard. There are three sensor pairs in line tracer module. When the center sensor is on line, it gives a ‘HIGH’ signal on the motherboard and both the motors work. When the right sensor gives ‘LOW’ signal, the robot turns left. This happens because the power supply is given to left motor only and when left sensor gives low signal, only right motor gets power, the robot turns right.

3.3.1.2 EDGE DETECTION

For edge detection, only line tracing module is used. IR sensors gives low output if it is not getting any IR rays. So, when there is no surface below the sensor, low output will be received on motherboard. After detecting the edge, reverse power supply will be given to both the motors.

3.3.1.3 OBSTACLE AVOIDING

As explained earlier, IR gives high output if anything come near to sensor. After getting high on motherboard, reverse power supply is given to both motors.

3.3.1.4 MOBILE CONTROL

One mobile will be connected to the robot with a 3.5 mm jack. Every number on the keypad has a different DTMF tone. DTMF IC HT-9170 converts DTMF tone into digital data. According to that, power supply is given to the motors.

3.3.1.5 REMOTE CONTROL

Each switch of the remote is connected to the motherboard. And for every button, a specific power supply is given to motor, in a specified way.

3.3.2 TRANSMITTER

ARDUINO UNO microcontroller with ATMEGA 8 is used on the motherboard of the transmitter. All the data from various sensors is taken. The sensors are as follows – DHT-11 (temperature and humidity), HC-SR04 (ultrasonic sensor), BMP-085 (pressure sensor). All the data from sensors is processed and displayed on the serial monitor of the ARDUINO software and/or sent as SMS using GSM module.

3.3.2.1 ARDUINO BOARD

Arduino board is used to take all the data from the sensors. Then all of that data is processed on Arduino microcontroller. After that the data is processed and given to GSM modules and sent through the SMS to central server. Also, all this data is backed up and saved in the SD card as a text file.

3.3.2.2 GPS MODULE (SIM-28M)

GPS module is used to get the coordinates (latitude and longitude) of the robot. GPS module gives us various data strings from which relevant data i.e., longitude and latitude are extracted. GPS module gives data according to NMEA protocol. GGA protocol is used in this project. GPS module gives data in the form of character strings. It is then converted into integer. Format of longitude and latitude is xxxx.xxxx but Indian standard is xx.xxxxxx. Therefore, it is converted into the format of Indian standards.

3.3.2.3 ULTRASONIC SENSOR (HC-SR04)

Ultrasonic sensor is used to get the distance of obstacle in its path so that robot can react according to that. Ultrasonic sensor converts the electric signal into ultrasound waves. Ultrasound waves are transmitted from the sensor. After reflecting from object, ultrasound waves comes back to sensor which is converted into electrical signal. The time between transmitted wave and received wave is calculated. And from that time, distance of the object is calculated.

3.3.2.4 TEMPERATURE AND HUMIDITY SENSOR (DHT-11)

DHT-11 which is temperature and humidity sensor gives combined data of temperature and humidity. As shown earlier that data is processed and separate data of temperature and humidity is displayed. There is acknowledgement (ACK) signal also to check if the data is correct or not.

3.3.2.5 PRESSURE SENSOR (BMP-085)

BMP-085 gives pressure and altitude of the robot. BMP-085 gives data in I2C bus format that is SCK and SDA. SCK is clock pulse and SDA is data pulse. From SCK sensor and microcontroller is synchronized and then microcontroller receives data from sensor.

3.3.2.6 GSM MODULE (SIM-800)

GSM module is used to send the message. All the data from sensors is collected and send to central server through the SMS (short message service). GSM module uses AT commands to send the SMS.

3.3.2.7 SD CARD

SD card is used to save the sensors data as back up. All the data of the sensor is saved into a text (.txt) file. SD card is used so that in the case of any loss of data, data should be stored somewhere as back up.

3.3.3 RECEIVER (CENTRAL SERVER)

Receiver or central server have Arduino board and GSM module which is connected to computer through USB to serial converter.

3.3.3.1 GSM MODULE

GSM module is used to receive the message. On the commands given by Arduino controller, GSM module gives the respective message to Arduino controller and it also deletes the message.

3.3.3.2 ARDUINO BOARD

Arduino board is connected to the computer acting as a central serve through USB to serial converter. It takes the data from GSM module and it gives the data to computer serially.

3.3.3.3 PLX DAQ

PLX-DAQ is used to display the data which is received serially from Arduino board and display on Excel sheet and make a graph of that. It also uses serial monitor only.

3.4 SUMMARY

In this chapter the details of design of the device are explained with reference to the block diagram of the device. Each block, its importance and purpose in the device is explained along with its expected working. Thus, here the microcontroller ATMEGA8 monitors the measurement of various parameters of environment. This is done by using the various sensor as explained above. The outputs will be displayed on an excel file with the help of a graph. The design aspects presented here will cover the guidelines for implementation of hardware and software for the project.

4.1 INTRODUCTION

In this chapter we elaborate on the PCB designing, manufacturing and coding part of the project. The function of each part of circuit and each function of the code is explained.

4.2 CIRCUIT

4.2.1 SMART TERRAIN ROBOT

4.2.1.1 Comparator

Sensors cannot itself provide output, which can solely be used as a reference to the controlling. Also every IR Receiver provides a different output even for the same conditions and is Analog in nature. Thus a fundamental signal conditioner is necessary to turn it into identifiable. This job is done using a comparator IC LM324. IC LM324 has 4 comparator in it, so it can compare 4 sensor outputs at a time.

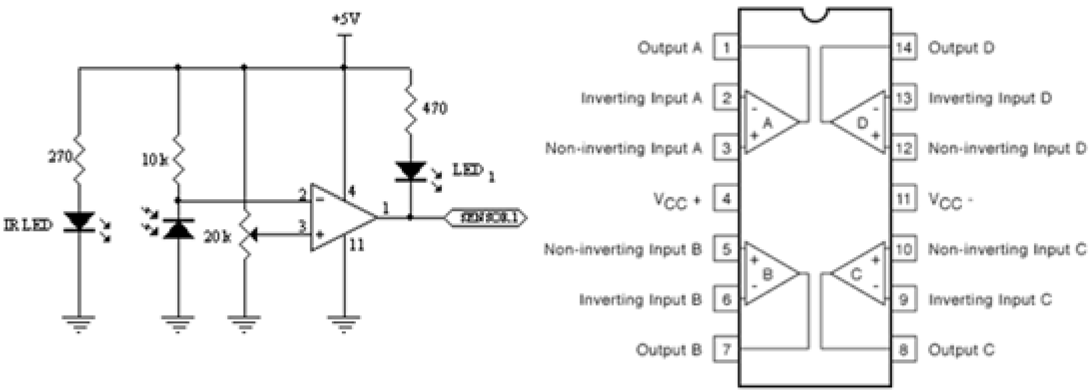


FIG-4.1-COMPARATOR

As shown above, one input of the comparator has given to the variable pot connected to the supply voltage, which will provide the reference comparator input. So the output of the sensor is compared with the reference voltage and the respective HIGH and LOW output is given out.

4.2.1.2 Motor Driver

While driving the motor, motors draw large currents from the source, which is in Amperes. Thus connecting the loads directly to the control circuitry is totally impractical. Thus to control the motors from the robot brain, driving loads are needed to be isolated from it, also the high current to drive the motors has to be provided from some other source.

