Accelerometer Controlled Robot with Collision Detection Using GSM GPS Module

DISSERTATION

Submitted in partial fulfilment of the requirement of the Degree of

MASTER OF TECHNOLOGY
IN
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SUBMITTED BY

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CERTIFICATE

This is to certify that the dissertation titled **“**Accelerometer Controlled Robot with Collision Detector using GSM GPS Module**”** is a bonafide record of work done by **AKSHYA KUMAR , Roll No. 2K14/VLS/01** at **Delhi Technological University, Delhi** for partial fulfilment of the requirements for the degree of Master of Technology in VLSI and Embedded System Design. This project was carried out under my supervision and has not been submitted anywhere else, either in part or full, for the award of any other degree or diploma to the best of my knowledge and belief.

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Abstract

The main aim of the project is to design "**Accelerometer Controlled Robot with Collision Detection using GPS GSM Module"**. In our project we can control the motion of robot by using wireless communication i.e. from Control section (acts as transmitter) we are sending the control signals, then the robot receives (acts as receiver) the signals, according to the signals being received the direction of the robot is controlled.

This project is designed around a Microcontroller which forms the control unit of the project. According to this project, a ZigBee transmitter is used to transmit the control signals, which controls the direction of the robot. In the same way, RF receiver which is placed on the robot receives the RF signals according to which the direction of the robot is controlled. The microcontroller plays important role in controlling the direction according to RF signals being received at the Receiver side i.e Robot section. The Robot has additional feature of collision detector and send the GPS location to the Emergency Number via GSM Module.

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Chapter 1

1.1 Introduction

The current emerging technology in the field of science is Robotics. It is the new emerging booming field of great use to people in the coming years. These days a number of wireless robots are being developed and put to various applications and uses. In order to enhance the contribution of robot in our daily lives we need to find an effective way of communicating with robots. For this purpose, there have been certain developments in area of human-machine interaction. One common form of communication is Gestures that are not only limited to face, body and fingers but also hand gestures. In order to increase the use of robot in places where conditions are not certain like rescue operations, robots can be made to follow the instructions of human operator and perform the task accordingly. This proposes an integrated approach of tracking and recognition of hands which is intended to be used as human-robot interaction interface

A hand Gesture Control Robot is a kind of robot which is controlled by the hand gestures and not by using buttons. The robot is equipped with two sections- **Transmitting section and Receiving section**. In the Transmitting section, the Accelerometer is mounted on hand of the user capturing its gesture and moving the robot accordingly. For assigning proper levels to the input voltages from the **Accelerometer IC** is used. Encoder IC is then used to encode the data which is transmitted to Microcontroller will later be transmitted by a **ZigBee device** in **Transmitter module**. In the receiving section, the received encoded data by **ZigBee receiver module** is then decoded using a decoder IC which is then processed by a **Microcontroller** and passed onto a **Motor driver** to rotate the motors in a special configuration to move the robot in the same direction as that of the hand. So, the primary basic aim of design is to make the robot move as soon as the operator makes any gesture.

Also the Robot have feature of **Collision detector using IR sensor** which will send signal to Microcontroller and accordingly it send the **GPS location (latitude,longitude)** of Robot to the particular mobile number via **GSM Module**. It will help in quick response from the emergency team in case of collision of vehicle in Road Accident. As shown in Figure 1 the different gesture of hand which control the motion of Robot in different direction i.e. right, left, forward and backward.

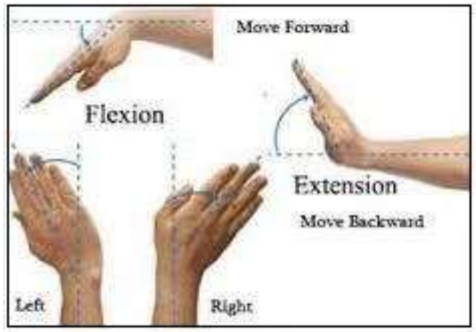

Figure 1.1 Different Motions of Hand

1.2 Motivation

Automatic accident detection system is used to recognize the location of the accident and easily to reach the location. Every second is valuable for the ambulance vehicle. There is loss of life due to the delay in the arrival of the ambulance to the hospital in the golden hours. This delay is mainly caused by the waiting of ambulance in the traffic signals. So time places an important role in this task. An ambulance will reach the nearest hospital at the exact time to save the human life. This is fully automated and thus it locates the accident spot exactly.

Now a days the vehicle accident rate has been increasing as compared to previous decade and the data shows accident rate has increased by 54%. This system minimizes the action time after an accident. It deals with such system to detect possible collision. In this work, C programming is used for better accuracy and GPS module used to locate the vehicle anywhere on the globe. GSM is used to send the exact location of the vehicle and also send alert or relax messages to this remote device (mobile phone).

In this paper it is presented here that the number of accidents has increased a lot, thus we lose our valuable life by making small mistakes while driving and if the operator of the vehicle was informed at least one half second prior to the collision 65% of the collisions can be avoided which dramatically reduces the total number of road way accidents. Many lives could have been saved if accident information has been sent to the emergency services so that they could reach in time. Therefore collision detection is one of the important criteria in today's situation. When **IR Sensor** sensed the collision has occurred and makes use of **GSM, GPS** to send the information which includes location to predefined telephone number [1].

1.3 Methodology

1.3.1 Methodology for Gesture Control

The Accelerometer Sensor here used to control the motion of Robot ,it transmit the signal to the Microcontroller and then Microcontroller process the signal.Then it transmit the signal wirelessly to the Robot via Zigbee Communication. Here Accelerometer gave different signal for different motion.

1.3.2 Zigbee Communication

It has certain advantage over RF communication like high data rate and long range transmission. It will act as a communication link between the Transmitter End to the Receiver End.

1.3.3Motion Control

L293D is twin H-bridge motor driver integrated circuit(IC). Motor drivers act as current amplifiers as they take a low-current management signal and supply a higher-current signal. This higher current signal is employed to drive the motors. L293D contains 2 integral H-bridge driver circuits. In common mode of operation, 2 DC motors will be driven at the same time, each in forward and reverse direction. The motor operations of 2 motors will be controlled by input logic and once the signal is changed to high, the connected driver gets enabled. As a result, the outputs become active and the corresponding motor runs. Similarly, once the change input is low, that driver is disabled, and motor get disabled with the high-impedance state.

1.3.4 GSM

GSM Module will be installed in the Receiver side to send the SMS in case of collision of Robot to the Emergency number. It sends the latitude, longitude of the robot which it receives via GPS Module. Microcontroller processes the data in case of collision and sends the location to Microcontroller and then to GSM Module which further send to the Emergency Number.

1.3.5 GPS

Satellite based navigation uses Global Positioning System (GPS) to send and receive the radio signals that serves the user with the required information. GPS Module here continuously receiving information regarding position of robot and will send the location in case of collision to the emergency number. GPS data continuously received by GPS Module and fed to the Microcontroller.

1.3.6 IR Sensor

It will act as a collision detector and send the signal to the Microcontroller and in case of collision it sends data to the Microcontroller. Thus Microcontroller after processing the data it sends the location of ROBOT to the Emergency Number via GSM Module.

Chapter 2

Literature Review

2.1 GPS and GSM Module

The high demand of cars has additionally raised the traffic hazards and therefore the road accidents have increased in number and this often result in death of victim because of the lack of best emergency facilities. An automatic alarm device for vehicle accidents is introduced in this paper. This style is a system that will observe accidents in considerably less time and sends the location info to Emergency Number center via GPS-GSM Module covering geographical coordinates. This alert message will be send to the rescue team in an exceedingly short time, which can facilitate in saving the precious lives. Once the accident happens the alert message will be send electronically to the rescue team and to the station. The message sends through the GSM module and therefore the location of the accident is detected with the GPS module [2].

The rapid development of economic construction and people's living standard continues to improve. As well as road vehicle accident take place frequently this caused huge losses of life and property to the country and people. Traffic has increased a lot in the country with the increased in number of vehicles. Poor emergency incident is a major cause for the high number of traffic fatalities and the death rate in our country [3].

GSM module: For The GSM modem is a specialized type of modem which accepts a SIM card operates on subscriber mobile number over a network, just like a cellular phone .It's a cell phone without display. Modem SIM 300 is the triband GSM/GPRS engine which works on EGSM900MHz, DCS1800Mhz and PCI1900 mHz frequiencies. GSM modem is UART compatible, i.e. it takes -3V to -15V as logic high and +3V to +15V as logic is low. This module having Shot Message Services (SMS) also and its used by more than over 1.5 billion people.Thus it provide the platform for communication between the rescue team and accident victim [4].

Many researchers carried out studies on collision avoidance and detection system. Different approaches have been proposed and great effort has been put in construction of accurate and reliable algorithms. Previously existing system mainly uses electric power source, photoelectric sensor and microcontroller for reducing the vehicle speed.It also suggests that it can be modify with Collision detector and can be apply in real life [5].

Collision detection system which makes use of a GPS receiver to know the location of vehicle and collision is detected by GPS Module and it send the location to Microcontroller which process the data and send the same to the Emergency Number via GSM Module [6].

The vehicle collision detection system can be placed inside the vehicle or in front of the vehicle which detects the accident location through GPS Module and sending a message it informed the Emergency Rescue team. With the help of GPS and GSM module location of accident can be send to the rescue team. GSM Module used to send an exact location of the vehicle [7].

A number of technological and sociological improvements have helped reduce traffic fatalities during the past decade, e.g., each 1% increase in seatbelt usage is estimated to save 136 lives as presented in the reference paper [8].

Also in this paper mentioned each minute that an injured crash victim does not receive emergency medical care and thus this system can make a large difference in their survival rate, e.g., analysis shows that reducing accident response time by one minute correlates to a six percent difference in the number of lives saved [9].

This design is a system that can detect accidents in considerably less time and sends the info to hospitals with the help of GPS, the time and angle in which a vehicle accident had happened. But here we can use the facility of collision detection but in this work, MEMS accelerometer and GPS location system is developed for accidental monitoring. In the incident of accident, this wireless device will send mobile phone short massage indicating the position of vehicle by GPS system via GSM Module to family, affiliate, emergency medical service and nearest hospital so that they can provide ambulance and treatment for the patients. An effective approach for reducing traffic fatalities, therefore, is time between once associate accident happens and once 1st responders, like medical personnel, are sent to the scene of the accident. Automatic collision notification systems use sensors embedded automobile to confirm once an accident has occurred. These systems right away dispatch emergency medical personnel to serious accidents. Eliminating the time between accident prevalence and 1st communicator dispatch reduces fatalities by 6% [10].

A different approach is proposed by integrating GPS and GSM/GPRS transmission technologies .The basic idea is to localize the vehicle system by receiving the real time position of the vehicle through GPS and send the information through GSM module via SMS service with an added feature of GPRS transmission to the monitoring center through usage of mobile services provider [11].

The module has a 20 channel receiver with a tracking sensitivity of -159dBm and an accuracy of 10m.This module has a startup first acquisition time of 2 seconds during normal temperatures and up to about 40 seconds under extreme cold conditions. It can be used different height of land. The output protocol **is NMEA (National Marine Electronics Association)** at data speeds of 4800 or 9600 bauds. The module works on 3.3Vdc which is provided from a regulator on board [12].

Statistics of accident in India shows that emergency services are not being provided at the proper time. Even though India has 1% of worlds vehicle but accounts for 10% of worlds total accidents and thus it shows the urgency of this kind of system [13].

This paper shows the statistics of accident and the accident rate has been increasing as compared to previous decade. The accident rate has increased by 54% is shown by this paper. The proposed system minimizes the action time after an accident. This paper deals with such system to detect possible collision location. In this work it shows the C programming is used for better accuracy and GPS module used to detect the location. GSM is used to send the exact location of the vehicle and also send alert or relax messages to this remote device (mobile phone) [14].

2.2 Accelerometer

The Accelerometer here is used to control the motion of Robot by different gesture of hand. Using data glove is a better idea over camera as the user has flexibility of moving around freely within a radius limited by the range of wireless connecting the glove to the computer, unlike the vision based technique where the user has to stay in position before the camera [15].

In the robotics field, several research efforts have been made to create user-friendly teach pendants, implementing intuitive user interfaces such as color touch screens, a 3D joystick (ABB Robotics). But, neither of these techniques is efficient to control the robot as they do not give accurate results and have slow response time. In the last few years the robot manufacturers have made great efforts towards creating “Human Machine Interfacing Device” -recognizing human gestures, recurring to vision-based systems In the last few years the robot manufacturers have made great efforts towards creating “Human Machine

Interfacing Device" -recognizing human gestures, recurring to vision-based systems [16] or using finger gesture recognition systems supported active trailing mechanisms [17].

2.3 Conclusion

Literature Review reveals that good amount of literature is available for the development of Accelerometer Control Robot having feature of collision detection and notify the GPS location of Robot via GSM Communication. This has application in real life where traffic has increased a lot and accident is increased day by day which has been confirmed by different report. Also Robot has feature of Gesture Control Motion which made the robot to be controlled by gesture only.

Chapter 3

Accelerometer

3.1 Introduction

An Accelerometer is an Electro mechanical device which measures the acceleration force and this force may be static and continuous force of gravity or, as is the case with many mobile devices, dynamic to sense movement or vibrations.

An accelerometer measures acceleration. Acceleration is a measure of how quickly speed changes. Accelerometer sensor is used to measure static (earth Gravity) or dynamic acceleration in all three axes, forward/backward, left/right and up/down.

An accelerator looks like a simple circuit for some larger electronic device. Despite its humble appearance, the accelerometer consists of many different parts and works in many ways, two of which are the piezoelectric effect and the capacitance sensor. The piezoelectric effect is the most common form of accelerometer and uses microscopic crystal structures that become stressed due to accelerative forces. These crystals create a voltage from the stress, and the accelerometer interprets the voltage to determine velocity and orientation.

The capacitance accelerometer senses changes in capacitance between microstructures located next to the device. If an accelerative force moves one of these structures, the capacitance will change and the accelerometer will translate that capacitance to voltage for interpretation.

Accelerometers are made up of many different components, and can be purchased as a separate device. Analog and digital displays are available, though for most technology devices, these components are integrated into the main technology and accessed using the governing software or operating system.

Typical accelerometers are made up of multiple axes, two to determine most two-dimensional movement with the option of a third for 3D positioning. Most smartphones typically make use of three-axis models, whereas cars simply use only a two-axis to determine the moment of impact. The sensitivity of these devices is quite high as they’re intended to measure even very minute shifts in acceleration. The more sensitive the accelerometer, the more easily it can measure acceleration.

Accelerometers, while actively used in many electronics in today’s world, are also available for use in custom projects. Whether you’re an engineer or tech geek, the accelerometer plays a very active role in a wide range of functionalities. In many cases you may not notice the presence of this simple sensor, but odds are you may already be using a device with it.

