Mini Project Report on

MULTI TERRAIN ROBOT

Submitted by

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Athira B

Fathima Faheema

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Focus on Excellence

Bachelor of Technology

Electronics and Communication Engineering

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CERTIFICATE

This is to certify that the mini project report titled **Multi Terrain Robot** submitted by **Jibin Sabu , Athira B , Fathima Faheema , Jashin Joseph Palatty**, towards partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology** in **Electronics and Communication Engineering** is a record of bonafide work carried out by them during the academic year **2013 –2014**.

Internal Guide

Head of the Department

Internal Examiner

External Examiner

Place: Mookkannoor

Date:

ACKNOWLEDGEMENT

First of all I am grateful to the Almighty God for enabling me to complete this mini project.

I wish to express my sincere thanks to **Dr.K.S.M.Panicker**, Principal of the college,for providing me with all the necessary facilities. I would like to extend my sincere gratitude to **Ms.P.R.Mini**, HOD, Department of electronics and communication engineering for her encouragement and support.I extend my hearty gratitude towards the project coordinator **Dr. S Krishnakumar** for his guidance.

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I once again thank, one and all who, directly or indirectly , have lent their helping hand in this venture.

ABSTRACT

The proposed vehicle is designed to move at all terrains . This is proposed to surveillance the disaster occurred location. The proposed autonomous vehicle is having chain pulled drives on both side and one single axial chain to move the vehicle up and downstream. The vehicle uses a webcam to monitor the location. The Human presence detector sensor is used to help rescue team to identify the location of people to be rescued. The proposed vehicle is controlled remotely using network connections such as Wi- Fi. The motion and objective of the bot is carried out with the help of a joystick, which is connected to the laptop. The proposed robot contains an LDR (Light Dependent Resistor), which have maximum resistance in the presence of light and minimum in the absence of light. The bot also have a camera module which is proposed to give live stream of surrounding of the robot. The camera module gives 1080p display at the user end. The bot transfer data to control the motion through the sockets created over the network.

Chapter 1 : INTRODUCTION

Disasters , both natural and man made are unavoidable. Lives of many people are being taken away due to poor surveillance of disaster stricken areas .Also , many war fighters ,military professionals and public safety personnel's have lost their lives due to inefficient surveillance methods adopted by the governments around the world. This vehicle can be used for surveillance of areas which are inaccessible by humans. It is controlled using joystick at remote location.

It is a lightweight, man portable Unmanned Ground Vehicle(UGV) capable of conducting military operations in urban terrain, tunnels, sewers, and caves. The SUGV aids in the performance of man power intensive or high risk functions (i.e. urban Intelligence, Surveillance, and Reconnaissance (ISR) missions, chemical/Toxic Industrial Chemicals (TIC), Toxic Industrial Materials (TIM), reconnaissance, etc.).

The main motive behind this robot is to minimize Soldiers' exposure directly to hazards. The SUGV's modular design allows multiple payloads to be integrated in a plug and play fashion. As part of our mini project we have tried to implement a smaller version of the same.