In our Robot, we will be using L293D ICs for driving the motors. The schematic diagram of a common motor driver circuit is like above. Each Motor Drives as follows:

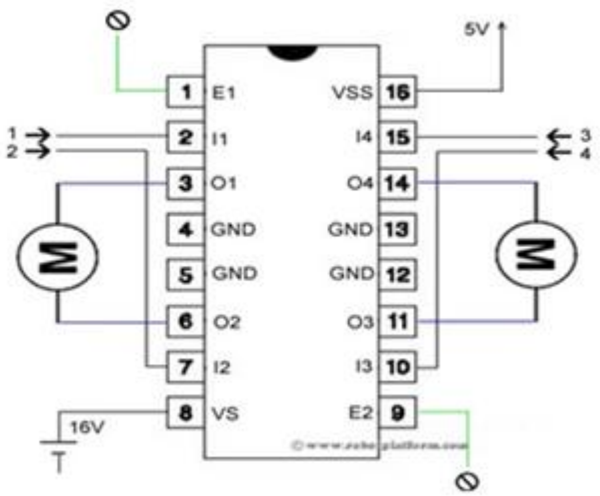


FIG-4.2-MOTOR DRIVER

4.2.1.3 VOLTAGE REGULATOR

A fixed voltage regulator, IC7805 will regulate any unstable voltage in the range of 7 volts to 30 V to a constant regulated voltage of 5V. It provides both Line and load regulation to the circuit. Also it has over voltage protection and thermal shutdown in it.

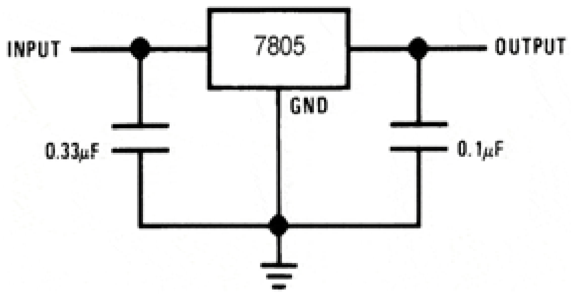


FIG-4.3-VOLTAGE CONTROLLER

4.2.1.4 GSM AND GPS MODULE

For communication to take place between the GSM module and microcontroller, we need to connect four pins namely, GND, VCC, Tx and Rx on the GSM module to GND, VCC, Rx and Tx of Microcontroller respectively.

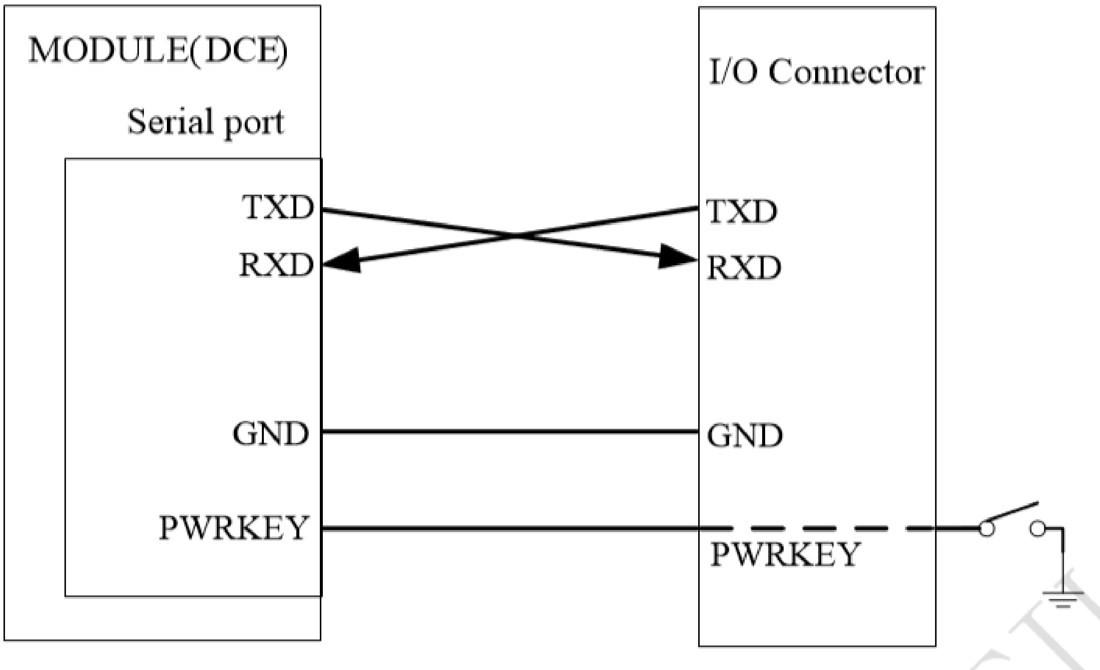


FIG-4.4-CONNECTION OF GSM MODULE

4.3 PCB LAYOUT

A printed circuit board (PCB), is used to mechanically support and electrically connect electronic components using conductive pathways, tracks or signal traces etched from copper sheets laminated onto a non-conductive substrate.

PCB FABRICATION

A number of methods are available for making PCBs. The Simplest is drawing pattern on a copper clad board with etch and resistant ink or paint, etching the board and drilling the holes. This method is suitable where there is no need for precision and the quantity of the required is only one or two pieces. But what the uses of IC’s and growing of the component on the board, this method becomes tedious. Another method is to make a silkscreen stencil by the photographic process. Print the pattern on the copper clad boards etches and drills the holes. This method become tedious and uneconomical of hobbyist whose requirement may not be more than 3 to 4 pieces at a time? In such a cases a method known a photochemical process should be adopted. These process large quantities single and double gives a professional touch to the finish board.

- MATERIAL REQUIRED FOR MAKING PCB

1) Copper clad board.
2) Poly vinyl alcohol solution with synthesizer.
3) Chromo line Film.
4) Squeegee.
5) Gloss ink.
6) Ferric Chloride.
7) Plastic tray for etching.
8) Stripper (Tri- Chloral ethylene or methylethyerkethonel)

SCREEN PRINTING

In this screen-printing technique, the circuit design is copied on the transparency sheet by Xerox method. The transparency sheet now serves as a projective; Screen-printing can be done on various materials like, paper, cloth, plastic bags, tin sheets, glass etc.

STENCIL MAKING

The stencil is made inside a room, which is completely dark. This room may have a red light bulb, since red light does not affect the chemical process involved during stencil making and it permits us to view things.

SCREEN PRINTING

When the screen is completely dried, it is placed. The projective (transparency sheet containing circuit design) is kept over the screen with it is readable side (copper side) facing the screen. Glass is placed over the projective. The screen is now exposed under mercury vapour lamp. The exposure time under mercury vapour lamp is six to eight minutes. After exposing the screen, it is washed in a tub of water.

PRINTING CIRCUIT DESIGN ON COPPER CLAD

The screen-printing ink is etch-resistant and is insoluble in water. Before printing, the transparent polyester film covered over the chromo line film is gently removed. White paper is placed under the screen. Squeegee is dipped in the ink and it is drawn against the screen. The circuit design gets printed on the white paper.

REMOVING THE STENCIL

A tray containing warm water is taken and two to three; spoonful of caustic soda or bleaching, powder are added to it. The screen is dipped in the tray for five minutes.
Then it is taken out and the stencil is slightly rubber with a one-out toothbrush. Finally, the screen is washed with detergent powder and plenty of water. The screen is then kept aside for drying. This screen can later be reused for making the stencil of some other circuit design.

ETCHING

Warm water is taken in a glass tray and two to three spoonfuls of Fed are added to it. The copper clad containing the circuit design is submerged in the tray having the FeCL3 solution. After some time (depending upon the concentration of FeCL3 solution), the exposed copper gets etched. The clad (PCB) is now taken out of the solution and washed toughly with wear and cleaning powder.

RESISTANCE REMOVAL

Once the etching job is complete, remove the photo-resistance from the image area with trichloro ethylene. Wash surface thoroughly and dry quickly.