3.2 ADXL335

The **ADXL335** is a bit small, low power, thin, and complete 3-axis accelerometer with the signal conditioned voltage outputs. The product measures acceleration with a minimum full-scale range of ±3 *g*. It will live the static acceleration of gravity in tilt-sensing applications, likewise as dynamic acceleration ensuing from motion, shock, or vibration

The bandwidth of the ADXL335 accelerometer using the CX, CY & CZ capacitors at the XOUT, YOUT & ZOUT pins (Figure 2). Bandwidths can be selected to suit the application, with a range of 0.5 Hz to 1600 Hz for the X and Y axes, and a range of 0.5 Hz to 550 Hz for the Z axis as shown in Figure 2.

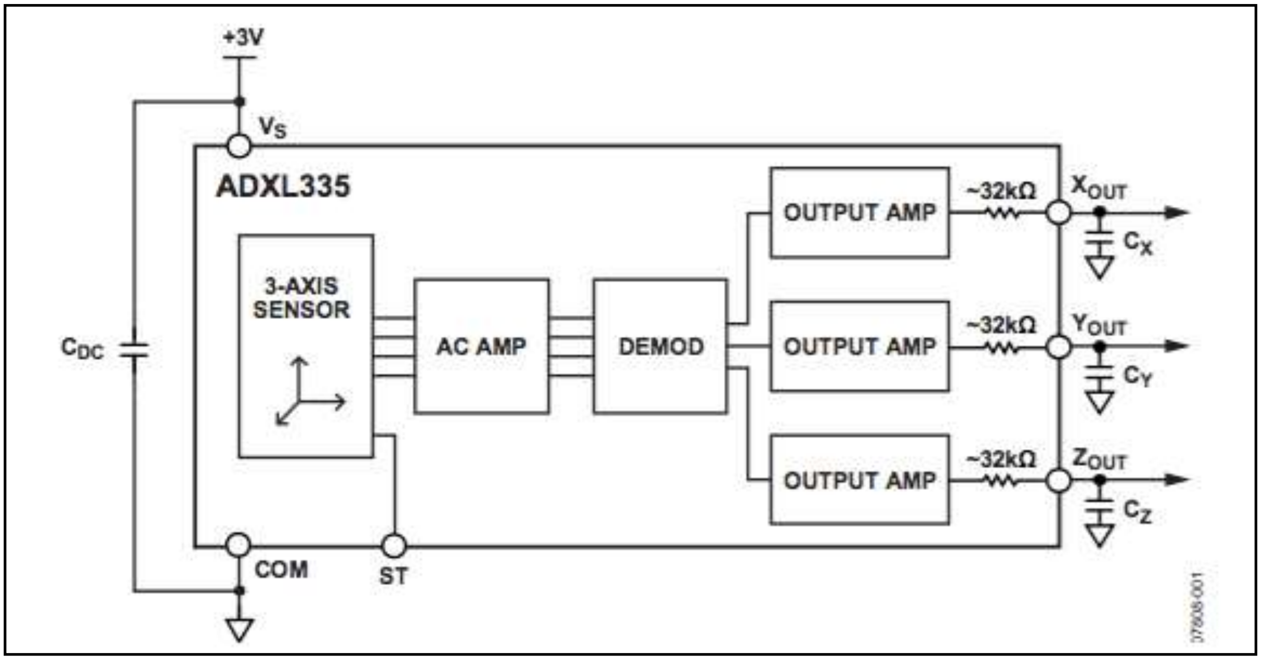

Figure 3.1 Functional Block Diagram (ADXL335 Datasheet)

3.3 Pin Configuration

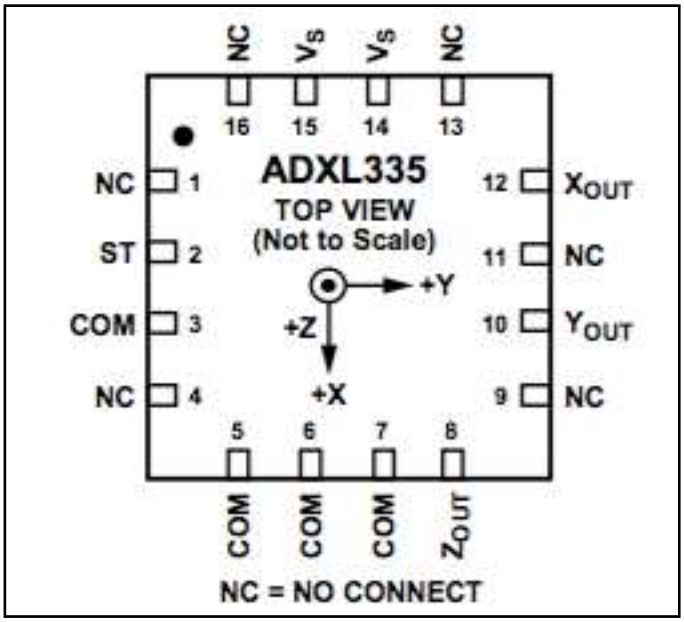

Figure 3.2 Pin Configuration of ADXL335 (ADXl335 datasheet)

It is a 16 pin as shown in Figure 3 IC which sense the orientation or gesture of hand and then gave appropriately output signal to the Microcontroller at PC0, PC1, PC2. The pin function has been given in the following table

Table 1: Pin configuration ADXL335

Pin No.	Mnemonic	Description
1	NC	No Connect.[1]
2	ST	Self-Test.
3	COM	Common.
4	NC	No Connect.[1]
5	COM	Common.
6	COM	Common.
7	COM	Common.
8	Z_{OUT}	Z Channel Output.
9	NC	No Connect.[1]
10	Y_{OUT}	Y Channel Output.
11	NC	No Connect. [1]
12	X_{OUT}	X Channel Output.
13	NC	No Connect. [1]
14	V_S	Supply Voltage (1.8 V to 3.6 V).
15	V_S	Supply Voltage (1.8 V to 3.6 V).
16	NC	No Connect. [1]
EP	Exposed Pad	Not internally connected. Solder for mechanical integrity.

[1] NC pins are not internally connected and can be tied to COM pins, unless otherwise noted.

3.4 Theory of Operation

It is a complete 3-axis acceleration measurement system. The ADXL335 has a measurement range of ±3 *g* minimum. It contains a **- polysilicon surface-micro machined sensor** and a signal conditioning circuitry to device an open-loop acceleration measurement design. The output signals are analog voltages that are proportional to acceleration and the static acceleration of gravity in tilt-sensing application and dynamic acceleration is measure by accelerometer resulting from shock, motion or vibration.

The detector may be a polysilicon surface-micro machined structure engineered on prime of a semiconducting material wafer. The Polysilicon springs overhang the structure over the surface of the wafer and supply a resistance in contrast to acceleration forces. Deflection of the structure is measured with employing a differential capacitance that consists of freelance mounted plates and the plates hooked up to the moving mass. The plates are driven by 180° out-of-phase sq. waves. Acceleration deflects the moving mass and unbalances the differential capacitance leading to a sensing element output whose amplitude is proportional to acceleration. Phase-sensitive reception techniques are then wont to verify the magnitude and direction of the acceleration. The detector output is amplified and brought off-chip through a thirty two kΩ resistance. The user then sets the signal information measure of the device by adding an electrical condenser. This filtering improves activity resolution and helps stop aliasing Samples"

The circuit here measured the change in resistance proportional to the acceleration of of device and the corresponding change in voltage in the device. The demodulator output is amplified and brought off-chip through a 32kΩ resistor. The user then sets the signal bandwidth of the device by adding a capacitor. This filtering improves measurement resolution and helps prevent aliasing.

3.5 Mechanical Sensor

The ADXL335 uses a single structure for sensing the X, Y, and Z axes. As a result, the three axes' sense directions are highly orthogonal and have little cross-axis sensitivity. Mechanical misalignment of the sensor die to the package is the chief source of cross-axis sensitivity. Mechanical misalignment can, of course, be calibrated out at the system level.

3.6 Performance

Rather than using additional temperature compensation circuitry, innovative design techniques ensure that high performance is built in to the ADXL335. As a result, there is no quantization error or non-monotonic behavior, and temperature hysteresis is very low (typically less than 3 m*g* over the −25°C to +70°C temperature range).

Table 2 : Maximum Rating (ADXL 335 Datasheet)

Parameter	Rating
Acceleration (Any Axis, Unpowered)	10,000 *g*
Acceleration (Any Axis, Powered)	10,000 *g*
V_S	−0.3 V to +3.6 V
All Other Pins	(COM − 0.3 V) to (V_S + 0.3 V)
Output Short-Circuit Duration (Any Pin to Common)	Indefinite
Temperature Range (Powered)	−55°C to +125°C
Temperature Range (Storage)	−65°C to +150°C

3.2 ATMega8

3.2.1 Introduction

The ATmega8 has the following features: 512 bytes of EEPROM, 1 KB of SRAM, 8 KB of In-System Programmable Flash with Read-While-Write capabilities ,23 general purpose I/O lines, 3 flexible Timer/Counters with compare modes, internal and external interrupts, a serial programmable USART, 32 general purpose working registers a byte oriented 2 wire Serial Interface, a six-channel ADC (8 channels in TQFP and QFN/MLF packages) with 10-bit accuracy, a programmable Watchdog Timer with Internal Oscillator, an SPI serial port and 5 software selectable power saving modes. In Power-save mode, the asynchronous timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The Idle mode stops the CPU while allowing the Static RAM, Timer/Counters, SPI port, and interrupt system to continue functioning. The Power down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next Interrupt or Hardware Reset. The ADC Noise Reduction mode stops and the Central Processing Unit and all Input/output ports except asynchronous timer and ADC, to minimize switching noise during ADC conversions. In Standby mode, the crystal or Oscillator resonator is running while the rest of the device is sleeping. This allows very fast start-up combined with low-power consumption.

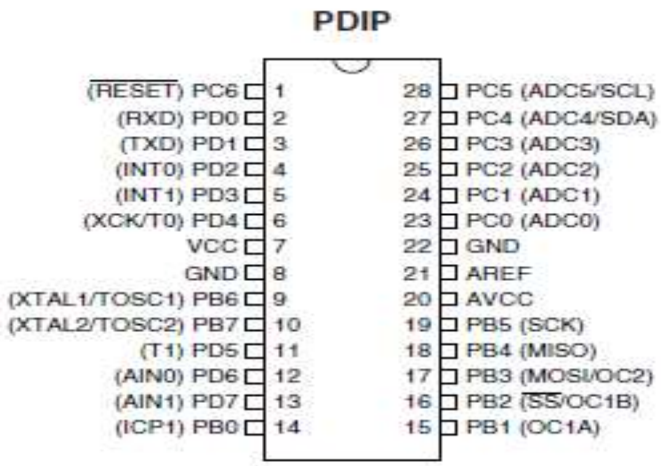

Figure 3.3 PIN Configuration of ATmega8 (ATmega8 datasheet)

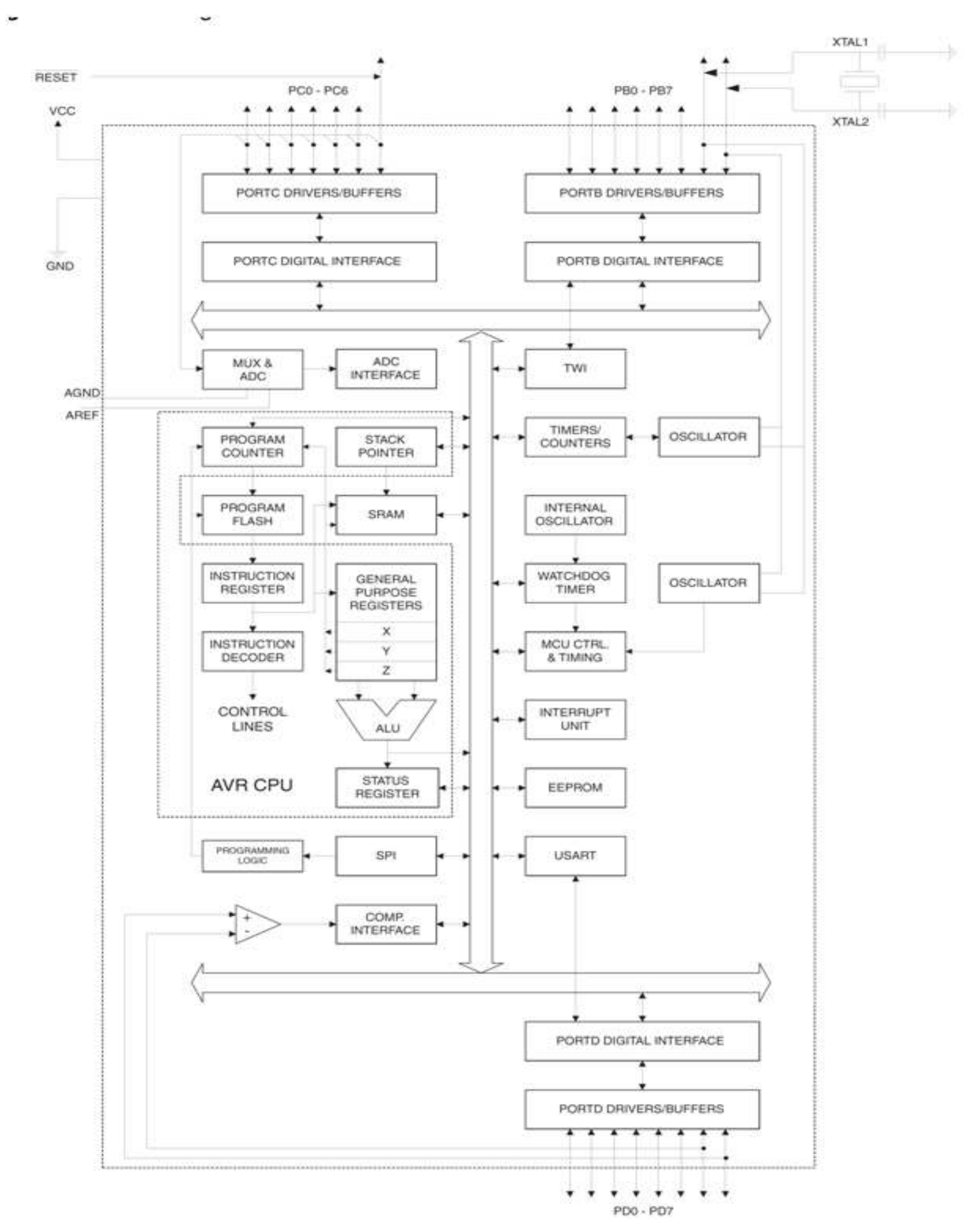

Figure 3.4 Block Diagram (ATmega8 datasheet)

3.2.2 Pin Description

- **VCC**

Digital Supply Voltage

- **GND**

Ground

- **Port B (PB7....PB0) XTAL1/XTAL2/TOSC1/TOSC2**

Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B pins are tri-stated when a reset condition becomes active, even if the clock is not running. Depending on the clock selection fuse settings, PB6 can be used as input to the inverting Oscillator amplifier and input to the internal clock operating circuit. Depending on the clock selection fuse settings, PB7 can be used as output from the inverting Oscillator amplifier. If the Internal Calibrated RC Oscillator is used as chip clock source, PB7and PB6 is used as TOSC2.One input for the Asynchronous Timer/Counter2 if the AS2 bit in ASSR is set.