Chapter 2 : BLOCK DIAGRAM AND COMPONENTS

2.1 BLOCK DIAGRAM

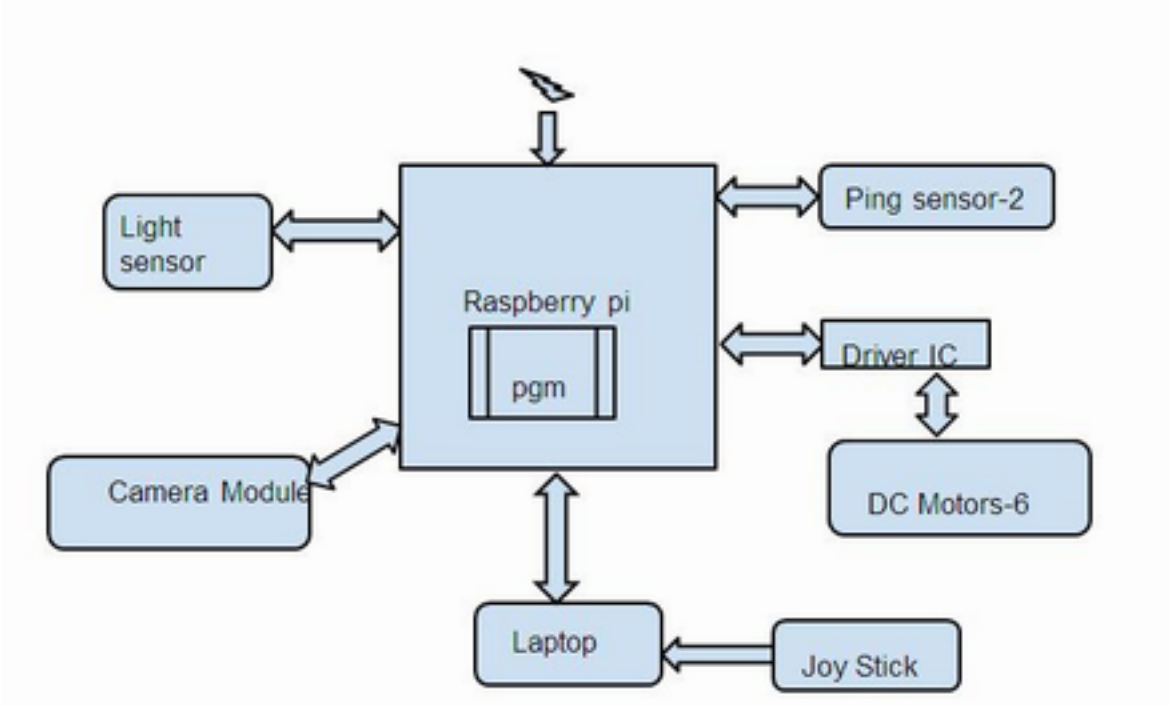

Fig 2.1: Block Diagram

2.2 L293 & L293D MOTOR DRIVER IC

Motor Driver and H bridge basics

Generally , even the simplest robot requires a motor to rotate a wheel or performs a particular action. Since motors require more current then the microcontroller pin can typically generate ,you need some type of a switch(Transistors, MOSFET, Relay etc.,) which can accept a small current, amplify it and generate a larger current, which further drives a motor. This entire process is done by what is known as a motor driver.

Motor driver is basically a current amplifier which takes a low current signal from the microcontroller and gives out a proportionally higher current signal which can control and drive a motor. In most cases, a transistor can act as a switch and perform this task which drives the motor in a single direction.

L293D is a typical motor driver IC which Allows DC motor to drive on either direction.L293D is a 16pin IC which can control a set of two dc motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC. It is a dual H bridge motor driver integrated circuit (IC)It works on the concept of H bridge. H bridge is a circuit which allows the voltage to be flown in either direction. As you know voltage need to change its direction for being able to rotate the motor in clockwise or anticlockwise direction. Hence H bridge IC are ideal for driving a DC motor.

H bridges can be built from scratch using relays, MOSFETs, field effect transistors (FET), bipolar junction transistors (BJT), etc. But if your current requirement is not too high and all you need is a single package which does the job of driving a small DC motor in two directions, then all you need is a L293D IC.

Motor drivers act as current amplifiers since they take a low current control signal and provide a higher current signal.

L293D contains two inbuilt H bridge driver circuits. In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction. The motor operations of two motors can be controlled by input logic at pins 2 & 7 and 10 & 15. Input logic 00 or 11 will stop the corresponding motor. Logic 01 and 10 will rotate it in clockwise and anticlockwise directions, respectively.