FINISHING

At this stage the PCB is ready for final operation of drilling the holes of required size at the appropriated place as shown in layout with a drilling machine or hand drill. If you are not using PCBs immediately after its preparation give a protecting coating to stop the oxidation of copper surface readymade solution are available for this purpose.

COMPONENT MOUNTING

The leads of component like resistance and capacitor should be inserted carefully. A inserting the component carefully cut the lead of component so that the lead remains 3 mm above the soldering side of the PCBs to make the field contact easily. In case of semiconductor device such as transistor and diodes the length of leads extended above the component disc of PCB should be remain about 5 mm. This prevents not only the heat, applied to the each lead while soldering but also useful for measuring the voltage across these leads.

SOLDERING

PCB soldering requires proper soldering techniques. For this purpose one should have to use light duty soldering iron of the range 10 to 25 W. This prevents the damage of PCB due to excess heating. To avoid the sour circuit between adjustments conducting path, one should not use excess solder. Solder. Solder wire of 60/40 ratio should be used. For soldering integrated circuits one should have to use a soldering iron of pointed tip. While soldering semiconductor device great care should be taken.

IMPLEMENTATION

The most important requirement of this project was to build a PCB with minimum weight and size. Designing procedure is as follows:

i. Making of layout of PCB on eagle software.

ii. Etching procedure of PCB.

iii. Mounting of actual component on the PCB.

iv. Testing for continuity and Debugging.

For this project two PCBs has been designed. The main PCB is Microcontroller Motherboard, other one is sensor board.