- **PC6/RESET**

PC6 is as an I/O pin and a low level pulse on this pin reset the Microcontroller and make the system start from beginning.

- **Port C (PC5....PC0)**

Port C is a seven-bit bi-directional Input /Output port having internal pull-up resistors (selected for each bit) with the Port C output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins have externally pulled low will source current if the pull-up resistors are put on. The Port C pins are tri-stated when a reset condition that becomes active, irrespective of the running of clock.

- **Port D(PD7-PD0)**

Port D is an 8 bit bidirectional I/O port with internal pull-up resistors.

- **AREF**

It is analog reference pin reset the Microcontroller and System.

- **RESET**

A low level input on this pin reset the Microcontroller and system.

3.2.3 Features

- High-performance, Low-power Atmel AVR 8-bit Microcontroller
- Advanced RISC Architecture
- Most Single-clock Cycle Execution
- High Endurance Non-volatile Memory segments
- Fully Static Operation
- Up to 16 MIPS Throughput at 16MHz
- On-chip 2-cycle Multiplier
- 130 Powerful Instructions
- 1Kbyte Internal SRAM
- 32 × 8 General Purpose Working Registers
- Data retention: 20 years at 85°C/100 years at 25°C
- Optional Boot Code Section with Independent Lock Bits
- 8KB of In-System Self-programmable Flash program memory – 512Bytes EEPROM
- In-System Programming by On-chip Boot Program True Read-While-Write Operation
- Two 8-bit Timer/Counters with Separate Pre scaler, one Compare Mode
- One 16-bit Timer/Counter with Separate Pre scaler, Compare Mode, and Capture Mode
- 6-channel ADC in PDIP package Six Channels 10-bit Accuracy
- Programmable Watchdog Timer with Separate On-chip Oscillator

- Byte-oriented Two-wire Serial Interface
- Special Microcontroller Features
- Master/Slave SPI Serial Interface
- Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
- Five Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, and Standby I/O and Packages
- Real Time Counter with Separate Oscillator
- 8-channel ADC in TQFP and QFN/MLF package Eight Channels 10-bit Accuracy
- Three Pulse Width Modulation Channels
- Programming Lock for Software Security
- On-chip Analog Comparator
- Programmable Serial USART
- Power-on Reset and Programmable Brown-out Detection
- Internal Calibrated RC Oscillator
- External and Internal Interrupt Sources
- 23 Programmable I/O Lines
- 28-lead PDIP, 32-lead TQFP, and 32-pad QFN/MLF
- Operating Voltages 2.7V - 5.5V (ATmega8L)
- 0 - 16MHz (ATmega8)
- Power-down Mode: 0.5µA
- Power Consumption at 4Mhz, 3V, 25C
- 0 - 8MHz (ATmega8L)
- 4.5V - 5.5V (ATmega8)
- Active: 3.6mA

- Idle Mode: 1.0mA

3.3 ZigBee Communication

3.3.1 Introduction

It is a **Wireless communication** and suitable for the controlling the robot. When it comes to robot communication the technique adopted should be such that it can cover wide distance and provide good data range. When these aspects are considered ZigBee is a better option than the others.

ZigBee is targeted at the applications that need lesser rate, long battery life. It operates over same 2.4GHz frequency varies as Wi-Fi and Bluetooth. In contrast to those technologies though, ZigBee transmit information with high data rate and also it transmit it with high speed, it's created for causation easy commands like turning on a TV, rotating left etc., or little bits of information. This low information rates, ZigBee tends to use so much less power than different networking technologies. ZigBee's normal utilizes mesh networking that allows ZigBee devices to mechanically connect with and transmit information through each other while not having to travel through a central entree sort of a router. **ZigBee uses IEEE 802.15.4** customary to permit wireless PAN (Personal area Network) in home. It uses digital radio waves to transfer data between electrical devices. It uses transistors in its electronic devices. The electronic devices communicate from a central laptop that sends and receives information. It's a lot of reliable, supports larger network and is a lot of absolutely featured than different networking technologies.

In this project it is use in accelerometer based gesture recognition technique to control robot and ZigBee networking technology to communicate.

RF data electronic equipment functioning at 2.4 GHz frequency at half duplex mode by automatic switching of receive/transmit mode with light-emitting diode indication. Receives and Transmits serial knowledge of adjustable baud rate of 9600/4800/2400/19200 bits per second at 5Volts or 3Volts level for direct interfacing to microcontrollers.

RF modem can be used for applications that need two way wireless data transmission. It features high data rate and longer transmission distance. The communication protocol is self-controlled and completely transparent to user interface. The module can be embedded in current design; therefore wireless communication can be set up easily.

When a Radio Frequency (RF) serial data communication between microcontrollers or a microcontroller to Computer, the RF modem is best useful and very easy to implement.

Figure 3.5 Zig Bee Interfacing working

3.3.2 Features

- Automatic switching between Transmitter and Receiver mode.
- 2.4 GHz band, no need to apply frequency usage license.
- FSK technology, half duplex mode, robust to interference.
- High sensitivity, reliable transmission range.
- TTL (3-5V) logic level.
- Protocol translation is self-controlled, easy to use.
- Standard UART interface
- Stable, small size, easier mounting.
- No tuning required, PLL based self-tuned.
- Error checking (CRC) of data in built.

3.3.3 Specification

- Frequency 2.4 GHz
- Voltage 4.5 to 9V (Typical 5V)

- Operating Range: 30-50 meters
- Output RF Power 1 dBm
- UART baud rate (8 bit data, no parity, 1 stop bit) 9600/4800/2400/19200 bps

3.3.4 Pin Description:

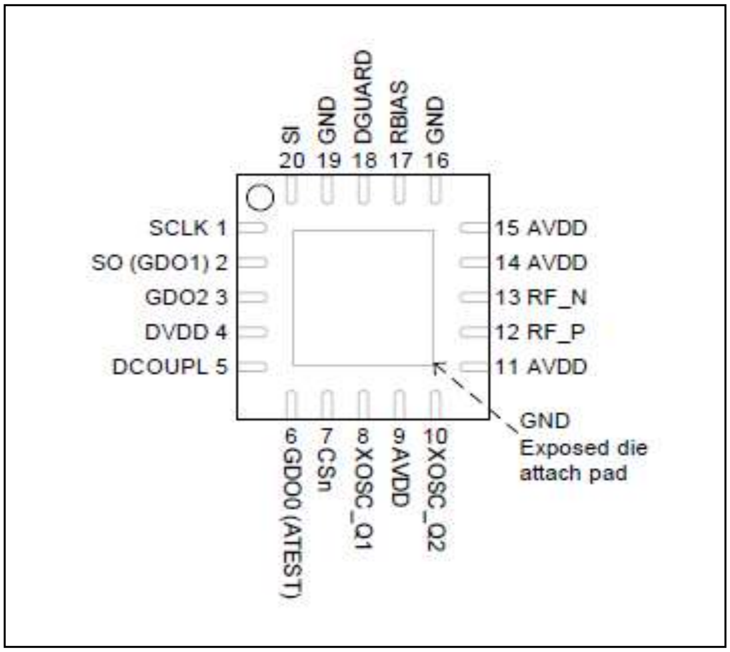

Figure 3.6 PIN Description (Texas CC2500 datasheet)

Table 3: Pin Configuration of ATmega8L Series

Pin #	Pin Name	Pin Type	Description
1	SCLK	Digital Input	Serial configuration interface, clock input
2	SO (GDO1)	Digital Output	Serial configuration interface, data output. Optional general output pin when CSn is high
3	GDO2	Digital Output	Digital output pin for general use: • Test signals • FIFO status signals • Clear Channel Indicator • Clock output, down-divided from XOSC • Serial output RX data
4	DVDD	Power (Digital)	1.8 - 3.6 V digital power supply for digital I/O's and for the digital core voltage regulator
5	DCOUPL	Power (Digital)	1.6 - 2.0 V digital power supply output for decoupling. NOTE: This pin is intended for use with the ***CC2500*** only. It can not be used to provide supply voltage to other devices.
6	GDO0 (ATEST)	Digital I/O	Digital output pin for general use: • Test signals • FIFO status signals • Clear Channel Indicator • Clock output, down-divided from XOSC • Serial output RX data • Serial input TX data Also used as analog test I/O for prototype/production testing
7	CSn	Digital Input	Serial configuration interface, chip select
8	XOSC_Q1	Analog I/O	Crystal oscillator pin 1, or external clock input
9	AVDD	Power (Analog)	1.8 - 3.6 V analog power supply connection
10	XOSC_Q2	Analog I/O	Crystal oscillator pin 2
11	AVDD	Power (Analog)	1.8 - 3.6 V analog power supply connection
12	RF_P	RF I/O	Positive RF input signal to LNA in receive mode Positive RF output signal from PA in transmit mode
13	RF_N	RF I/O	Negative RF input signal to LNA in receive mode Negative RF output signal from PA in transmit mode
14	AVDD	Power (Analog)	1.8 - 3.6 V analog power supply connection
15	AVDD	Power (Analog)	1.8 - 3.6 V analog power supply connection
16	GND	Ground (Analog)	Analog ground connection
17	RBIAS	Analog I/O	External bias resistor for reference current
18	DGUARD	Power (Digital)	Power supply connection for digital noise isolation
19	GND	Ground (Digital)	Ground connection for digital noise isolation
20	SI	Digital Input	Serial configuration interface, data input

- RXD (Receive Input): Input serial data of 3 to 5V logic level, generally connected to TXD pin of microcontrollers.

- TXD (Transmit Input): Output serial data of 3V logic level, usually connected to RXD pin of microcontrollers.

- +5V: Regulated 5V supply input.

- GND: Ground level of power supply. Must be common ground with microcontroller.

3.3.5 Circuit Description

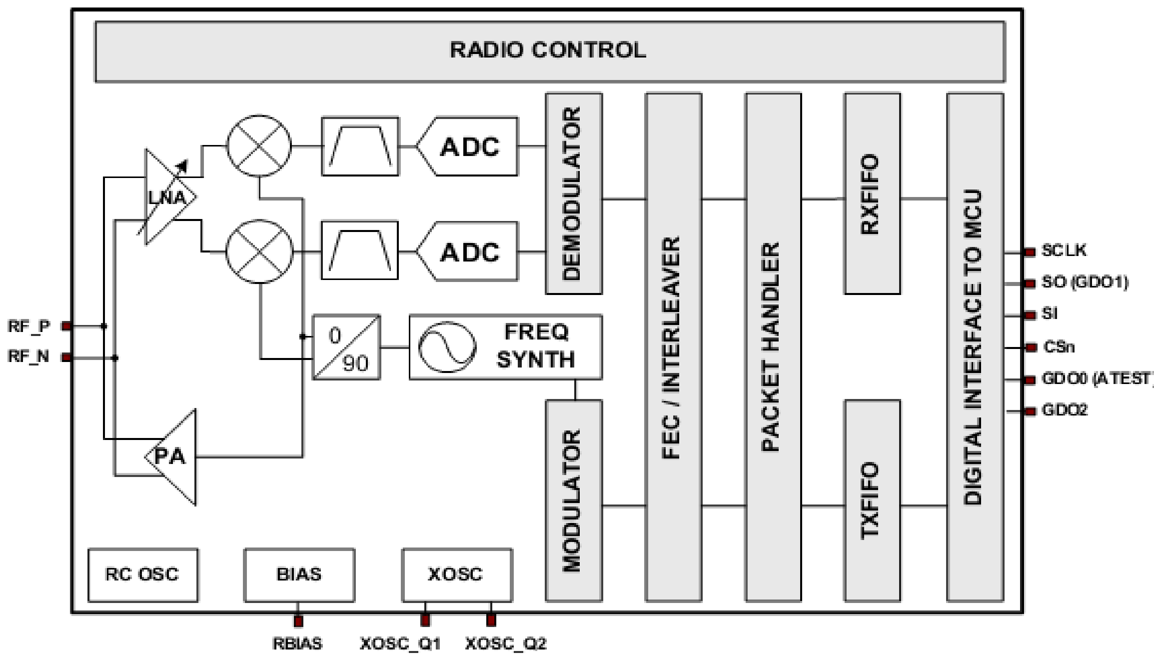

Figure 3.7 CC2500 Block diagram(Texas CC2500 datasheet)

CC2500 features a low-IF receiver. The received RF signal is amplified by the low-noise amplifier (LNA) and down-converted in quadrature (I and Q) to the intermediate frequency (IF). At IF, the I/Q signals are digitised by the ADCs. Automatic gain control (AGC), fine channel filtering, demodulation bit/packet synchronization are performed digitally. The transmitter part ofCC2500 is based on direct synthesis ofthe RF frequency. The frequency synthesizer includes a completely on-chip LC VCO and a 90 degrees phase shifter for generating the I and Q LO signals to the down-conversion mixers in receive mode. A crystal is to be connected toXOSC_Q1and XOSC_Q2. The crystal oscillator generates the reference frequency for the synthesizer, as well as clocks for the ADC and the digital part. A 4-wire SPI serial interface is used for configuration and data buffer access. The digital baseband includes support for channel configuration, packet handling, and data buffering.

3.3.6 Operation

This module works in half-duplex mode i.e. it will either transmit or receive but not every at same time. Once each transmission, module is getting to be switched to receiver mode spontaneously. The light-emitting diode for Tx and Rx indicates whether or not IC is presently receiving or transmission data. The data sent is checked for CRC error if any. If chip is transmission and any data is input to transmit, it's going to be unbroken in buffer for next transmission cycle. It's internal buffer for incoming data so they do not drift once module is active transmission data.
When it power on the unit, the Tx diode can in brief blink indicating that data format is complete and it's able to use. The RX diode is directly on Tx OUT pin to point that actual data is received and it's sent to output pin.

Frequency channel setting

Setting Frequency Channel can be used to have multiple sets operating at same time but without interfering with each other. The pair having same Channel setting will be able to communicate with each other. Frequency channel has to be set when unit is OFF, as the jumper are read only during power up. Modifying this setting during operation will have no effect on operation of module. To make any jumper on, short that jumper by soldering its pads. By default unit is supplied with no jumpers set making it channel#1.

- F2 = OFF F1 = OFF is Channel #1 (**Default**)
- F2 = OFF F1 = ON is Channel #2
- F2 = ON F1 = OFF is Channel #3
- F2 = ON F1 = ON is Channel #4

Baud rate

Baud rate has to be set when unit is OFF, as the jumper setting is read only during power up. Modifying during power up will have no effect on operation of module. To make any jumper on, short that jumper by soldering its pads. By default unit is supplied with no jumper.