Enable pins 1 and 9 (corresponding to the two motors) must be high for motors to start operating. When an enable input is high, the associated driver gets enabled. As a result, the outputs become active and work in phase with their inputs. Similarly, when the enable input is low, that driver is disabled, and their outputs are off and in the high impedance

state. For driving the motor with left H bridge you need to enable pin 1 to high. And for right H Bridge you need to make the pin 9 to high. If anyone of the either pin1 or pin9 goes low then the motor in the corresponding section will suspend working. It's like a switch. L293 has an inbuilt flyback diode which protects the driving transistors from voltage spikes that occur when the motor coil is turned off. Pin out of L293D and motor interfacing circuit are respectively shown below.

Fig 2.2: Connection Diagram

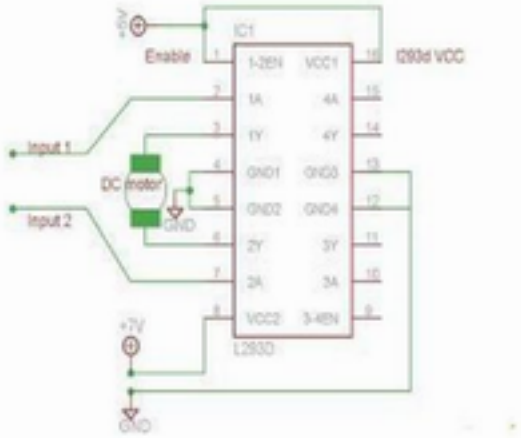

Fig 2.3: Pin out of L293D

L293D IC generally comes as a standard 16pin DIP (dual in line package). This motor driver IC can simultaneously control two small motors in either direction; forward and reverse with just 4 microcontroller pins (if you do not use enable pins). Some of the features (and drawbacks) of this IC are:

1. Output current capability is limited to 600mA per channel with peak output current limited to 1.2A (non repetitive). This means you cannot drive bigger motors with this IC. However, most small motors used in hobby robotics should work. If you are unsure whether the IC can handle a particular motor, connect the IC to its circuit and run the motor with your finger on the IC. If it gets really hot, then beware... Also note the words "non repetitive" ; if the current output repeatedly reaches 1.2A, it might destroy the drive transistors.

2. Supply voltage can be as large as 36 Volts. This means you do not have to worry much about voltage regulation.

3. L293D has an enable facility which helps you enable the IC output pins. If an enable pin is set to logic high, then state of the inputs match the state of the outputs. If you pull this low, then the outputs will be turned off regardless of the input states.

4. The datasheet also mentions an "over temperature protection" built into the IC. This means an internal sensor senses its internal temperature and stops driving the motors if the temperature crosses a set point.

5. Another major feature of **L293D** is its internal clamp diodes. This fly-back diode helps protect the driver IC from voltage spikes that occur when the motor coil is turned on and off (mostly when turned off).

6. The logical low in the IC is set to 1.5V. This means the pin is set high only if the voltage

across the pin crosses 1.5V which makes it suitable for use in high frequency applications like switching applications (upto 5KHz).

7. Lastly, this integrated circuit not only drives DC motors, but can also be used to drive relay solenoids, stepper motors etc.

L293D Connections

The circuit shown to the right is the most basic implementation of L293D IC. There are 16 pins sticking out of this IC and we have to understand the functionality of each pin before implementing this in a circuit.

Pin1 and Pin9 are "Enable" pins. They should be connected to +5V for the drivers to function. If they pulled low (GND), then the outputs will be turned off regardless of the input states, stopping the motors. If you have two spare pins in your microcontroller, connect these pins to the microcontroller, or just connect them to regulated positive 5 Volts.

1. Pin4, Pin5, Pin12 and Pin13 are ground pins which should ideally be connected to microcontroller's ground.

2. Pin2, Pin7, Pin10 and Pin15 are logic input pins. These are control pins which should be connected to microcontroller pins. Pin2 and Pin7 control the first motor (left); Pin10 and n15 control the second motor(right).

3. Pin3, Pin6, Pin11, and Pin14 are output pins. Tie Pin3 and Pin6 to the first motor, Pin11

and Pin14 to second motor .