4.4 PCB DESIGNS

4.4.1 PCB SCHEMATIC OF ROBOT

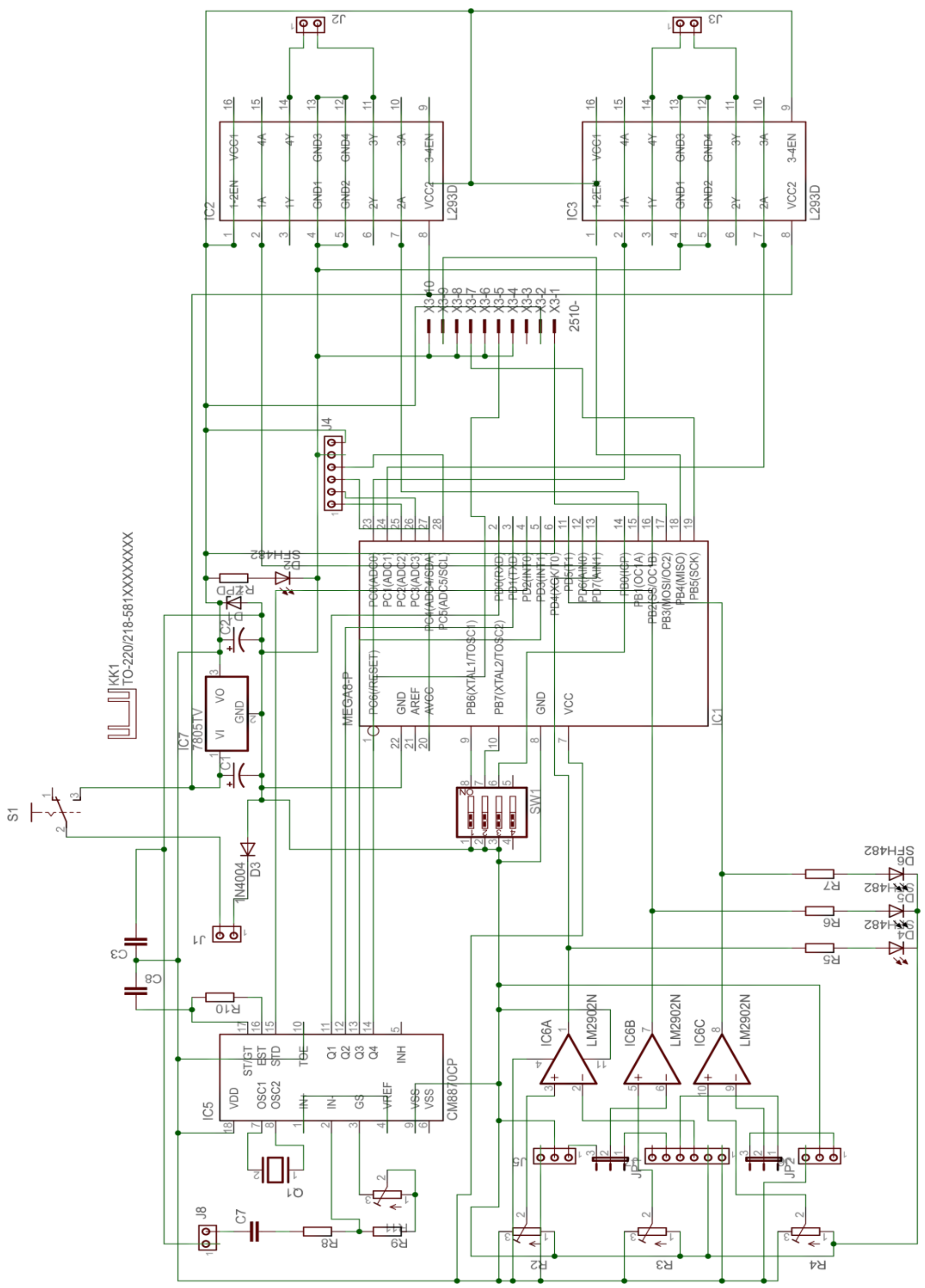


Fig-4.5-PCB SCHEMATIC OF ROBOT

4.4.2 PCB LAYOUT OF ROBOT

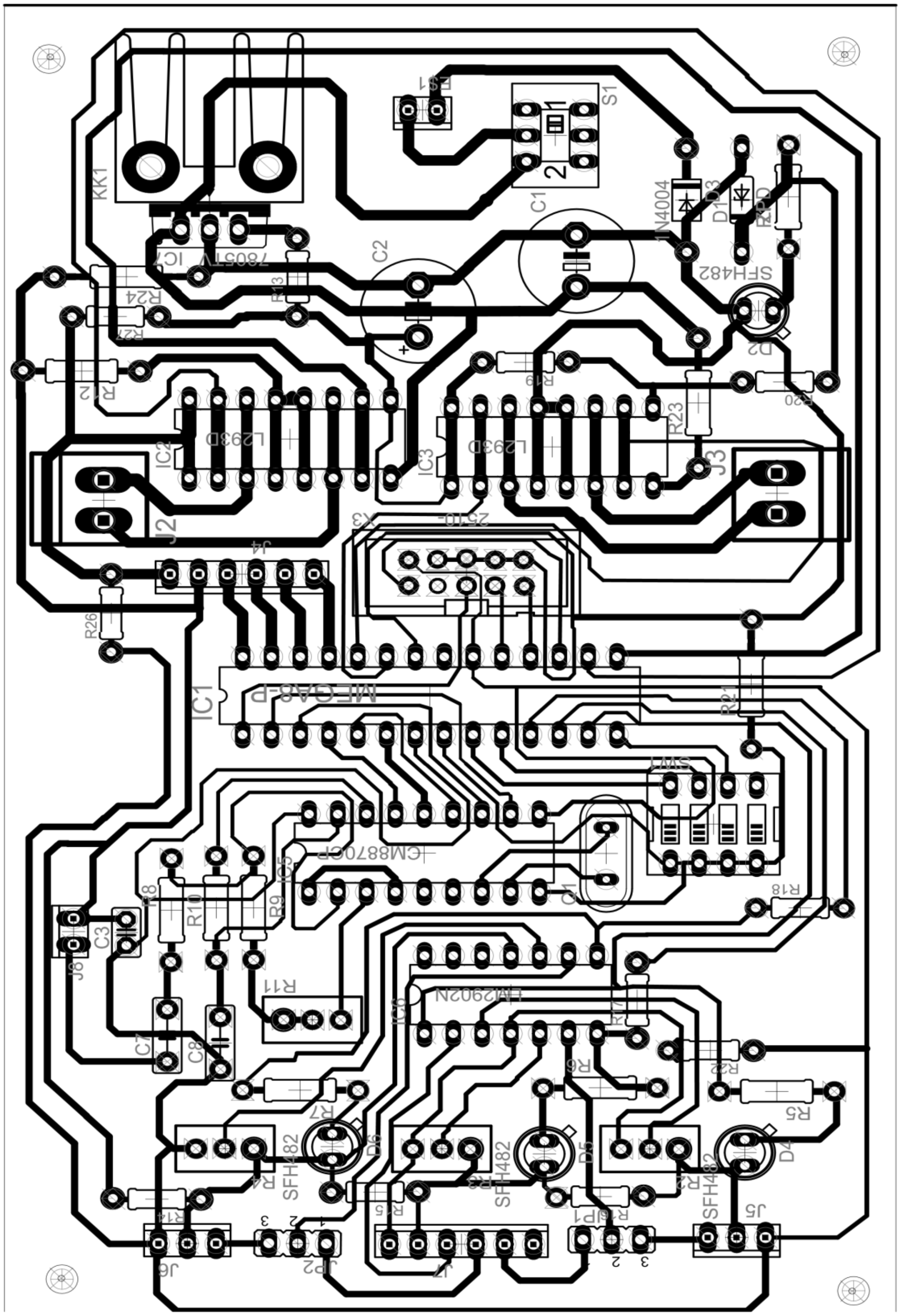


FIG-4.6-PCB LAYOUT OF ROBOT

4.4.3 PCB SCHEMATIC AND LAYOUT OF LINE TRACER SENSOR

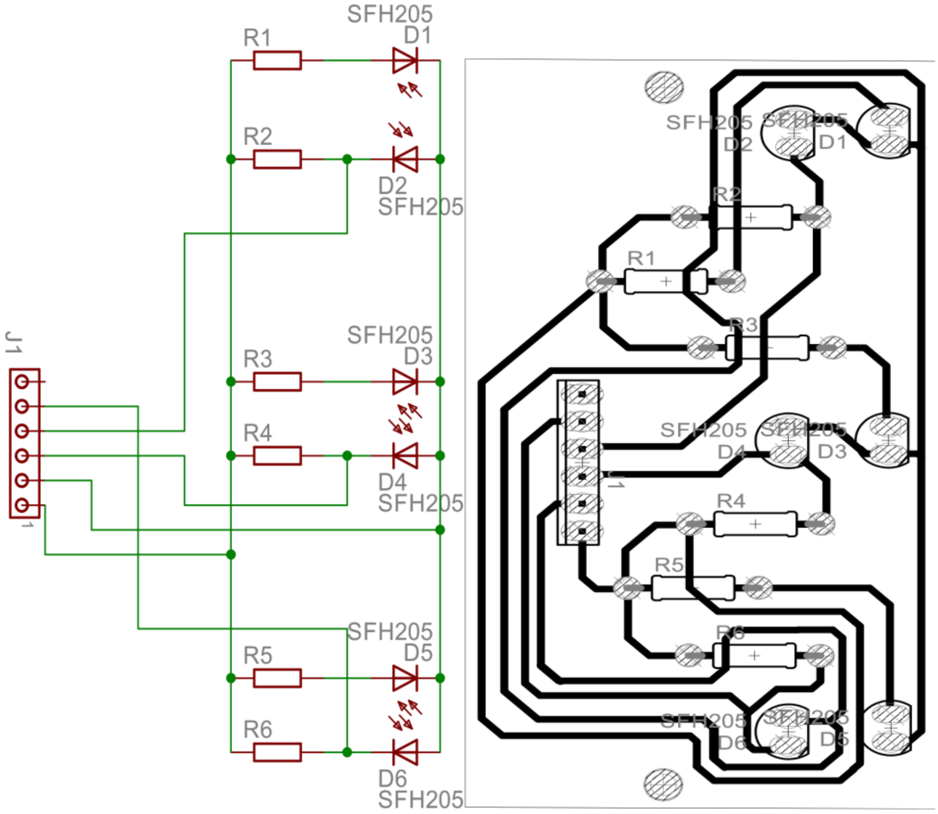


Fig-4.7-PCB SCHEMATIC AND LAYOUT OF LINE TRACER SENSOR

4.4.4 PCB SCHEMATIC AND LAYOUT OF OBSTACLE SENSOR

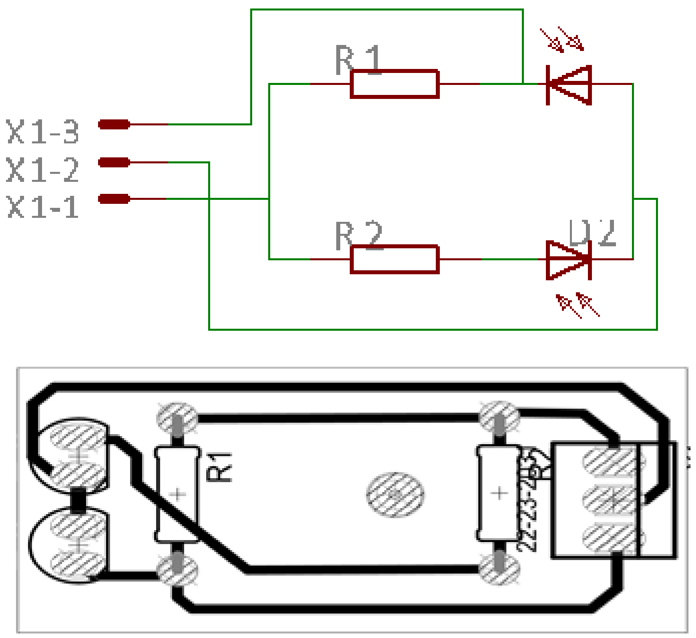


Fig-4.8-PCB SCHEMATIC AND LAYOUT OF OBSTACLE SENSOR