There are two jumpers on PCB called B1 and B2. Normally they are left open so unit is in 9600 baud rate. Solder the two pads to make them ON so you can configure baud rate as per settings below

- B2 = OFF B1 = OFF is 9600 bps (**Default**)

- B2 = OFF B1 = ON is 4800 bps
- B2 = ON   B1 = OFF is 2400 bps
- B2 = ON   B1 = ON is 19200bps

Why ZigBee is better as compared to other communication method :

As compared to the Wi-Fi, Bluetooth, ZigBee, it is ZigBee which has better range of communication and the life of Battery in case of ZigBee is very long thus it is always advisable to use it for Battery operated devices. It is very easy to use in the Embedded system application thus provide versatility to the circuit.

Table 4 ZigBee Comparison with other communication devices

Category	Wi-Fi	Bluetooth	ZigBee
Distance	50m	10m	50-1600m
Extension	Depend on the existing network	None	Automatic
Power Supply	Hours	Days	Years
Complexity	Very Complicated	Complicated	Simple
Transmission Speed	1-54Mbps	1Mbps	250Kbps
Frequency Range	2.4GHz	2.4GHz	868MHz, 916MHz, 2.4GHz
Network Nodes	50	8	65535
Linking Time	Up to 3s	Up to 10s	30ms
Ease of Use	Hard	Normal	Easy

3.3.7 Application

- Data collection
- Access control / Identity discrimination
- IT home appliance system
- Smart house Project and Security Systems
- Remote control or Remote measurement system
- Weather stations

3.4 GSM Module

3.4.1 Introduction

GSM (Global System for Mobile communication) is a digital mobile telephony system that is widely used in India and is used three digital wireless technologies i.e. Time Division Multiple Access (TDMA), GSM and CDMA.GSM compress the Data in digitize form and sent to the user. It works on different frequency band. Here it has application sending the GPS location of Robot where it collided as a SMS to the Emergency Number. Global System for Mobile Communications (GSM) is the almost popular wireless standard for mobile phones in the world. GSM module allows transmission **of Short Message Service (SMS)** in Text mode and PDU mode. The proposed design uses **SIM 300 GSM module** in text mode. This design uses SIM300 GSM module that provide 900/1800/1900MHz Tri-band for VOICE, SMS, DATA, and FAX. This module operates on AT command over TTL interface. AT command is an abbreviation for Attention command that is recognized by GSM Module. This abbreviation is always used to start a command line to be send from TE (Terminal Equipment) to TA (Terminal Adaptor). The information contains information position (latitude, longitude). The GSM Module is configured at 9600 baud rate.

3.4.2 Features

- Quad Band GSM/GPRS : 850 / 900 / 1800 / 1900 MHz
- Built in RS232 to TTL or vice versa Logic Converter (MAX232)
- Configurable Baud Rate
- SMA (Subminiature version A) connector with GSM L Type Antenna
- Built in SIM (Subscriber Identity Module) Card holder
- Built in Network Status LED

- Inbuilt Powerful TCP / IP (Transfer Control Protocol / Internet Protocol) stack for internet data transfer through GPRS (General Packet Radio Service)
- Audio Interface Connectors (Audio in and Audio out)
- Most Status and Controlling pins are available
- Normal Operation Temperature : -20 °C to +55 °C
- Input Voltage : 5V to 12V DC
- LDB9 connector (Serial Port) provided for easy interfacing

3.4.3 Hardware Description

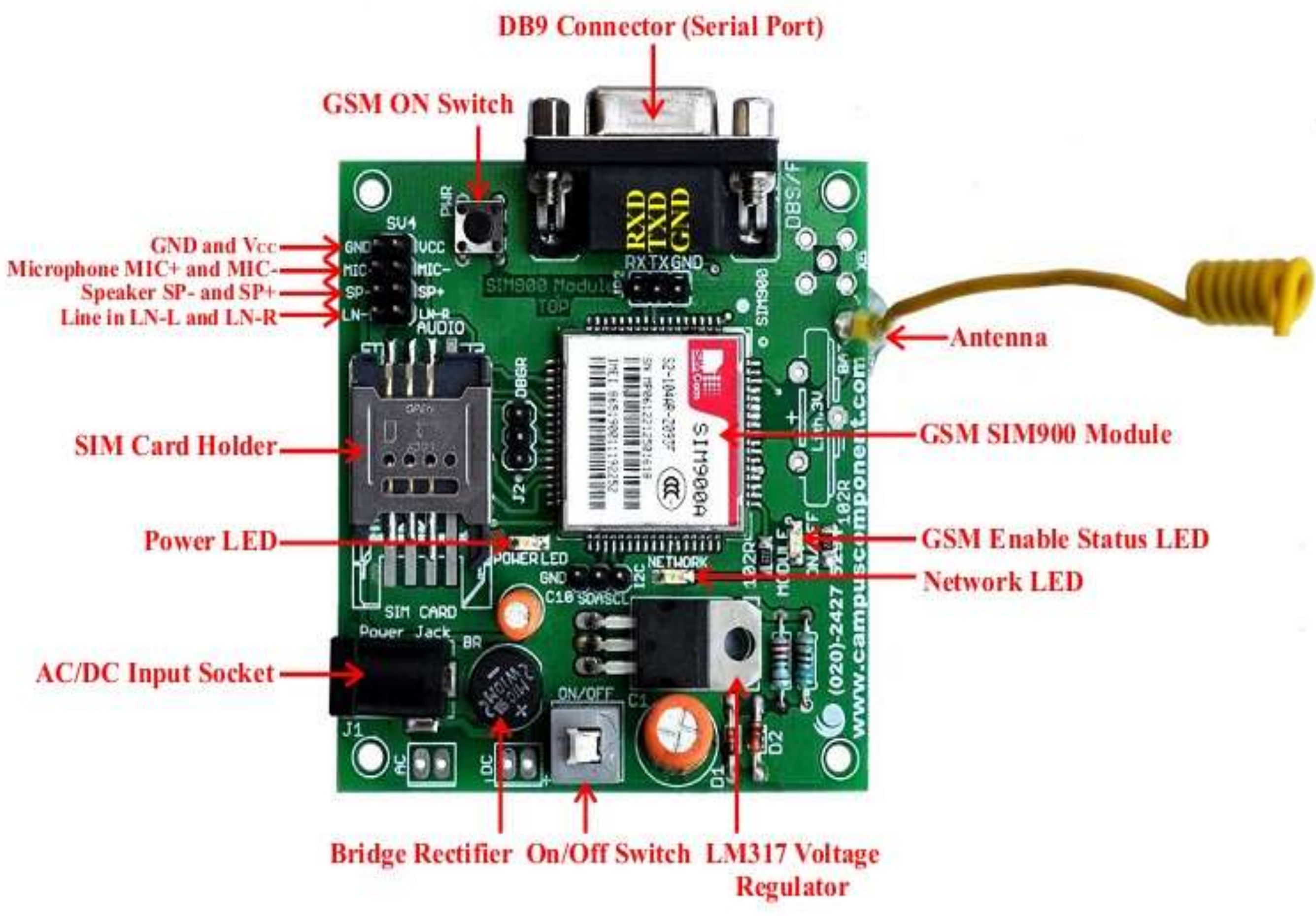

Figure 3.8 Description of GSM Module

3.4.4 SIM900

Figure 3.9 SIM900 GSM Module (Datasheet)

This is a GSM/GPRS-compatible Quad-band cell phone, which works on a frequency of 850/900/1800/1900MHz and which can be used not only to access the Internet, but also for oral communication (provided that it is connected to a microphone and a small loud speaker) and for SMSs. Externally, it looks like a big package (0.94 inches x 0.94 inches x 0.12 inches) with L-shaped contacts on four sides so that they can be soldered both on the side and at the bottom. Internally, the module is managed by an AMR926EJ-S processor, that controls mobile communication, data communication (through an integrated TCP/IP stack), and (through an UART and a TTL serial interface) the communication with the circuit interfaced with the cell phone itself.

The processor is also in charge of a SIM card (3 or 1,8 V) which needs to be attached to the outer wall of the module.

In addition, the GSM900 device integrates an analog interface, an A/D converter, an RTC, an SPI bus, an I²C, and a PWM module. The radio section is GSM phase 2/2+ compatible and is either class 4 (2 W) at 850/ 900 MHz or class 1 (1 W) at 1800/1900 MHz

The TTL serial interface is in charge not only of communicating all the data relative to the SMS already received and those that come in during TCP/IP sessions in GPRS (the data-rate is determined by GPRS class 10: max. 85,6 kbps), but also of receiving the circuit commands (in our case, coming from the PIC governing the remote control) that can be either AT standard or AT-enhanced SIMCom type.

The module is supplied with continuous energy (between 3.4 and 4.5 V) and absorbs a maximum of 0.8 A during transmission.

3.4.5 Max 232 IC

The MAX232 is an integrated circuit first that converts signals from a TIA-232(RS-232) serial port to signals suitable for use in TTL-compatible digital logic circuits.

3.4.6 Serial Port/DB9 Connector

It is attached with RS 232 cable so that it con be work with devices having serial port/DB9 connector.

Figure 3.10 RS232 Configuration

Table 5 : Pin Cinfiguration of RS232

Pin 1 : DCD (Data Carrier Detect)
Pin 2 : RxD (Receive Data)
Pin 3 : TxD (Transmit Data)
Pin 4 : DTR (Data Terminal Ready)
Pin 5 : Signal Ground (SG)
Pin 6 : Data Set Ready (DSR)
Pin 7 : Request To Send (RTS)
Pin 8 : Clear To Send (CTS)
Pin 9 : Ring Indicator (RI)

3.4.7 Power Supply Socket

It provide the power supply to the circuit and it take 12 Volt from the main Adapter supply.Here it need to connect the jack with adapter.

Figure 3.11 Power Supply Socket

3.4.8 Subscriber Identity Module (SIM) Card Slot

SIM Card of any company put here and power supply is put OFF while inserting the Card as precautionary step.

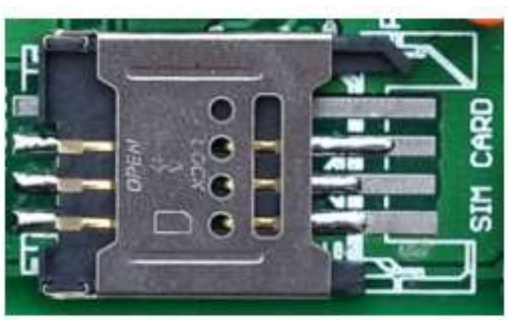

Figure 3.12 SIM Card slot

3.4.9 Indicator LEDs

It shows the indicator of different module of circuit like:

- Power ON/OFF
- Network status
- Module On/OFF

Power On/OFF LED will keep On until power supply is enable .Network LED shows whether inserted SIM connected to the service provider successfully or not Module On/OFF shows the status of Module On/OFF.

Figure 3.13 Indicator LED GSM Module

3.4.10 TXD,RXD AND GND PINS(JP2)

These pins are connected to the Microcontroller Atmega8 for the communication using Universal Synchronous Asynchronous Receiver and Transmitter (USART).

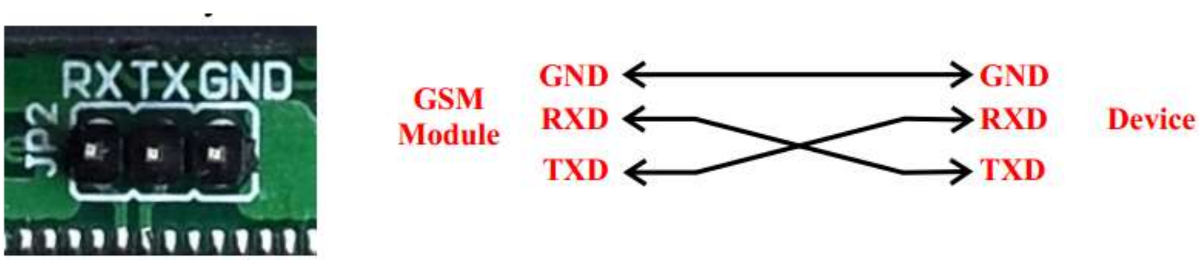

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Figure 3.14 Rx, Tx & GND Pin

3.5 GPS

3.5.1 Introduction

“The global Positioning System (GPS) is a space-based navigation system which provides location and time data altogether climatic conditions, anyplace on or close to the planet wherever there's an unclogged line of sight to four or additional GPS satellites. The system provides vital capabilities to military, civil, and industrial users round theworld. The united states government created the system, maintains it, and makes it freely accessible to anyone with a GPS receive”.

Satellite based navigation uses Global Positioning System (GPS) to send and receive the radio signals that serves the user with the required information. GPS posse’s twenty four satellites that revolve orbit of earth in twelve hours, the ground stations and the receivers. The GPS receiver in the ground station determines the location and distance accurately in all sough’s weather without distortions are made easy with the satellite in orbit as a reference. GPS is used in laptop, mobile, airplane etc.

The receiver uses the messages it receives to determine the transit time of each message and computes the distance to each satellite using the speed of light. Each of these distances and satellite locations defines a sphere. The receiver is on the surface of each of these spheres when the distances and the satellites' locations are correct. These distances and satellites' locations are used to compute the location of the receiver using the navigation equations. This location is then displayed, perhaps with a latitude and longitude on the LCD.

It has a lot application in daily life like

- Security System
- Location Base Service
- Navigation

3.5.2 GPS Module and its Features

The GPS module is used to detect the location (Latitude, longitude) of Robot during collision and the same information is send to the Emergency number for quick response by the concerned authority. 66 Channel GPS Engine Board Smart Antenna is a module with a revised version of POT (Patch on Top) GPS Module. It has an advanced feature of extra antenna I/O and comes with **Automatic Antenna Switching Function** and short circuit protection. It has features that if it connected to the external antenna then it switch automatically to that one. It also protected to the short circuiting of antenna.