4. Pin16 powers the IC and it should be connected to regulated +5Volts

5. Pin8 powers the two motors and should be connected to positive lead of a secondary battery. As per the datasheet, supply voltage can be as high as 36 Volts.

Here is the truth table representing the functionality of this motor driver.

Table 2.1: Truth Table for L293D

	Pin 2	Pin 7	Function
High	High	Low	Turn Anti-clockwise (Reverse)
High	Low	High	Turn clockwise (Forward)
High	High	High	Stop
High	Low	Low	Stop
Low	X	X	Stop

2.3 ULTRA SONIC SENSOR

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

This technology can be used for measuring wind speed and direction (anemometer), tank or channel level, and speed through air or water. For measuring speed or direction a device uses multiple detectors and calculates the speed from the relative distances to particulates in the air or water. To measure tank or channel level, the sensor measures the distance

to the surface of the fluid. Further applications include: humidifiers, sonar, medical ultrasonography, burglar alarms and nondestructive testing.

Ultrasonic ranging module HC SR04 provides 2cm 400cm noncontact 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 whether 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.

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

Wire connecting direct as following:

5V Supply

Trigger Pulse Input

Echo Pulse Output 0V

Ground

Table 2.2: Electric Parameters

Working Voltage	**DC 5 V**
Working Current	**15mA**
Working Frequency	**40Hz**
Max Range	**4m**
Min Range	**2cm**
MeasuringAngle	**15 degree**
Trigger Input Signal	**10uS TTL pulse**
Echo Output Signal	**Input TTL lever signal and the range in proportion**
Dimension	**45*20*15mm**

Ultrasonic sensor provides an easy method of distance measurement. This sensor is perfect for any number of applications that require you to perform measurements between moving or stationary objects. Interfacing to a micro controller is a snap.

A single I/O pin is used to trigger an ultrasonic burst (well above human hearing) and then "listen" for the echo return pulse. The sensor measures the time required for the echo return, and returns this value to the micro controller as a variable width pulse via the same I/O pin.

Timing Diagram

The Timing diagram is shown below. You only need to supply a short 10μS pulse to the trigger input to start the ranging, and then the module will send out an 8 cycle burst of ultrasound at 40 kHz and raise its echo. The Echo is a distance object that is pulse width and the range in proportion .You can calculate the range through the time interval between sending trigger signal and receiving echo signal.

Formula:

μS / 58 = cms or μS / 148 =inch;

or: the range = high level time * velocity(340m/S) / 2

We suggest to use over 60ms measurement cycle, in order to prevent trigger signal to the echo signal.

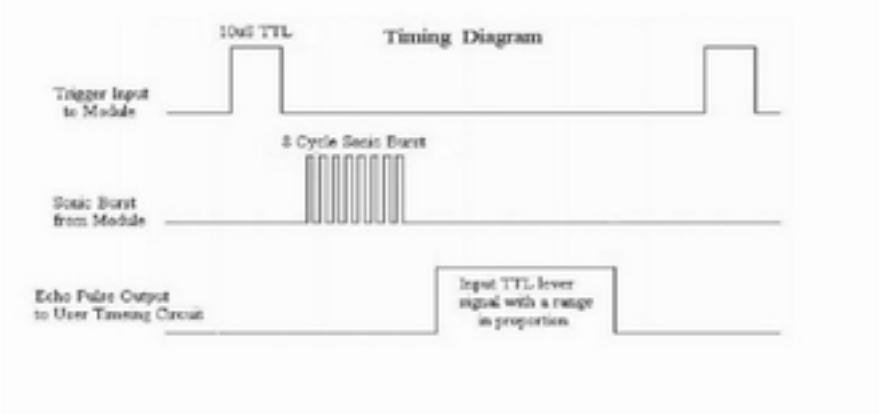

Fig 2.4: Timing Diagram for Ultrasonic Sensor

Key Features:

● Provides precise, noncontact distance measurements within a 2 cm to 3 m range.