4.4.5 PCB SCHEMATIC OF TRANSMITTER

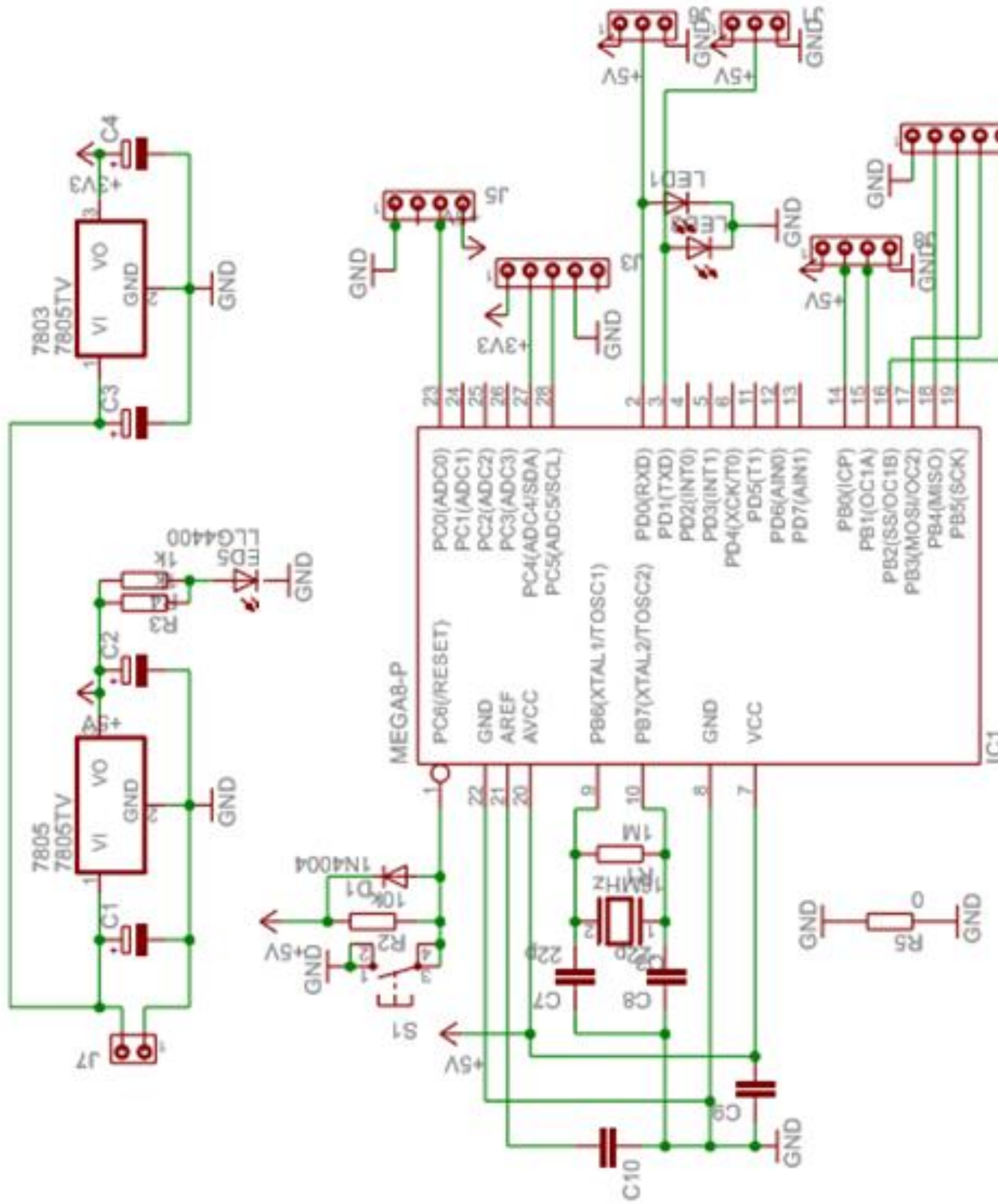


Fig-4.9-PCB SCHEMATIC OF TRANSMITTER

4.4.6 PCB LAYOUT OF TRANSMITTER

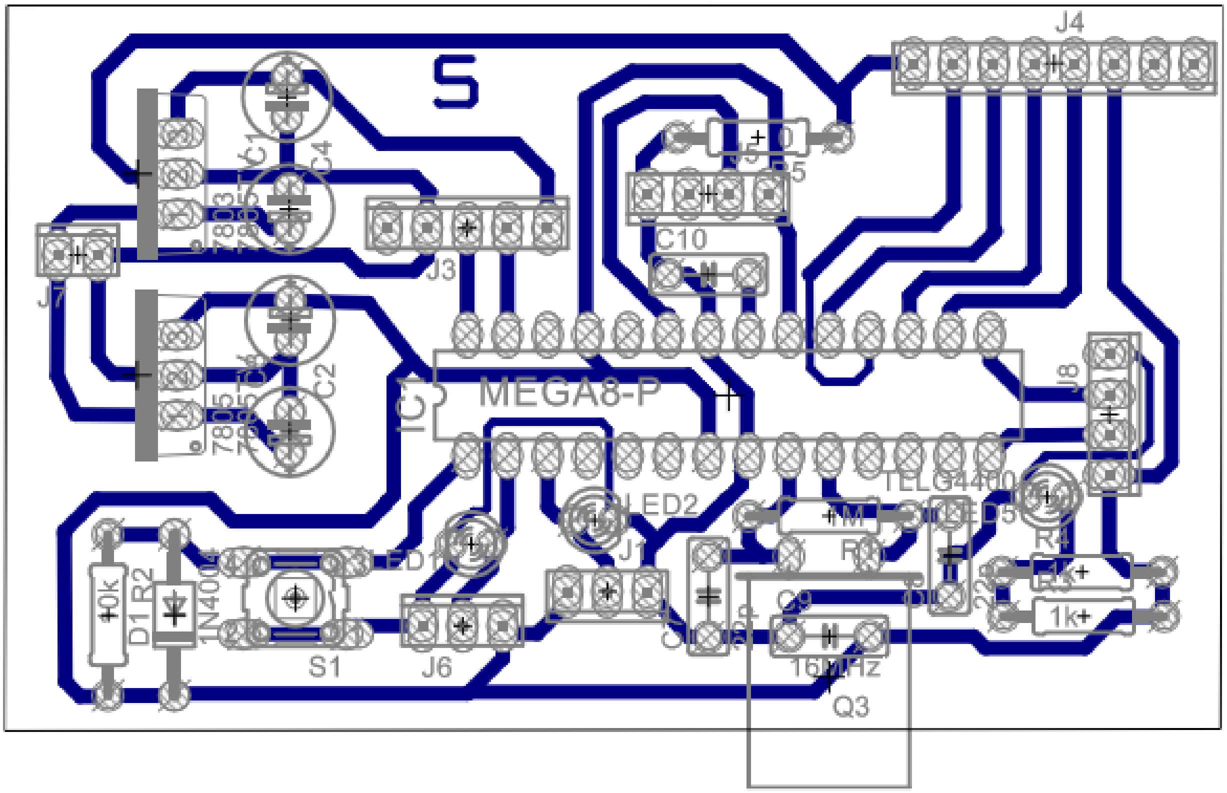


FIG-4.10- PCB LAYOUT OF TRANSMITTER

4.5 SOFTWARE DESIGN

Atmel studio development tool for the ATMEGA 8 Microcontroller Architecture support every level of software developer from the professional applications engineer to the student just learning about embedded software development.