- MediaTek MT3329 Single Chip
- FCC E911 compliance
- L1 Frequency, C/A code, 66 channels
- Protection from Short Circuits to External Antenna (3V power supply or lower)
- Jammer detection and reduction
- Max. Update Rate: up to 10Hz (Configurable by firmware)
- Multi-path detection and compensation
- DGPS(WAAS/EGNOS/MSAS/GAGAN) support (Default: Enable)
- External Antenna I/O interface
- Low Shut-Down Power Consumption: 15uA, typical

- Automatic External / Internal Antenna Switching
- Low Shut-Down Power Consumption: 15uA, typical
- Dimension: 16mm x 16mm x 6mm / Patch Antenna Size: 15mm x 15mm x 4mm
- Low Power Consumption: 48mA @ acquisition, 37mA @ tracking
- High Sensitivity: Up to -165 dBm tracking, superior urban performances
- RoHS compliant

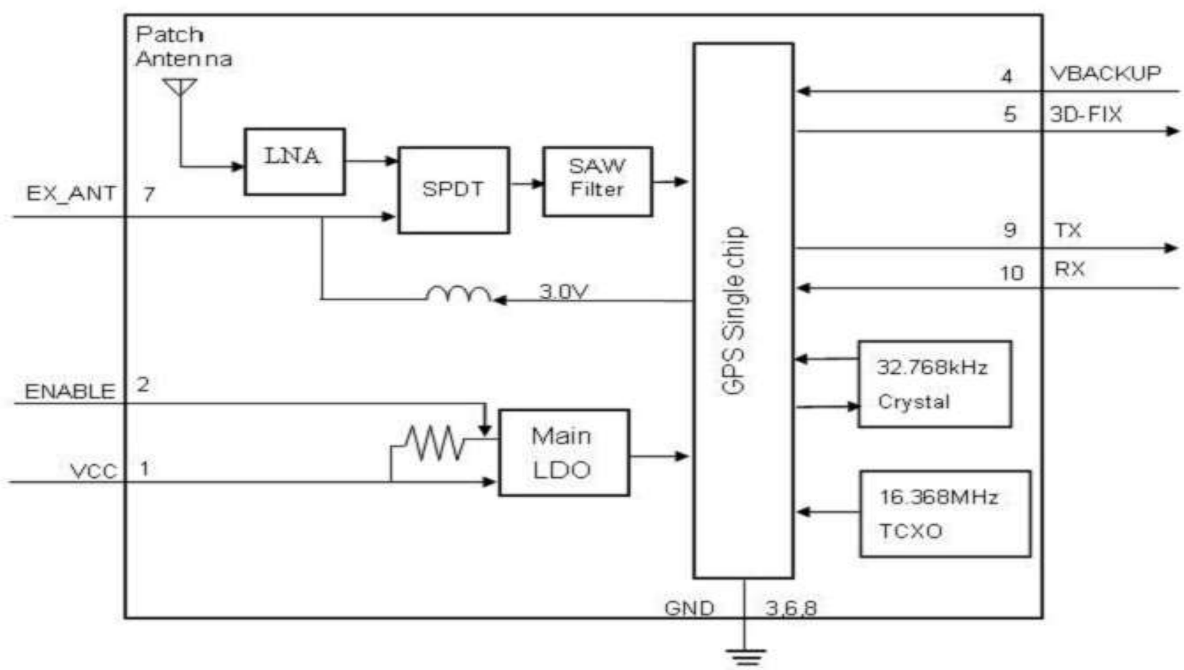

Figure 3.15 Block Diagram of 66 Channel GPS Smart Antenna

3.5.5 Pin Configuration and Description:

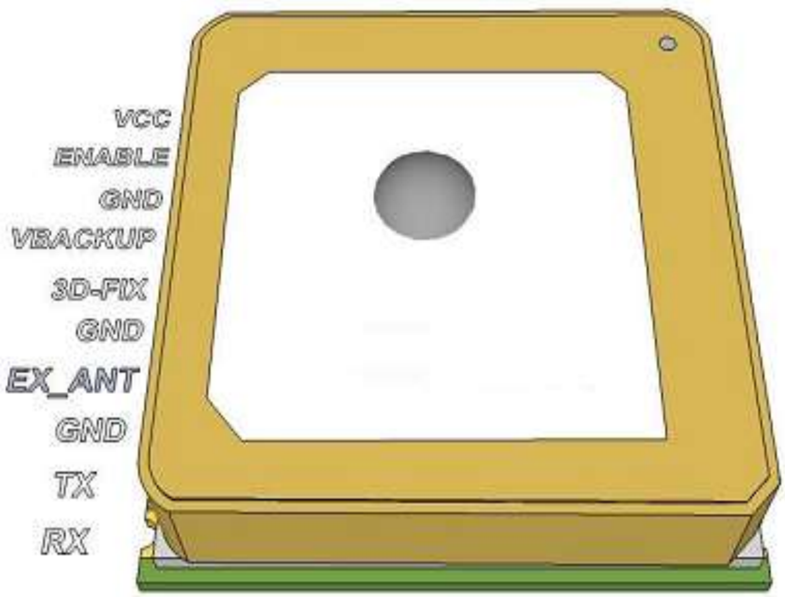

Figure 3.16 Pin Configuration

Table 6 Pin configuration

Pin	Name	I/O	Description
1	VCC	PI	Main DC power input
2	ENABLE	I	High active, or keep floating for normal working
3	GND	P	Ground
4	VBACKUP	PI	Backup power input
5	3D-FIX	O	3D-fix indicator
6	GND	P	Ground
7	EX_ANT	I/O	External Antenna 3.0V input and output for external antenna. The maximum consumption current for the GPS antenna is limited to 30mA. When a 3mA or higher current is detected, the IC will acknowledge the external antenna as being present and uses external antenna for reception. In the event of short circuit occurring at external antenna, the module will limit the drawn current to a safe level.
8	GND	P	Ground
9	TX	O	Serial data output of NMEA
10	RX	I	Serial data input for firmware update

3.5.4 Data Received and Format

This is the data received by GPS Module and continuous monitor by the Microcontroller and time is being fixed in the programming when the data be received as a Interrupt in programming. As the data send by the GPS satellite have a particular format and here we need the location of robot in case of accident and that data should be decoded and send to the Emergency Mobile Number. This is the NMEA Output Sequence which need to be decoded accordingly

3.5.5 NMEA Output Sequence

1. **GGA-Global Position System Fixed Data,Time,Position**, and fixed related data for receiver E.g.

   $GPGGA,064951.000,2307.1256,N,12016.4438,E,1,8,0.95,39.9,M,17.8,M,,*65

Table 7 : NMEA Output Sequence(A)

Name	Example	Units	Description
Message ID	$GPGGA		GGA protocol header
UTC Time	064951.000		hhmmss.sss
Latitude	2307.1256		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12016.4438		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Position Fix Indicator	1		
Satellites Used	8		Range 0 to 14
HDOP	0.95		Horizontal Dilution of Precision
MSL Altitude	39.9	meters	Antenna Altitude above/below mean-sae-level
Units	M	meters	Units of antenna altitude
Geoidal Separation	17.8	meters	
Units	M	meters	Units of geoidal separation
Age of Diff. Corr.		second	Null fields when DGPS is not used
Checksum	*65		
<CR> <LF>			End of message termination

2. **GSA DOP and Active Satellie** e.g.
$GPGSA,A,3,29,21,26,15,18,09,06,10,,,,,2.32,0.95,2.11*00

Table 8 : NMEA Output Sequence(B)

Name	Example	Units	Description
Message ID	$GPGSA		GSA protocol header
Mode 1	A		
Mode 2	3		
Satellite Used	29		SV on Channel 1
Satellite Used	21		SV on Channel 2
....	….	….	....
Satellite Used			SV on Channel 12
PDOP	2.32		Position Dilution of Precision
HDOP	0.95		Horizontal Dilution of Precision
VDOP	2.11		Vertical Dilution of Precision
Checksum	*00		
<CR> <LF>			End of message termination

3. **GSV –GNSS Satellite in View e.g.**

Table 9 : NMEA Output Sequence(C)

Name	Example	Units	Description
Message ID	$GPGSV		GSV protocol header
Number of Messages	3		Range 1 to 3 *(Depending on the number of satellites tracked, multiple messages of GSV data may be required.)*
Message Number1	1		Range 1 to 3
Satellites in View	09		
Satellite ID	29		Channel 1 (Range 1 to 32)
Elevation	36	degrees	Channel 1 (Maximum 90)
Azimuth	029	degrees	Channel 1 (True, Range 0 to 359)
SNR (C/No)	42	dBHz	Range 0 to 99, (null when not tracking)
....	....	....	....
Satellite ID	15		Channel 4 (Range 1 to 32)
Elevation	21	degrees	Channel 4 (Maximum 90)
Azimuth	321	degrees	Channel 4 (True, Range 0 to 359)
SNR (C/No)	39	dBHz	Range 0 to 99, (null when not tracking)
Checksum	*7D		
<CR> <LF>			End of message termination

4. **RMV-Recommended Minimum Navigation Information** e.g.

$GPRMC,064951.000,A,2307.1256,N,12016.4438,E,0.03,165.48,260406, 3.05,W,A*55.

Table 10 : NMEA Output Sequence(D)

Name	Example	Units	Description
Message ID	$GPRMC		RMC protocol header
UTC Time	064951.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Latitude	2307.1256		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12016.4438		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Speed Over Ground	0.03	knots	
Course Over Ground	165.48	degrees	True
Date	260406		ddmmyy
Magnetic Variation	3.05,W	degrees	E=east or W=west
Mode	A		A= Autonomous mode D= Differential mode E= Estimated mode
Checksum	*55		
<CR> <LF>			End of message termination

5. **VTG-Course and Speed** information with respect to the ground e.g

$GPVTG,165.48,T,,M,0.03,N,0.06,K,A*37

Table 11 : NMEA Output Sequence(E)

Name	Example	Units	Description
Message ID	$GPVTG		VTG protocol header
Course	165.48	degrees	Measured heading
Reference	T		True
Course		degrees	Measured heading
Reference	M		Magnetic
Speed	0.03	knots	Measured horizontal speed
Units	N		Knots
Speed	0.06	km/hr	Measured horizontal speed
Units	K		Kilometers per hour
Mode	A		A= Autonomous mode D= Differential mode E= Estimated mode
Checksum	*06		
<CR> <LF>			End of message termination

3.6 L293D MOTOR DRIVER

3.6.1 Introduction

L293D are quadruple high-current half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V.

3.6.2 Features

- Wide Supply Voltage
- Separate Input –Logic Supply
- High-noise immunity

3.6.3 Functional Block Diagram and PIN Diagram

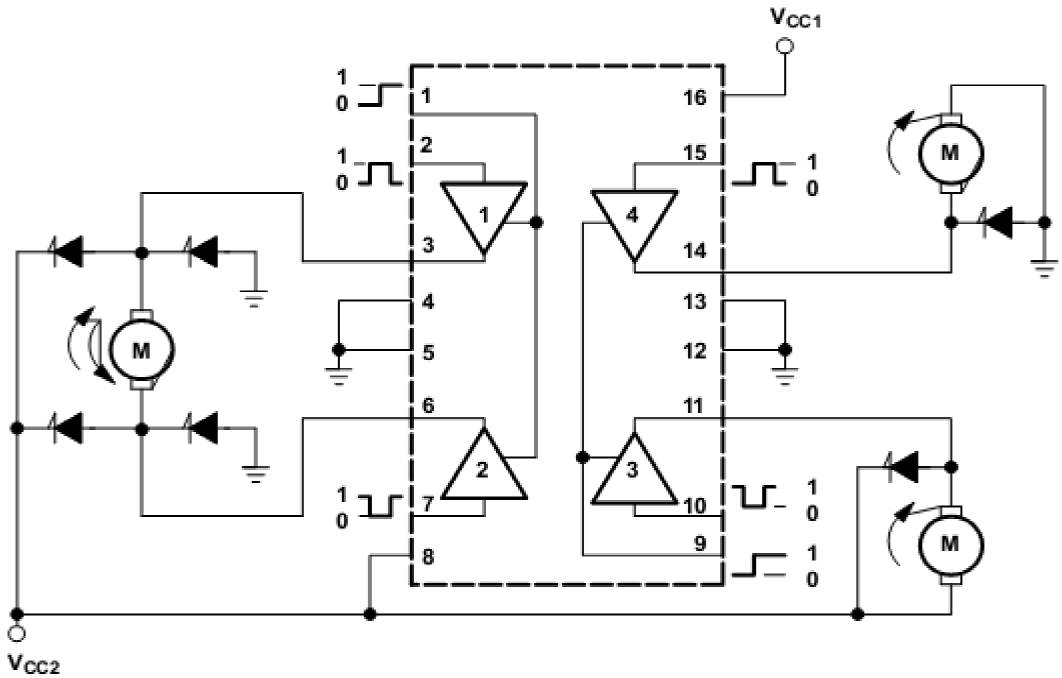

Figure 3.17 Functional Block of L293D

Pin diagram

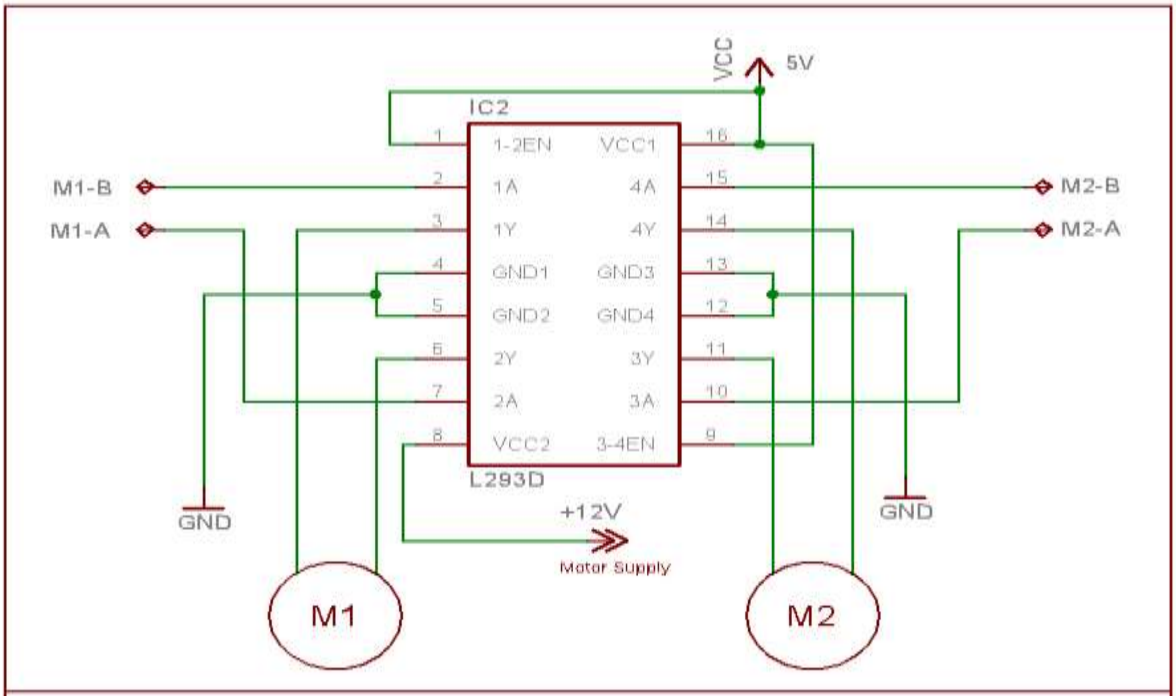

Figure 3.19. PIN Diagram of L293D

This circuit is used to run the two DC Motors and it takes the signal from the Microcontroller and drive the Robot forward, backward, left, right accordingly.

3.7 DC Motor and Steering System

3.7.1 Steering System

The differential steering system is familiar from ordinary life because it is the arrangement used in a wheelchair. Two wheels mounted on a single axis are independently powered and controlled, thus providing both drive and steering. Additional passive wheels (usually casters) are provided for support. Most of us have an intuitive grasp of the basic behavior of a differential steering system. If both drive wheels turn in tandem, the robot moves in a straight line. If one wheel turns faster than the other, the robot follows a curved path. If the wheels turn at equal speed, but in opposite directions, the robot pivots.