● Ultrasonic measurements work in any lighting condition, making this a good choice to supplement infrared object detectors.

● Simple pulse in/pulse out communication requires just one I/O pin.

● 3pin header makes it easy to connect to a development board, directly or with an extension cable, no soldering required.

Application Ideas:

● Security systems

● Parking assistant systems

● Robotic navigation

2.4 LIGHT SENSOR CIRCUIT

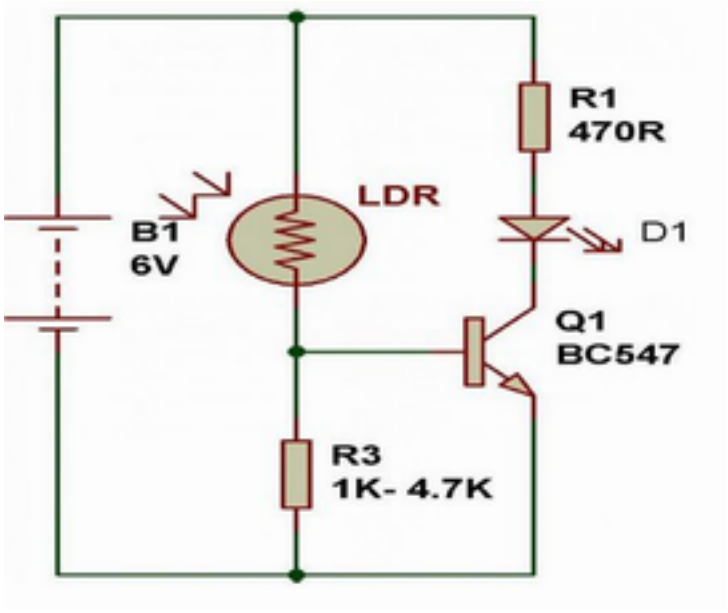

Fig 2.5: Circuit Diagram

The LDR used in the circuit is NSL19M51. It has a resistance of 20k in the presence of light and 20M otherwise. The transistor used is BC547 ,which is a high gain transistor ,has a gain of maximum upto 800.It is used for switching and amplification purposes.

Circuit working:

The light dependent resistor has high resistance in the absence of light. When light falls, resistance of LDR decreases, LDR conducts. The transistor also starts conducting turning on the LED. In the absence of light, LDR resistance increases, turning off the transistor and the LED.

Circuit design equations:

$V_{out}=V_{in}$ X $R_3/(R_{ldr} + R_3)$ .....(1)

V_{out}=0.7V (to turn BC 547 ON) .....(2)

=>R_3=3.7k from (1) and (2)

Use 1k-4.7k pot

$R_1=(V_{cc}-V_{led})/I_{led}$ (V_{cc}=6V,V_{led}=0.7V,I_{led}=10mA)

=>R_1=530 ohm

Use R_1=470 or 680 ohms

2.5 LIGHT DEPENDENT RESISTOR

A photo resistor or light dependent resistor (LDR) is a resistor whose resistance decreases with increasing incident light intensity; in other words, it exhibits photoconductivity.

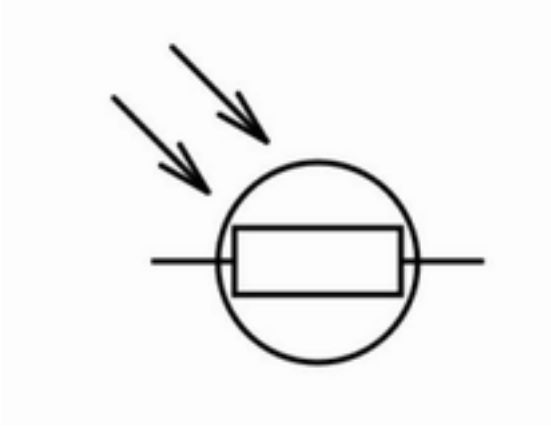

Fig 2.6: Symbol for a Photo resistor

A photo resistor is made of a high resistance semiconductor. If light falling on the device is of high enough frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electron (and its whole partner) conduct electricity, thereby lowering resistance.