4.5.1 FLOWCHART

1. Smart Terrain Robot

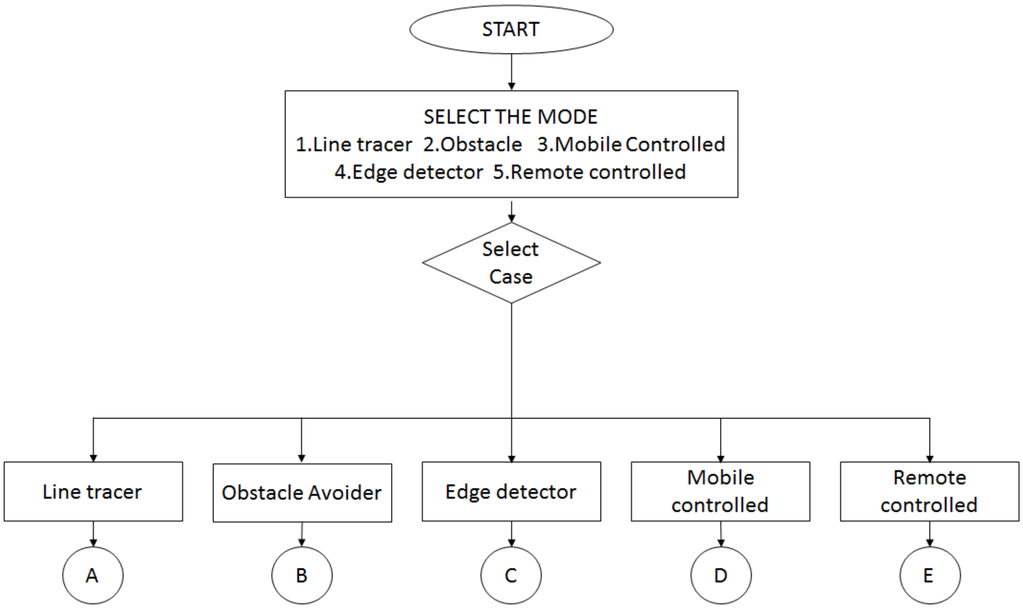


FIG-4.11-FLOW CHART OF ROBOT

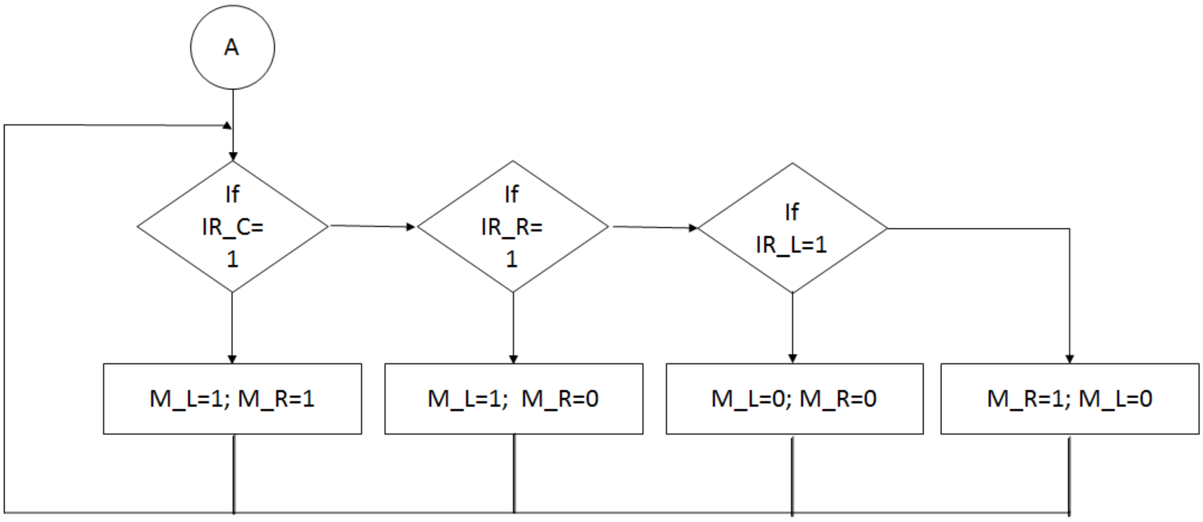


FIG-4.12-FLOW CHART OF LINE TRACER FUNCTION

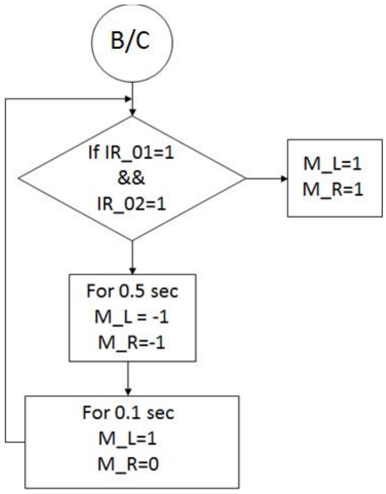


FIG-4.13-FLOW CHART OF OBSTACLE AND EDGE DETECTOR FUNCTION

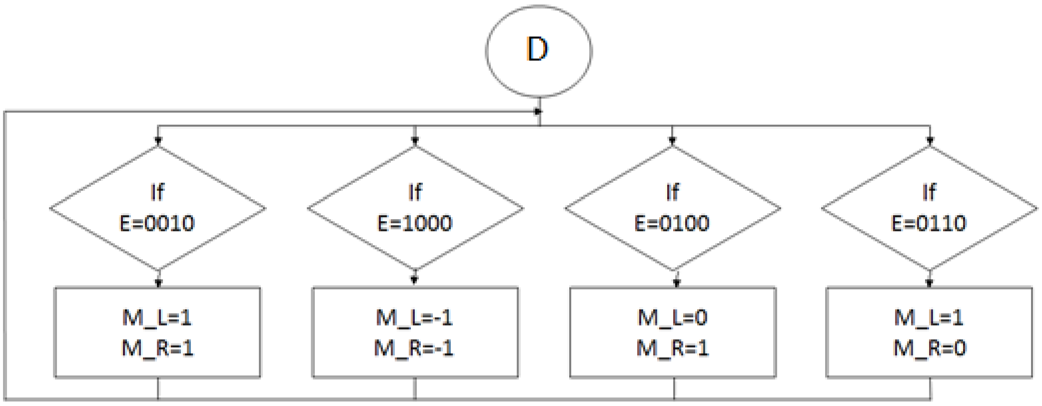


FIG-4.14-FLOW CHART OF MOBILE CONTROL FUNCTION

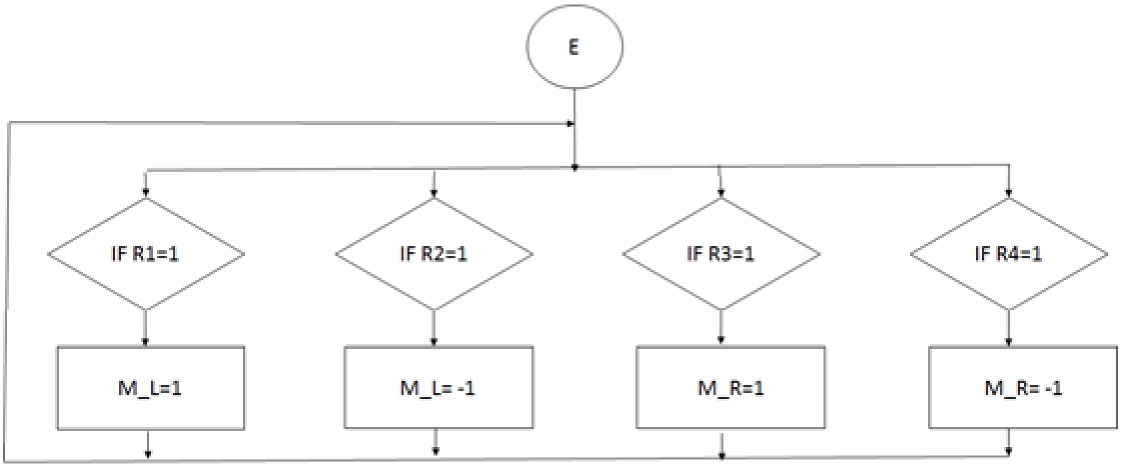


FIG-4.15-FLOW CHART OF REMOTE CONTROL FUNCTION

2. Transmitter

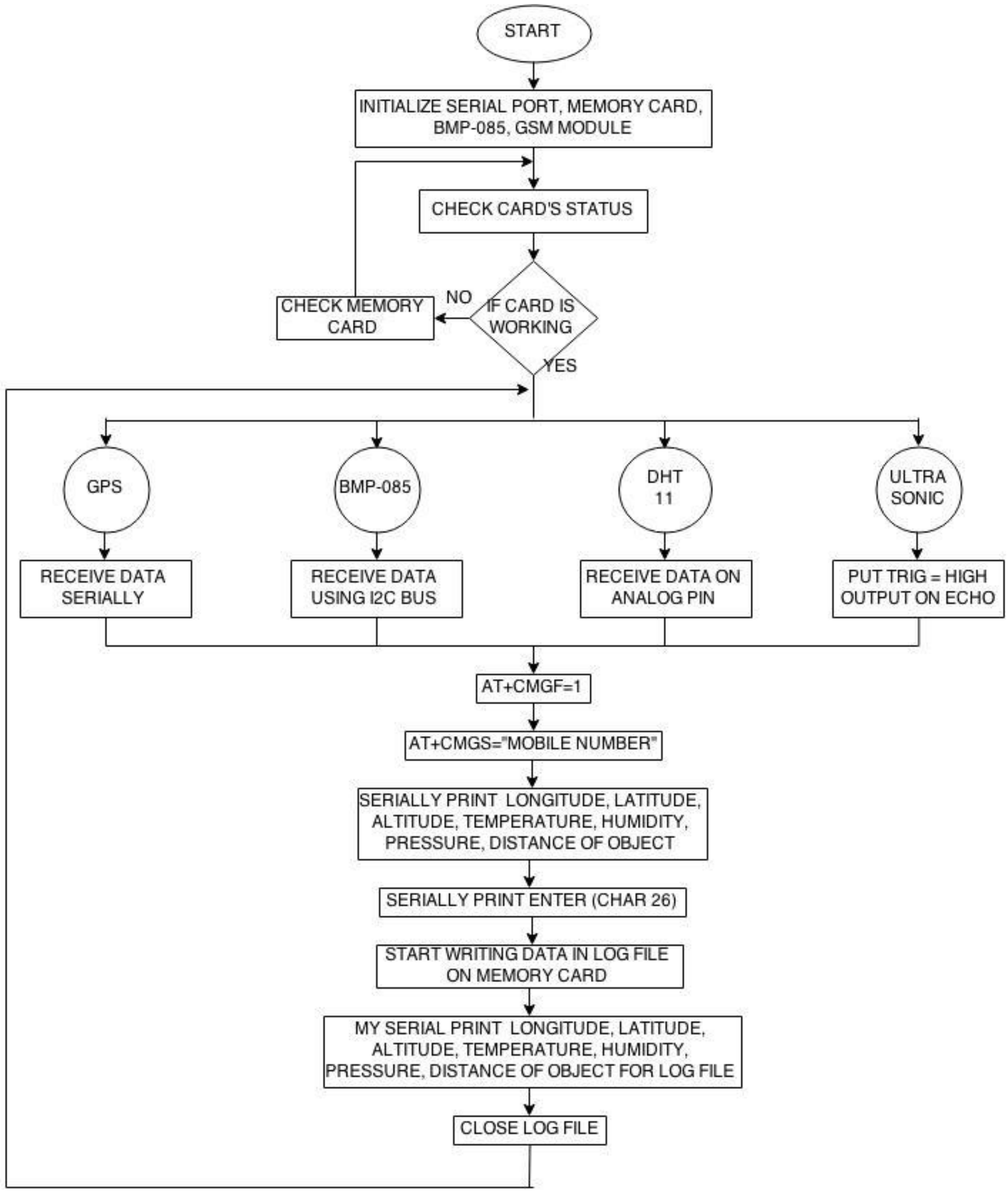