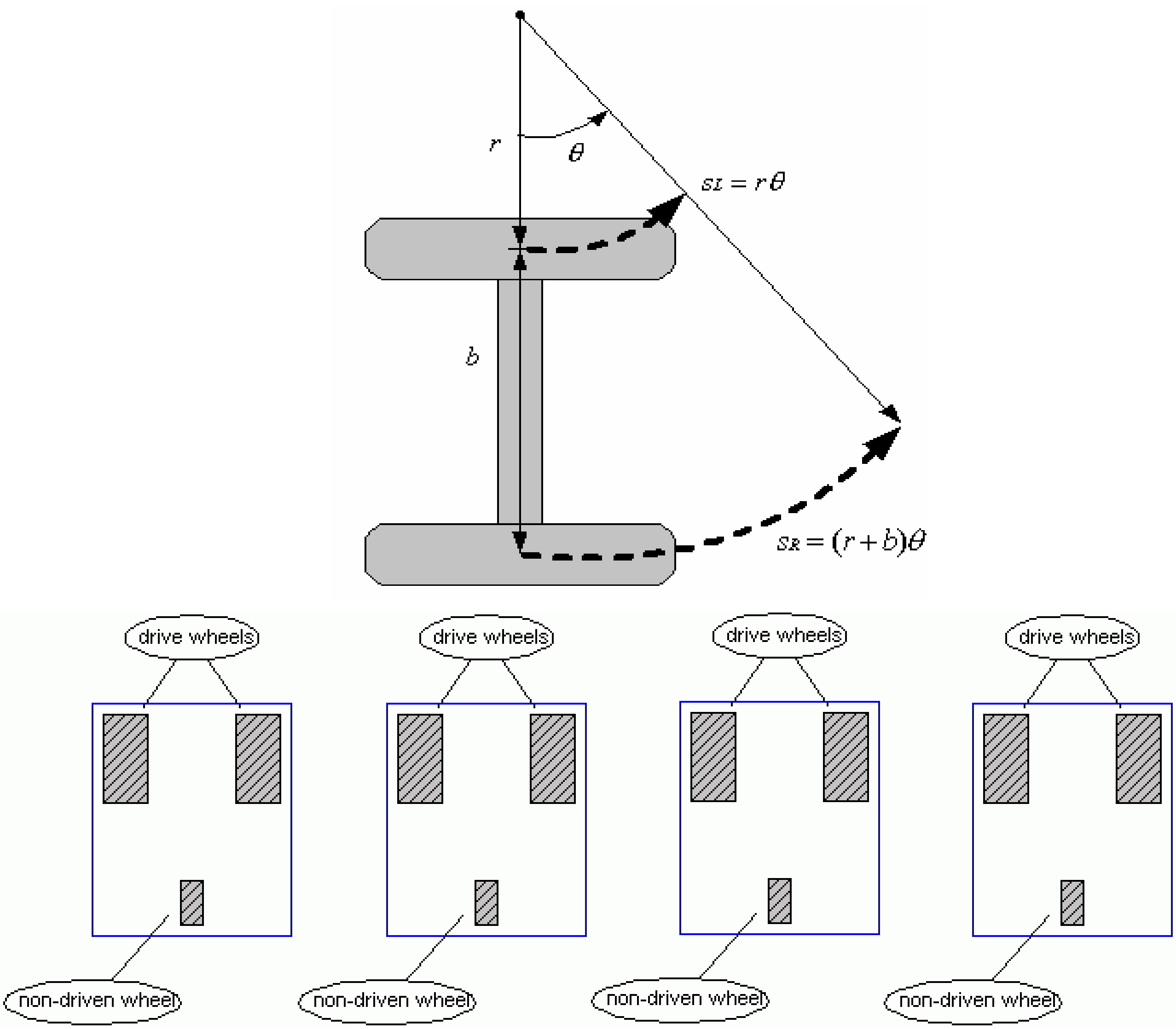

Figure 3.20 Differential Driving

3.7.2 DC Motors

DC motors are widely used, inexpensive, small and powerful for their size. Reduction gearboxes are often required to reduce the speed and increase the torque output of the motor. Unfortunately more sophisticated control algorithms are required to achieve accurate control over the axial rotation of these motors. Although recent developments in stepper motor technologies have come a long way, the benefits offered by smooth control and high levels of acceleration with DC motors far outweigh any disadvantages.

3.8 LCD

3.8.1 Introduction

LCD display is plays a very important part of every project in an almost all embedded projects, thus 16×2 LCD here interfaced with the ATmega8 Microcontroller. It is very easy to use to interface LCD module with the Microcontroller but the fact is that it it is used in the circuit properly , its a very easy job and by knowing it can easily design embedded projects like digital voltmeter / ammeter, status indicator display, digital clock, home automation displays, digital code locks, display for music players etc. It is always helpful in system having some devices to show the status of the working of circuit.

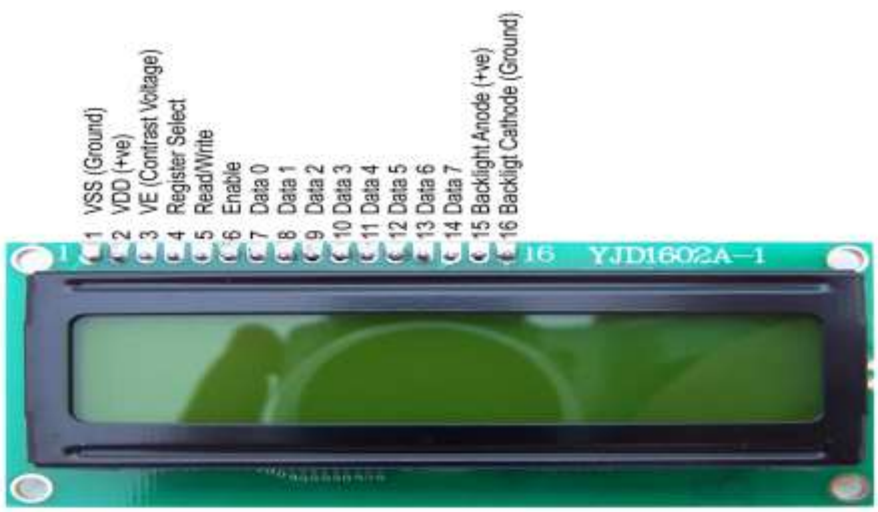

Figure 3.21 16*2 LCD Description

3.8.2 Features and Interface PIN Description

- 5*8 dots with cursor
- 16 character and 2 lines display
- 4 bit or 8-bit MPU interface
- Display Mode & Backlight Variation

Table 12 : PIN Configuration of LCD

Pin no.	Symbol	External connection	Function
1	Vss	Power supply	Signal ground for LCM
2	V_{DD}		Power supply for logic for LCM
3	V_0		Contrast adjust
4	RS	MPU	Register select signal
5	R/W	MPU	Read/write select signal
6	E	MPU	Operation (data read/write) enable signal
7~10	DB0~DB3	MPU	Four low order bi-directional three-state data bus lines. Used for data transfer between the MPU and the LCM. These four are not used during 4-bit operation.
11~14	DB4~DB7	MPU	Four high order bi-directional three-state data bus lines. Used for data transfer between the MPU
15	LED+	LED BKL power supply	Power supply for BKL
16	LED-		Power supply for BKL

Chapter 4

Main Project

4.1 Power Supply

Power Supply circuit used to supply the regulated voltage to the whole circuit. The 12 V, 1A Adapter is connected to the jack and simultaneously capacitor (100uF) is connected to the input to bypass the initial high voltage spark.IC27805 provide the regulated voltage supply to the output. LED at output indicates the power is coming or not.

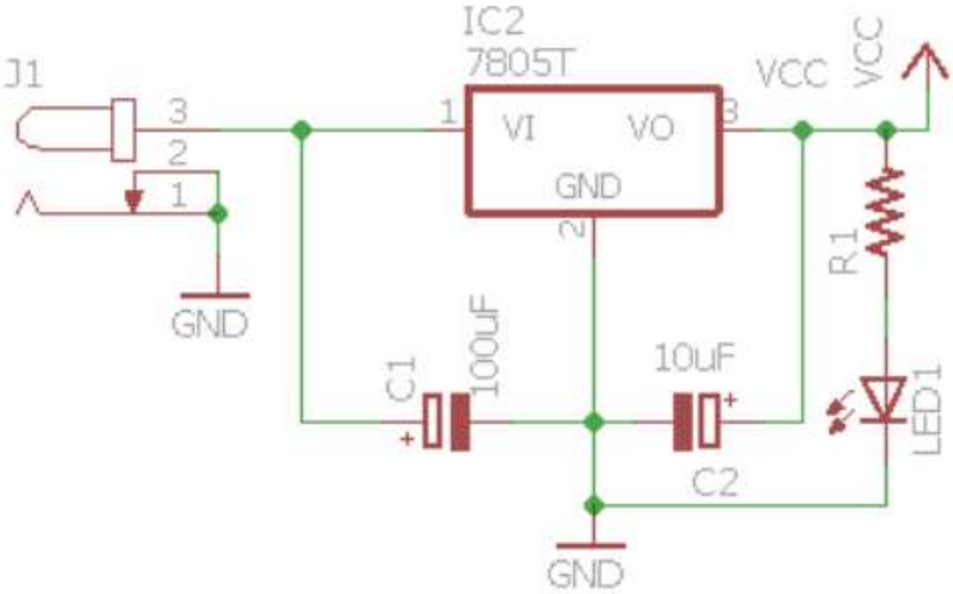

Figure 4.1 Power Supply

4.2 Transmitter Side and its working

4.2.1 Working

This circuit is made transmitter side which actually controls the motion of Robot in forward, backward, left and right. Accelerometer transmits the different signal to the Microcontroller then it gave signal serially to ZigBee accordingly. ZigBee used here as wireless communication between transmitter and receiver. It has antenna which transmit the signal to the receiver. Thus transmitter transmits the different gesture signals to receiver for controlling the robot.

The Transmitter first planned to be use Gyroscope as an sensor for control the motion of robot but it was not showing as much accuracy and was also adding more complexity to the system then looked for other alternative in the market and also the same discussed with mentor. Finally looking at the merit of Accelerometer in the project with less complexity and much accuracy it is used in the project. Then the Transmitter tested for the different input signal and the error is reduced as much as possible and robot was running with good range of signal.

Block diagram

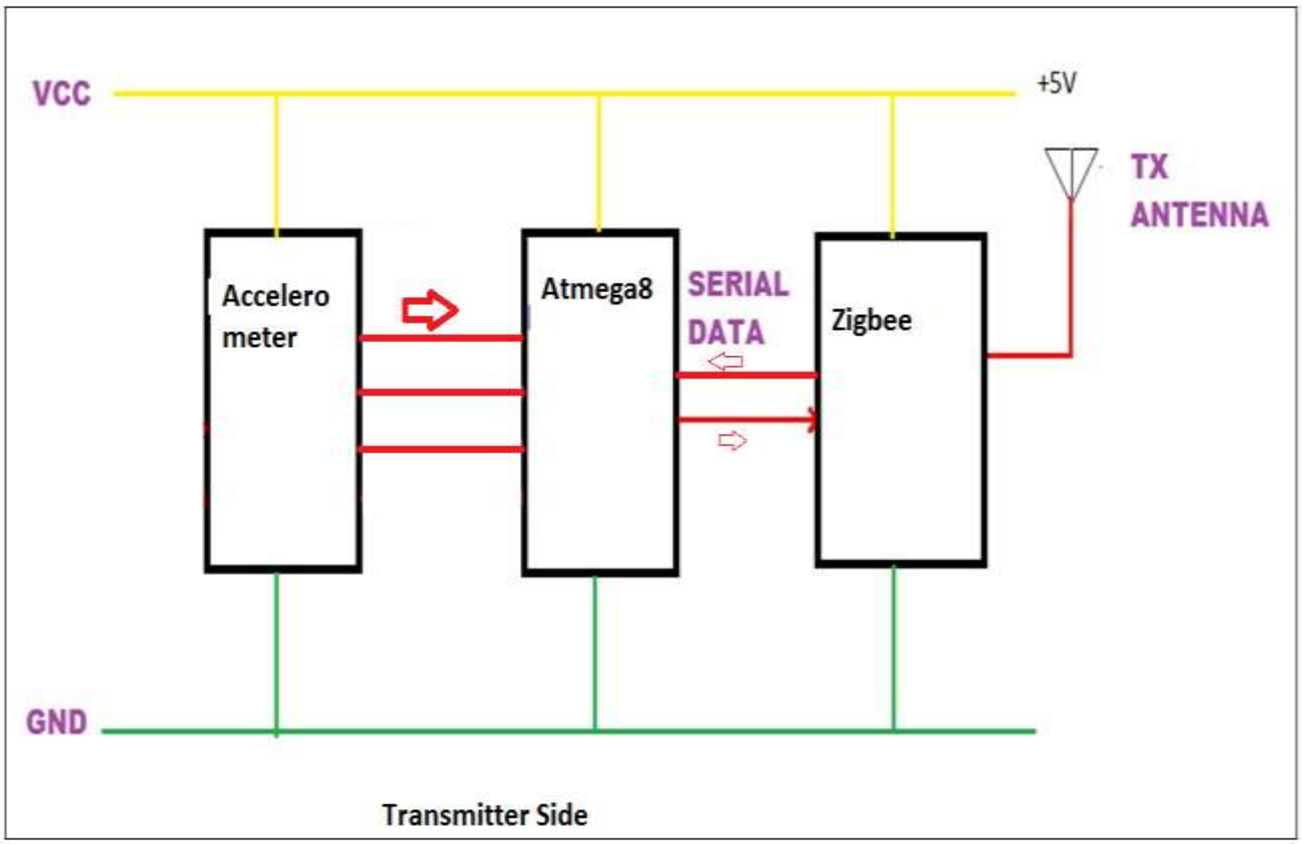

Figure 4.2 Transmitter Side

4.3 Receiver Side and its working

4.3.1 Working

This whole circuit is made in Receiver side of robot. It had different features which is controlled by the single Microcontroller. Microcontroller takes the input from different devices like Zigbee Receiver, GPS Module, IR Sensor. Atmega8 has single port for taking input serial data that's why it is connected through Multiplexer. In programming time slot has been made for Zigbee and GPS data and then process accordingly. If it takes data from the Zigbee then it controls the motion of robot. It is using differential motion control for robot motion.L293D is the driver IC of DC Motor.

LCD is there to display the status of Robot like latitude, longitude and motion.

IR sensor transmit the signal in case of collision and the Microcontroller process the signal of GPS and it transmit the latitude, longitude of location as a SMS to the Emergency Number via GSM Module.

During testing of Robot collision and the location of Robot in case of collision it was showing deviation as compare to exact location of Robot. In basement it was showing a large variation in location but when robot was tested on Open floor it was showing much more accuracy and the robot was responding to collision and was sending the SMS to the Programmed Mobile Number.