A photoelectric device can be either intrinsic or extrinsic. An intrinsic semiconductor has its own charge carriers and is not an efficient semiconductor, for example, silicon. In intrinsic devices the only available electrons are in the valence band, and hence the photon must have enough energy to excite the electron across the entire band gap. Extrinsic devices have impurities, also called dopants, and added whose ground state energy is closer to the conduction band; since the electrons do not have as far to jump, lower energy photons (that is, longer wavelengths and lower frequencies) are sufficient to trigger the device. If a sample of silicon has some of its atoms replaced by phosphorus atoms (impurities), there will be extra electrons available for conduction. This is an example of an extrinsic semiconductor. Photo resistors are basically photocells. LDRs or Light Dependent Resistors are very useful especially in light/dark sensor circuits. Normally the resistance of an LDR is very high, sometimes as high as 1000 000 ohms, but when they are illuminated with light resistance drops dramatically. Two cadmium sulphide (CdS) photoconductive cells with spectral responses similar to that of the human eye. The cell resistance falls with increasing light intensity. Applications include smoke detection, automatic lighting control, batch counting and burglar alarm systems.Photo resistors come in many types. Inexpensive cadmium sulphide cells can be found in many consumer items such as camera light meters, street lights, clock radios, alarm devices, outdoor clocks, solar street lamps and solar road studs, etc.

They are also used in some dynamic compressors together with a small incandescent lamp or light emitting diode to control gain reduction and are also used in bed lamps, etc.

Lead sulphide (PbS) and indium antimonide (InSb) LDRs (light dependent resistor) are used for the mid infrared spectral region. Ge:Cu photoconductors are among the best far infrared detectors available, and are used for infrared astronomy and infrared spectroscopy.

2.5.1 Analog Applications

● Camera Exposure Control

- Auto Slide Focus dual cell
- Photocopy Machines density of toner
- Colorimetric Test Equipment
- Densitometer
- Electronic Scales dual cell
- Automatic Gain Control – modulated light source
- Automated Rear View Mirror

2.5.2 Digital Applications

- Automatic Headlight Dimmer
- Night Light Control
- Oil Burner Flame Out
- Street Light Control
- Absence / Presence (beam breaker)

2.5.3 Sensitivity

The sensitivity of a photo detector is the relationship between the light falling on the device and the resulting output signal. In the case of a photocell, one is dealing with the relationship between the incident light and the corresponding resistance of the cell.

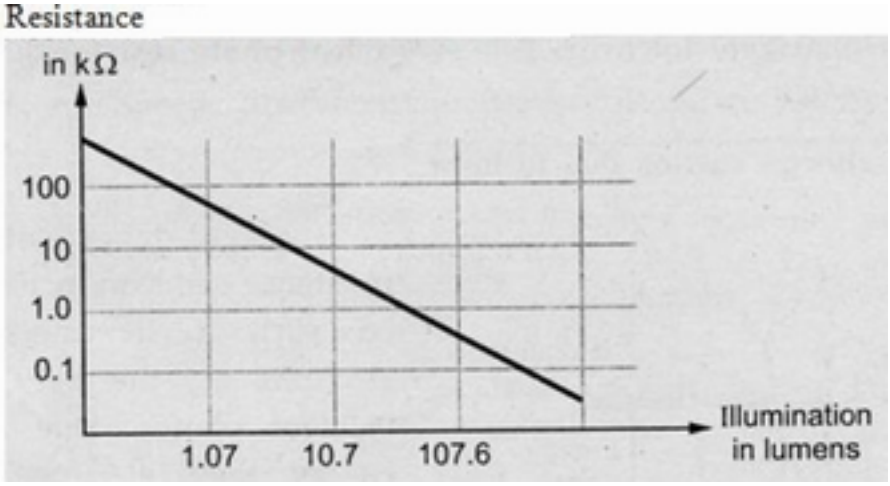

Fig 2.7: Resistance as a function of Illumination

2.5.4 Spectral Response

Like the human eye, the relative sensitivity of a photoconductive cell is dependent on the wavelength (color) of the incident light. Each photoconductor material type has its own unique spectral response curve or plot of the relative response of the photocell versus wavelength of light.