FIG-4.16-FLOW CHART OF TRANSMITTER

3. Receiver

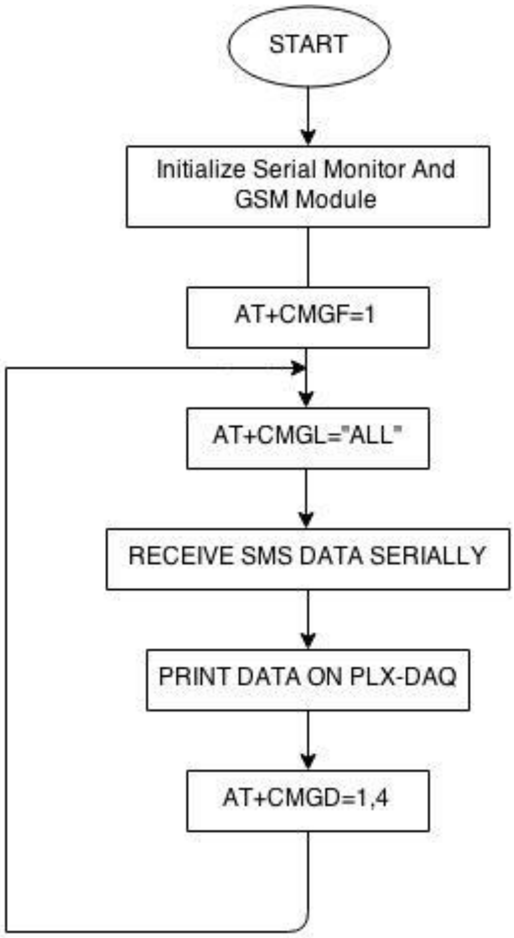


FIG-4.17-FLOW CHART OF RECEIVER

5.1 INRODUCTION

The project testing was done. The hardware and software work satisfactorily.

5.1.1 TRANSMITTER AND SMART TERRAIN ROBOT

- A sample prototype model of smart terrain robot has been developed with the help of Atmega 8 board.
- The robot is tested in all aspects.
- Environmental data is taken at various locations.
- And all the data is sent through SMS to the receiver.