Block diagram

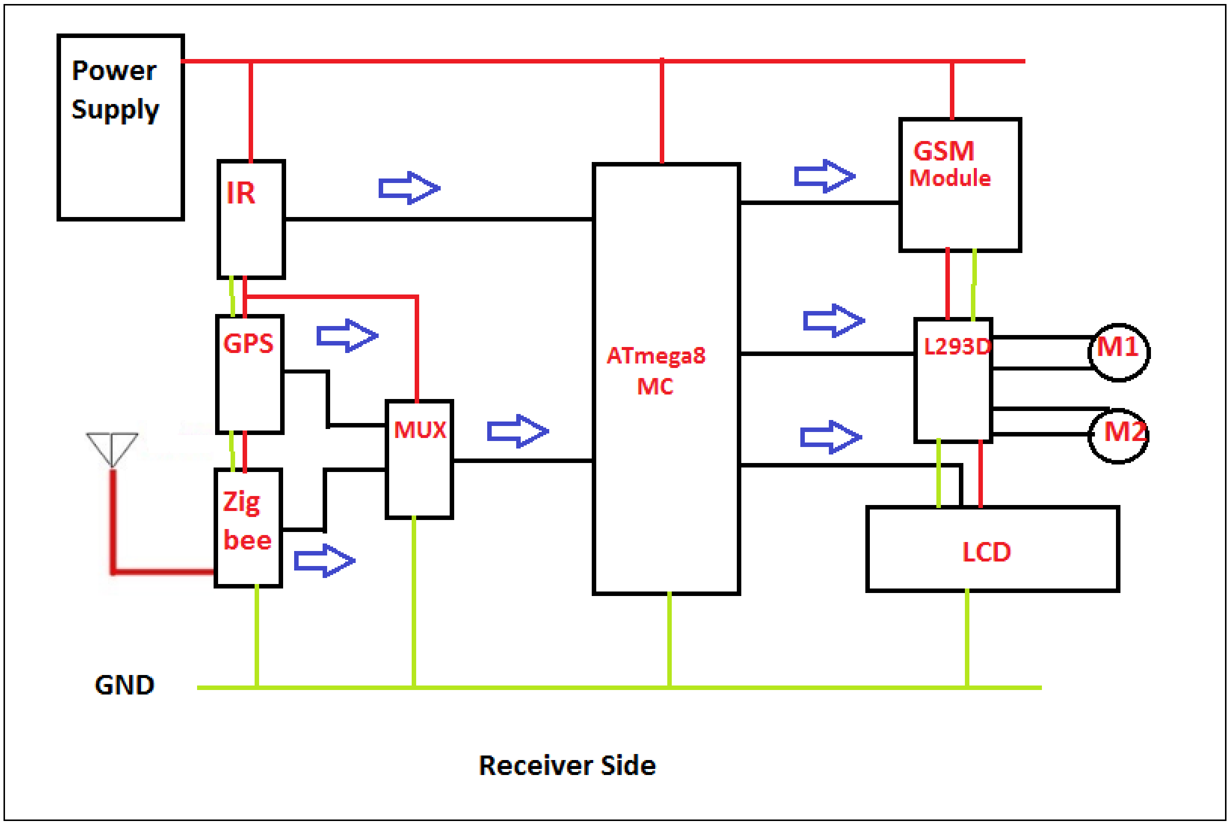

Figure 4.3 Receiver Side

4.4 Schematic Diagram

4.4.1 Transmitter

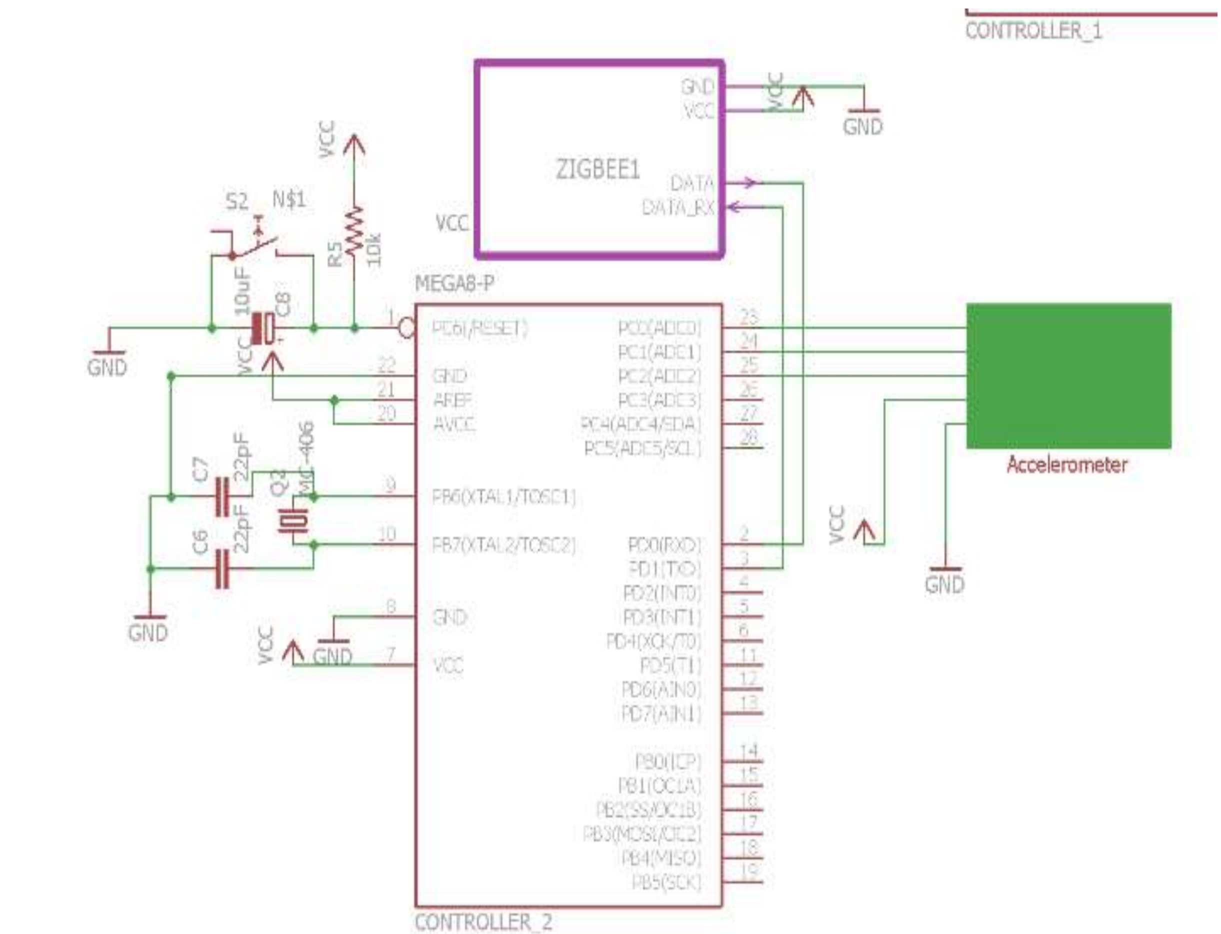

Figure 4.4 Transmitter Schematic Diagram

4.4.2 Receiver

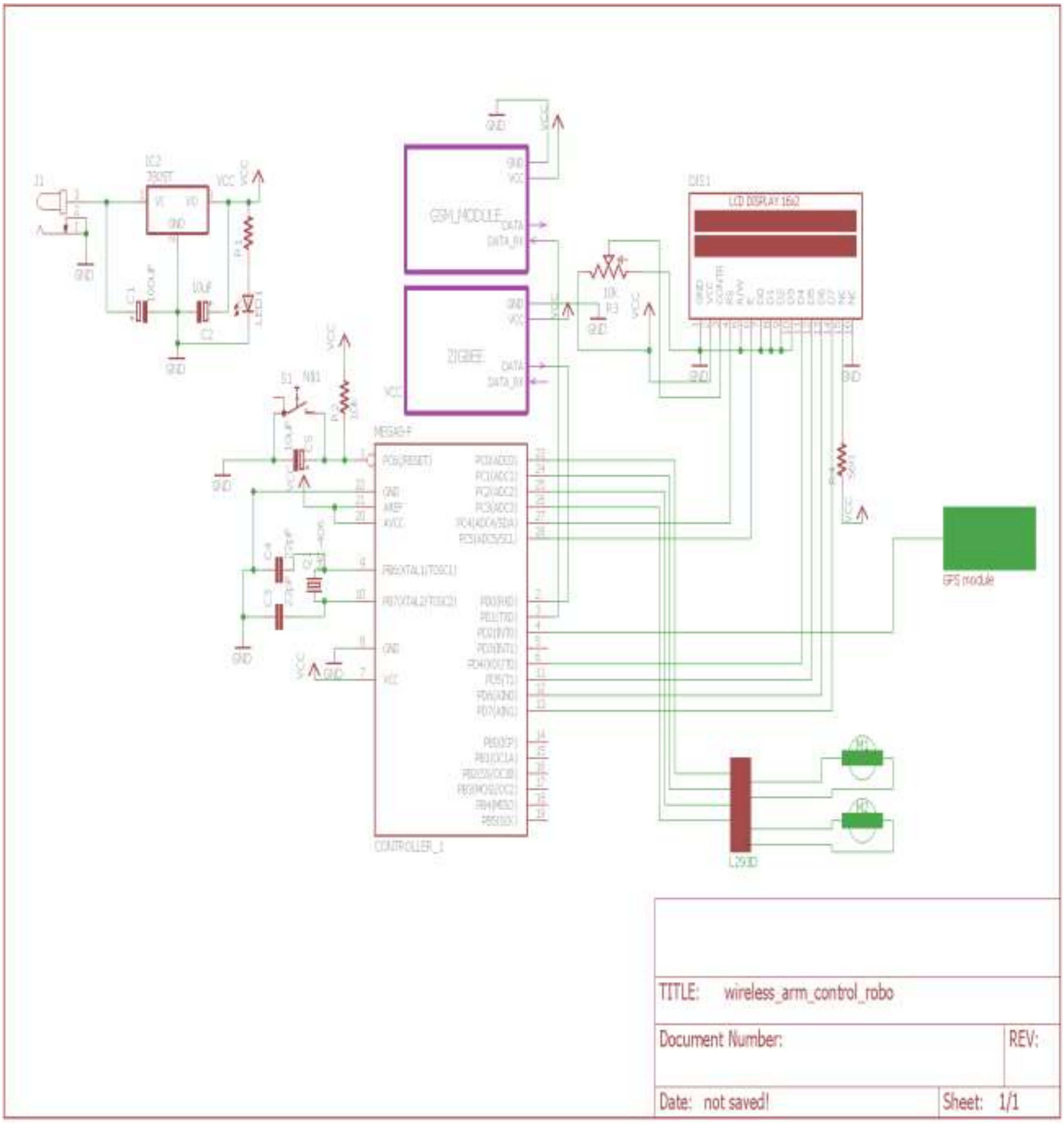

Figure 4.5 Receiver Schematic

Final Project with Transmitter and Robot with Receiver Part

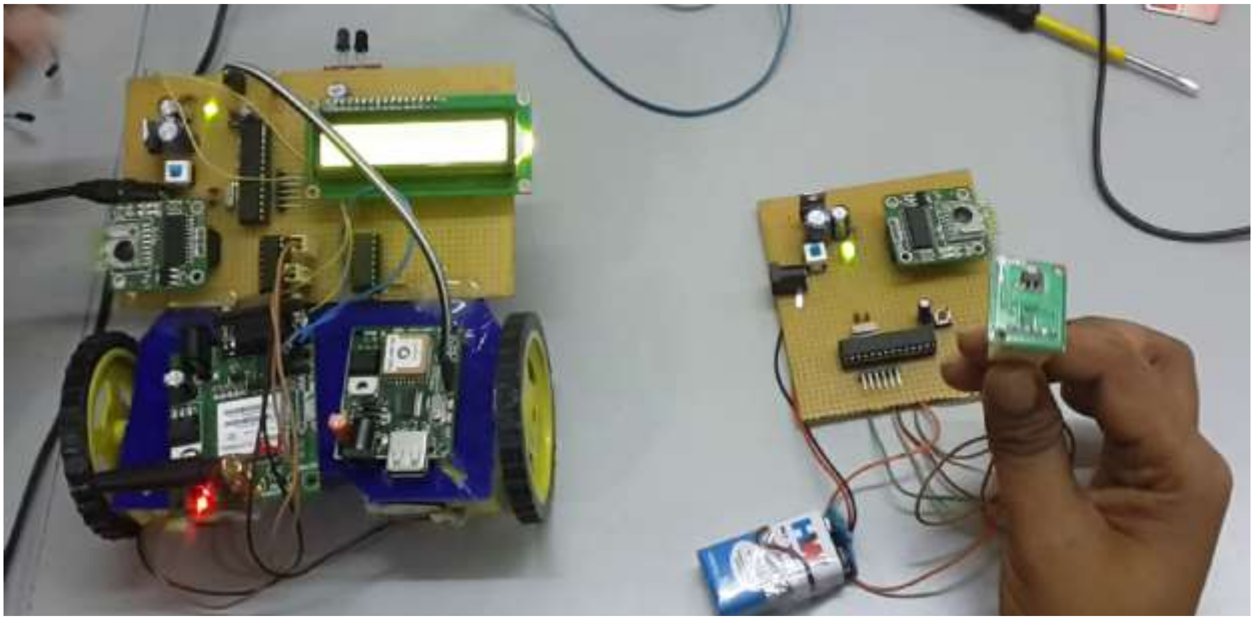

Figure 4.6 Robot with Receiver and Transmitter

Figure 4.7 Robot with Receiver

4.5 Software Used:

4.5.1 Proteus

It is a fully functional and procedural programming language created in 1998 by Simone Canella which incorporates many functions derived from other languages: C, BASIC, Assembly, Clipper/dBase. The main usage of this language is transforming data from one form to another. It was designed to be practical, readable and consistent. Its major points are powerful manipulation; comprehensibility of Proteus scripts; availability of advanced data structures: arrays, queues (single or double), stacks, bit maps, sets, AVL trees. It has a fully functional, procedural approach and variables are untyped, do not need to be declared, can be local or public and can be passed by value or by reference. New functions can be defined and used as native functions. There are three Data types that are supported by Proteus: integer numbers, floating point numbers and strings. It includes hundreds of functions for accessing file system; sorting data; manipulating data and strings; interacting with the user (console functions) calculating logical and mathematical expressions.

4.5.2 AVR Studio

It is basically a Harvard architecture 8-bitRISC single-chip microcontroller developed by Atmel in 1996. It was one of the first microcontroller families that are used on-chip flash memory for program storage. The AVR chips are designed into 8-bit Arduino platform, and the program and data are stored in separate physical memory systems that appear in different address spaces, but have the ability to read data items from memory using special instructions. Program instructions are stored in non-volatile flash memory and the address space consists of the register file, I/O registers, and SRAM. The AVRs have 32 single-byte registers and I/O memory. AVRs basically have a two-stage, single-level pipeline design i.e. the next machine instruction is fetched as the current one is executing. Most instructions take just one or two clock cycles, making AVRs relatively fast among 8 bit microcontrollers.

The software programming is done in C language. Data (co-ordinates) received by GPS from the satellites is defined in the software. Decoding the NMEA (National Marine Electronics Association) protocol is the main purpose of developing this software. The mobile number of the user should be included in the software programming in order to receive the location values from the SIM card which we are using in GSM modem. The NMEA protocol consists of set of messages. These messages are ASCII character set. GPS receives data and present it in the form of ASCII comma–delimited message strings. ‘$’ sign is used at the starting of each message. The locations (latitude and longitude) have the format of ddmm.mmmm. i.e. degrees minutes and decimal minute.

Chapter 5

Conclusion and Future Scope

5.1 Conclusion

An Embedded System is designed which can be most useful for Gesture control Robot and Accidents detection . It's a low cost, power efficient by which the action time can be minimized and exact location of an accident site can also be defined with GPS service and also the information regarding accident can be sent to particular contact numbers e.g., Police stations, Doctors etc. Because of the flexibility of embedded system, it is very much compatible to any kind of vehicles because design of this system is compact. Overall this system is very much affordable to a common man and this can be easily implemented. Accelerometer control feature provide it a kind of gesture control which has numerous application in general life. This feature gives a device control feature without touching the device i.e. person can control the device from anywhere within the range of communication.

Due to the growing demand for natural Human Machine Interfaces and robot intuitive programming platforms, a robotic system that allows users to control an robot using arm gestures and postures was proposed. 3-axis accelerometer was selected to be the input devices of this system, capturing the human arms behaviors. This approach using accelerometers is more intuitive and easy to work, besides offering the control a robot by wireless means. Using this system, a non-expert robot programmer can control the motion of robot quickly and in a natural way. The low price and short set-up time are other advantages of the system.

With the beginning of science and technology in every part of life the importance of gesture control and vehicle safety has increased. The main priority is being given to cut back the alarming time once an accident occur, therefore that the wounded lives will be attended in lesser time by the rescue team. This provides the look that has the benefits of low value, movableness, and little size and straightforward expansibility. The platform of the system is Atmel ATmega8 on with ZigBee communication, accelerometer detector; IR sensor for collision detector, GPS and GSM Module, interfacing that shortens the alarm time to a large extent and find the location of accident accurately. This system will overcome the issues of lack of automated system for accident location detection. Consequently, the time for looking out the location is reduced and the person will be treated as shortly as attainable that can save several lives. This technique can have broad application prospects as it integrates the positioning systems and the network of medical primarily based services.

5.2 Future Scope

This system can be extended by using ARM processors and Arduino controllers instead of microcontroller for very fast operation of processors. And also the cameras can be interfaced with this system to map the exact scene of an accident. An improved new system can be designed which automatically shuts off vehicle engine when accident occurs. We can also use the onboard GPS-GSM modem for designed compactness. And also the system can be design which automatically shutoff vehicle engine while accident occurs. The design of Robot can be extended to help the Differently Abled person to control the things with hand gesture and also to the Industry Application.

Appendix

Program Code

Transmitter Side

Program Code:

```
#ifndef F_CPU

#define F_CPU 8000000UL // 8 MHz clock speed

#endif

#define PORT_ON(port,pin) port |= (1<<pin)

#define PORT_OFF(port,pin) port &= ~(1<<pin)

#include <avr/io.h>

#include <util/delay.h>

#include <string.h>

uint16_t NewAccX=0,NewAccY=0,NewAccZ=0,curAccX=0,curAccY=0,curAccZ=0,flex=0;

uint16_t adc0,adc1,adc2;

char buffer[10];

// *******************functions********************************

void my_delay_ms(uint16_t count){


	while(count--) {

		_delay_ms(1);

	}

}
```

```
#define USART_BAUDRATE 9600

#define BAUD_PRESCALE (((F_CPU / (USART_BAUDRATE * 16UL))) - 1)



void adc_init(void)                    // Initialization of ADC

{

//      ADMUX |= (1<<REFS0); // reference voltage set to 5v

        ADCSRA |= (1<<ADPS2)|(1<<ADPS1)|(1<<ADPS0)|(1<<ADEN); //speed of adc at 8mhz and adc enable

}

uint16_t adc_read(uint8_t ADCchannel)

{

        ADMUX = (ADMUX & 0xF0) | (ADCchannel & 0x0F);  //single conversion mode

        ADCSRA |= (1<<ADSC); // wait until ADC conversion is complete

        while( ADCSRA & (1<<ADSC) );

        return ADC;

}


void InitUART()

{

        UCSRA&=~(1<U2X);

        UCSRB = (1<<RXCIE)|(1 << RXEN) | (1 << TXEN); // Turn on the transmission and reception circuitry

        UCSRC = (1 << URSEL) | (1 << UCSZ0) | (1 << UCSZ1);
```

```
UBRRH = (BAUD_PRESCALE >> 8); // Load upper 8-bits of the baud rate value into the high byte of the UBRR register

UBRRL = BAUD_PRESCALE; // Load lower 8-bits of the baud rate value into the low byte of the UBRR register

/* Flush receive buffer */

//UBRR=51


}

void transmit_char(char Data1)

{	// Wait if a byte is being transmitted



		while((UCSRA&(1<<UDRE)) == 0); // Transmit data

		UDR = Data1;


}

void transmit_string(char Data[140])

{	int x;

	for(x=0;Data[x]!=('\0');x++){

		while((UCSRA&(1<<UDRE)) == 0); // Wait if a byte is being transmitted

		UDR = Data[x];   // Transmit data

	}

}

// ********************************main**********************
```

```
int main(void)
{
	DDRD = 0xFe;
	PORTD=0X00;

	DDRC = 0x00;
	PORTC = 0x00;

	DDRB=0xff;
	PORTB=0x00;

	adc_init();
	InitUART();

	while(1)
	{
		adc0=adc_read(0);
		adc1=adc_read(1);
		adc2=adc_read(2);

		/*
		sprintf(buffer,"%d",adc0);
		transmit_string(buffer);
		transmit_char(' ');
```

```
my_delay_ms(100);
sprintf(buffer,"%d",adc1);
transmit_string(buffer);
transmit_char(' ');
my_delay_ms(100);
sprintf(buffer,"%d",adc2);
transmit_string(buffer);
my_delay_ms(1000);
transmit_char('\r');
*/
if (adc0>400 &&( adc1>300 && adc1<400))
{
	transmit_char('1');
}
else if(adc0<300 &&( adc1>300 && adc1<400))
{
	transmit_char('2');
}
else if(adc1>400 &&( adc0>300 && adc0<400))
{
	transmit_char('3');
}
else if(adc1<300 &&( adc0>300 && adc0<400))
{
```

```
                transmit_char('4');
            }
                my_delay_ms(10);
        }
}
```

Receiver Side

Program Code

```
#ifndef F_CPU
#define F_CPU 8000000UL // 8 MHz clock speed
#endif
```

```
#define ser_del 800


#define USART_BAUDRATE 9600
#define BAUD_PRESCALE (((F_CPU / (USART_BAUDRATE * 16UL))) - 1)


#define RS eS_PORTC5
#define EN eS_PORTC4
#define D4 eS_PORTD4
#define D5 eS_PORTD5
#define D6 eS_PORTD6
#define D7 eS_PORTD7



#include "lcd.h"



#define PORT_ON(port,pin) port |= (1<<pin)
#define PORT_OFF(port,pin) port &= ~(1<<pin)




#define motor_00 PC0
#define motor_01 PC1
```

```
#define motor_10 PC2

#define motor_11 PC3

#define ir PD2


#define multipexer_s0 PB0

#define multipexer_s1 PB1

#define deb_t 100



#include <avr/io.h>

#include <util/delay.h>

#include <stdio.h>

#include <avr/interrupt.h>

#include <string.h>

#include <util/atomic.h>



char UART_RxBuf,byte,cyte[10],gps_data[70],time[20],latitute[20],longitute[20],date[20];

uint16_t t;

void my_delay_ms(uint16_t count){


        while(count--) {

                _delay_ms(1);

        }
```

```
}

void InitUART()
{
	UCSRA&=~(1<U2X);
	UCSRB = (1<<RXCIE)|(1 << RXEN) | (1 << TXEN); // Turn on the transmission and reception circuitry
	UCSRC = (1 << URSEL) | (1 << UCSZ0) | (1 << UCSZ1);// this 8 bit data mode

	UBRRH = (BAUD_PRESCALE >> 8); // Load upper 8-bits of the baud rate value into the high byte of the UBRR register
	UBRRL = BAUD_PRESCALE; // Load lower 8-bits of the baud rate value into the low byte of the UBRR register
	// Flush receive buffer
	//UBRR=51

}

void transmit_data(char Data[140])
{	int x;
	for(x=0;Data[x]!=('\0');x++){
		// Wait if a byte is being transmitted


		while((UCSRA&(1<<UDRE)) == 0);
		// Transmit data
```

```
                    UDR = Data[x];
          }
}
void sms(char *message, char *message2)
{
          transmit_data("AT\r");
          my_delay_ms(ser_del);
          transmit_data("AT+CMGF=1\r");
          my_delay_ms(ser_del);

          transmit_data("AT+CMGS=\"+919013654349\"\r");//9899805839//9999916526
          my_delay_ms(ser_del);
          transmit_data("***GSM GPS based  System***\n\r");
          my_delay_ms(ser_del);
          transmit_data(message);
          my_delay_ms(ser_del);
          transmit_data("Latitude and longitudes\n\r");
          my_delay_ms(ser_del);
          transmit_data(message2);
          my_delay_ms(ser_del);
          UDR=0x1A;   //ctrl+z
          my_delay_ms(ser_del);
          my_delay_ms(ser_del);
}
```

```
ISR (USART_RXC_vect)
{

if(t<=20)
{
	{	while ((UCSRA & (1 << RXC)) == 0);
		UART_RxBuf=UDR;
		//	transmit_data(UART_RxBuf);
	}
}
////////////////////////////////////////////////////
else if(t>20&& t<=40)
{

while ( !(UCSRA & (1<<RXC)));	//USART data reception starts
byte=UDR;
if(byte=='$')		//1st bit of packet data of GPS protocol starts with '$'
{
	for(int f=0;f<5;f++)		//capture next 5 bits to sorts out packets of information
	{
		while(!(UCSRA &(1<<RXC)));
		cyte[f]=UDR;
	}
```

```
if((cyte[0]=='G')&&(cyte[1]=='P')&&(cyte[2]=='R')&&(cyte[3]=='M')&&(cyte[4]=='C'))
{
    for(int p=0;p<60;p++)        //capture next 60 bytes to sample and extract parameters from each packet data
    {
        while ( !(UCSRA & (1<<RXC)));
        gps_data[p]=UDR;
    }
    for(int k=1;k<10;k++)   //time       //time info extraction
    {
        time[k-1]=gps_data[k];

    }

    for(int k=14;k<25;k++)   //latitude
    {
        latitute[k-14]=gps_data[k];

    }



    for(int k=26;k<38;k++)   //longitude
    {
        longitute[k-26]=gps_data[k];
```

```
                }

                for(int k=40;k<55;k++)    //date
                {
                        date[k-40]=gps_data[k];

                }
                }
        }
  }
}
void select_gps()
{
        PORT_OFF(PORTB,0);
        PORT_OFF(PORTB,1);
}

void select_zigbee()
{
        PORT_OFF(PORTB,1);
        PORT_ON(PORTB,0);
}
```

```
void motor_off()
{
        PORT_ON(PORTC,motor_00);
        PORT_ON(PORTC,motor_01);

        PORT_ON(PORTC,motor_10);
        PORT_ON(PORTC,motor_11);
}
void motor_forward()
{
        PORT_ON(PORTC,motor_00);
        PORT_OFF(PORTC,motor_01);

        PORT_ON(PORTC,motor_10);
        PORT_OFF(PORTC,motor_11);
        my_delay_ms(10);
        motor_off();
        my_delay_ms(3);
}
void motor_backward()
{
        PORT_OFF(PORTC,motor_00);
        PORT_ON(PORTC,motor_01);
```

```
        PORT_OFF(PORTC,motor_10);
        PORT_ON(PORTC,motor_11);
        my_delay_ms(10);
        motor_off();
        my_delay_ms(3);
}
void motor_left()
{
        PORT_ON(PORTC,motor_00);
        PORT_OFF(PORTC,motor_01);

        PORT_OFF(PORTC,motor_10);
        PORT_OFF(PORTC,motor_11);
        my_delay_ms(10);
        motor_off();
        my_delay_ms(3);
}
void motor_right()
{
        PORT_OFF(PORTC,motor_00);
        PORT_OFF(PORTC,motor_01);

        PORT_ON(PORTC,motor_10);
        PORT_OFF(PORTC,motor_11);
```

```
            my_delay_ms(10);
            motor_off();
            my_delay_ms(3);
    }
    int main(void)
    {
             DDRD  = 0xFa;    //
             PORTD = 0x04;
             DDRB  = 0xFF;
             PORTB = 0x00;
             DDRC  = 0xFF;
             PORTC = 0x00;

             InitUART();

             sei();  // enable all(global) interrupts

       Lcd4_Init();
       Lcd4_Set_Cursor(1,0);
       Lcd4_Write_String("arm control Robo       ");
       Lcd4_Set_Cursor(2,0);
       Lcd4_Write_String("welcome          ");
             my_delay_ms(2000);
              Lcd4_Set_Cursor(2,0);
```

```
        Lcd4_Write_String("              ");
        t=0;

      while(1)
      {
//**************************************************************************
if(t<=20)
{
      t++;
         PORT_OFF(PORTB,0);
              Lcd4_Set_Cursor(2,15);
              Lcd4_Write_Char(UART_RxBuf);
              switch (UART_RxBuf)
              {
                     case  '1'  :motor_left();                Lcd4_Set_Cursor(2,0);
Lcd4_Write_String("Left      ");  break;
                     case  '2'  :motor_right();               Lcd4_Set_Cursor(2,0);
Lcd4_Write_String("Right     ");  break;
                     case  '3'  :motor_forward();             Lcd4_Set_Cursor(2,0);
Lcd4_Write_String("Forward   ");  break;
                     case  '4'  :motor_backward();            Lcd4_Set_Cursor(2,0);
Lcd4_Write_String("Left      ");  break;
                     default:          Lcd4_Set_Cursor(2,0); Lcd4_Write_String("stop
");  break;
              }
              my_delay_ms(10);
```

```
                    UART_RxBuf='0';
}
// ****************************************GPS***********************
else if(t>20 && t<40)
{
t++;
  PORT_ON(PORTB,0);
  Lcd4_Clear();
  Lcd4_Set_Cursor(1,0);
  Lcd4_Write_String(latitute);
  Lcd4_Set_Cursor(2,0);
  Lcd4_Write_String(longitute);
  my_delay_ms(5000);

//   Lcd4_Set_Cursor(2,0);
//   Lcd4_Write_String(time);
 //  my_delay_ms(5000);
 if (~PIND&(1<<ir))
 {
          sms(latitute,longitute);
 }

          }
 }}
```

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