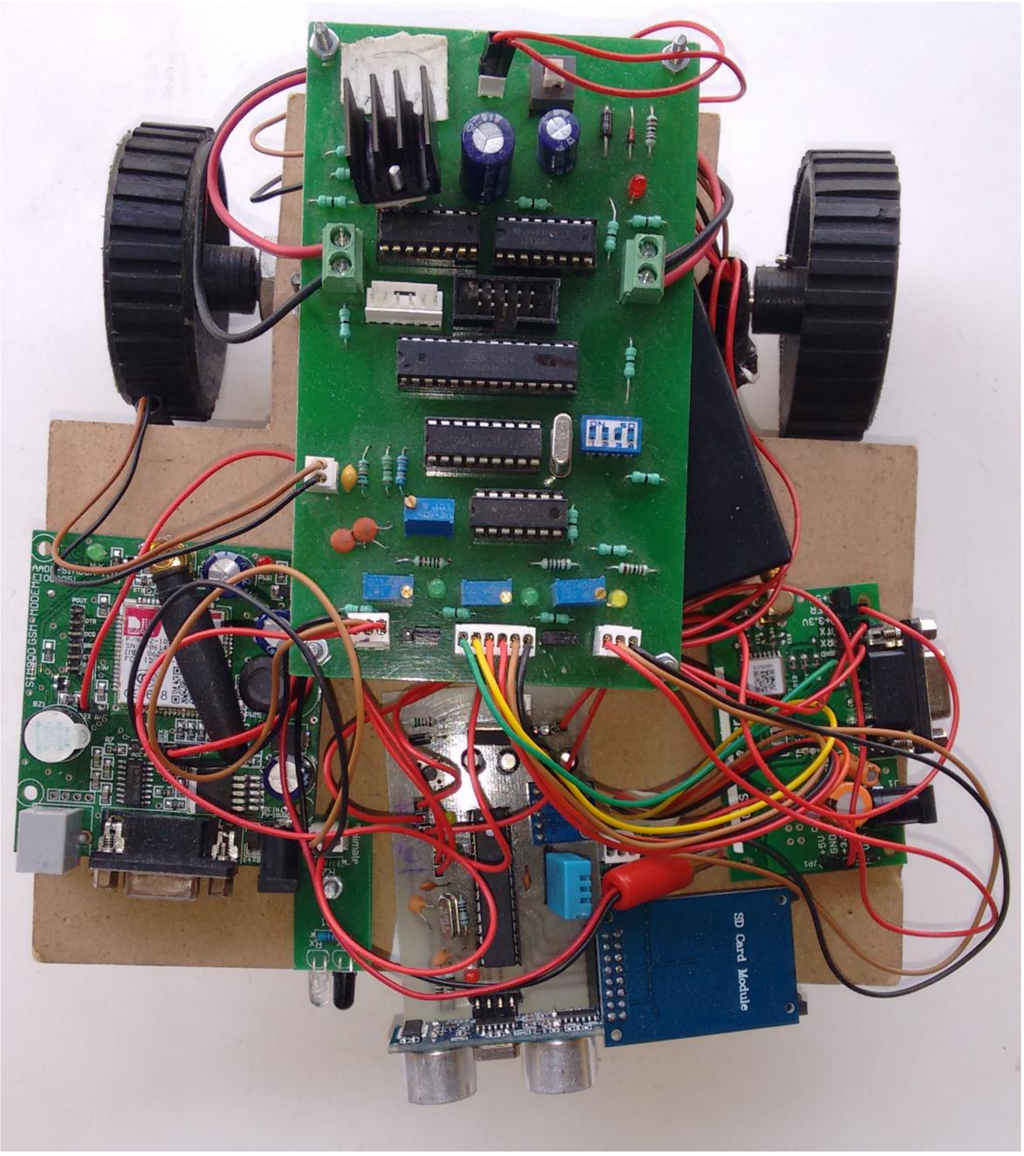


FIG-5.1-TRANSMITTER ASSEMBLY WITH ROBOT

FIG-5.2-SMS SENT FROM ROBOT

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Date : 24/02/2015
TIME : 02:58:42
Latitude  : 18.465288
Longitude : 73.836532

To know location click on the link :
https://maps.google.co.in/?q=18.465288,73.836532

Humidity  : 32.00%
Temperature : 27.00C
UltraSonic Distance Measurement : 0 cm
Pressure : 94003 Pa
Altitude : 628.44 meters
---------------
```

FIG-5.3-TEXT FILE (BACKUP FILE)

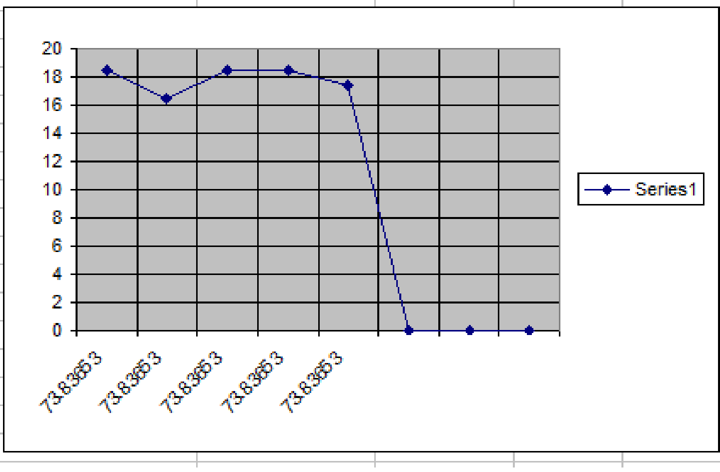
5.1.2 RECEIVER

- The received message is processed and displayed on the serial monitor.
- Data from serial monitor is taken and displayed on the Excel file with the help of PLX-DAQ software.
- Data is displayed on Graphs also.

5.2 RESULTS

The output observed at various locations are given in the following image:

A	B	C	D	E	F	G	H	
Time	Server number	Longitude	Latitude	Humidity	Temperature	Ultrasonic	Pressure	Altitude
13:37:29	1.00	18.465288	73.83653	32	27	0	94003	628.44
13:38:09	1.00	16.465286	73.83653	32	27	0	94003	628.44
13:38:50	1.00	18.465284	73.83653	32	27	0	94003	628.44
13:40:10	1.00	18.465282	73.83653	32	27	83	94003	628.44
13:40:10	1.00	17.46528	73.83653	32	27	0	94003	628.44



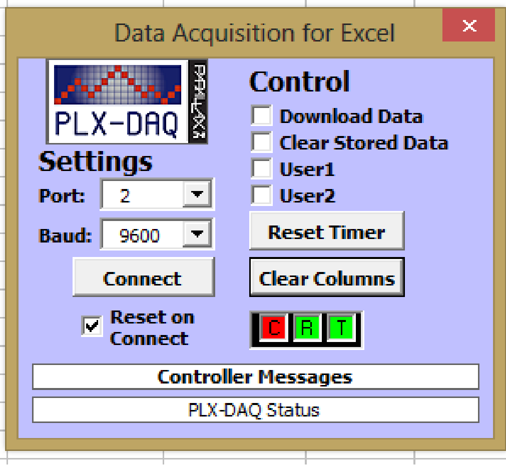


FIG-5.4-FINAL RESULT ON EXCEL SHEET

6.1 ADVANTAGES

- This is an integrated assembly equipped with tools for weather monitoring.
- Data transmission can be done using a wired connection or wirelessly.
- Extremely robust and portable.
- Can be used in inaccessible and difficult terrains.
- No repeaters are required to amplify the signal/ message.
- The sensor board can be detached from the movable bot. It can be used as a permanent setup in one particular place. For e.g. in a boiler room in a ship, in testing chambers etc.
- Better the sensor quality, better will be the sensing.

6.2 DISADVANTAGES

- Limited accuracy and range of sensors.
- Data will be lost in case of poor network for long durations.
- Delay in transmission may occur due to bad weather conditions.

6.3 APPLICATIONS

- Weather monitoring in rough terrain and harsh climatic conditions (hot /cold deserts, hills, valleys).
- Weather monitoring in inaccessible areas like mines, gas pipelines or hazardous areas like chemical laboratories, testing chambers in industries.
- Domestic purposes for environment monitoring in offices, homes etc. Can be used for agricultural purpose with minor modifications. Wireless transmission of data to a main server.
- Automatic collection, sorting and storing information using a data acquisition tool.
- Convenient statistical and graphical analysis of collected data.

7.1 CONCLUSION

- A weather monitoring system using a smart robot has been successfully implemented.
- With the help of this wireless weather monitoring robot the human efforts are largely reduced.
- It is the advanced technology which is rising rapidly in the field of automation.
- Using GSM modules, now LAN systems can be replaced.

7.2 FUTURE SCOPE:

- By using ARDUINO UNO (Atmega 8) the response of the device which is being controlled will be much faster.
- Everything can be automated and in future will be done in a wireless fashion.
- All data will be streamed live on the internet using raspberry pi b+.
- A camera can be interfaced with raspberry pi b+ and upload the data on the internet.
- Night vision camera or thermal camera can be used so that at night.
- Solar panel can be used so that it has replenish able power source so that it can be used in the day as well as in the night.

8.1 IEEE PAPERS

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- Grzonka, S. ; Albert-Ludwigs-Univ. of Freiburg, Freiburg, Germany ; Grisetti, G. ; Burgard, W. “A Fully Autonomous Indoor ROBOT”, Robotics, IEEE Transactions on (Volume:28 , Issue: 1) , Feb. 2012.
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8.2 BOOKS

- O’Reilly; Massimo Banzi “Getting started with Arduino”.
- Manning Publication Company; Martin Evans, Joshua Noble, Jordan Hochenbaum “Arduino in action”.
- O’Reilly; Michael Margolis “Arduino cookbook”.
- McGraw-Hill/TAB electronics; Simon Monk “30 Arduino projects for the evil genius”.
- O’Reilly; Emily Geertz, Patrick Di Justo “Environmental monitoring with Arduino”.
- Technology in Action; Jonathan Oxer, Hugh Blemings “Practical Arduino: Cool projects for open source hardware”.

8.3 WEB REFERENCES

- www.atmel.in
- www.avr-tutorials.com
- www.arduino.cc
- ww.instructables.com