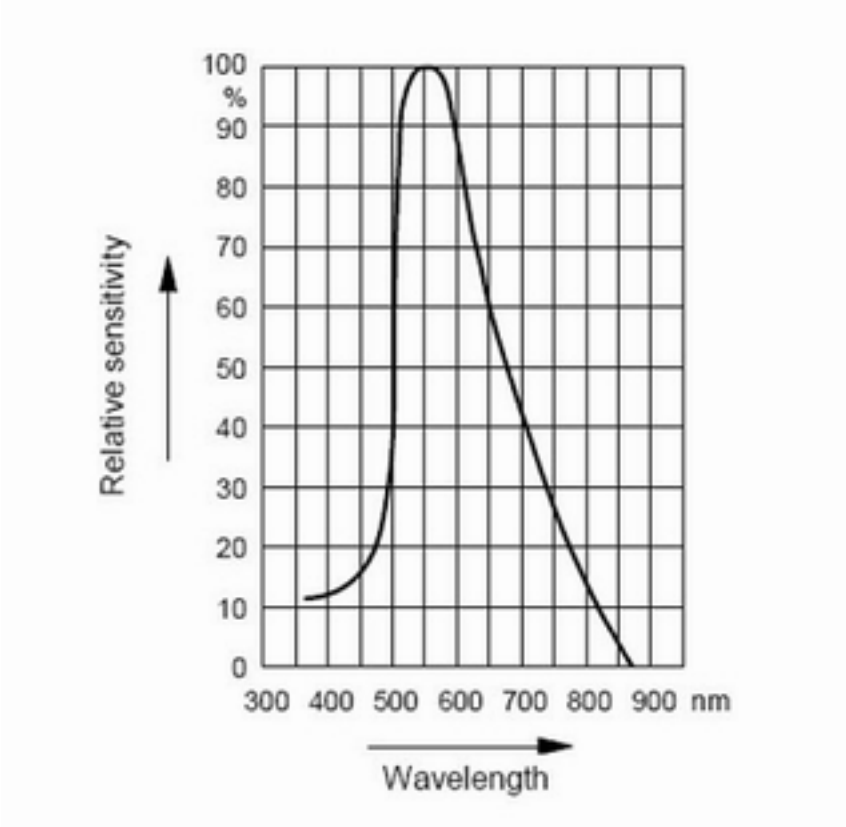

Fig 2.8: Spectral Response

Chapter 3 :RASPBERRY PI

The Raspberry Pi is a credit card sized single board computer developed in the UK by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer. Model A has one USB port and no Ethernet controller, and costs less than the Model B with two USB ports and a 10/100 Ethernet controller.

Though the Model A does not have an Ethernet port, it can connect to a network by using an external user supplied USB Ethernet or WiFi adapter. On the model B the Ethernet port is provided by a buil-tin USB Ethernet adapter. Raspberry pi is powered by 5v micro USB.

Typically, the model B uses between 7001000mA depending on what peripherals are connected, and the model A can use as little as 500mA with no peripherals attached. The maximum power the Raspberry Pi can use is 1 Amp. If you need to connect a USB device that will take the power requirements of the Raspberry Pi above 1 Amp then you must connect it to an externally powered USB .

Table 3.1: Features of Raspberry Pi

Components	Raspberry Pi Ver B
Processor	700 Mhz,Single Core Arm 11
RAM	512 MB
Graphics	Dual core video core IV
Ethernet	Yes
USB 2.0	Yes
Video O/P	Composite RCA HDMI
Audio O/P	Yes
Storage	32 GB SD Card
Operating System	Only Linux
Dimensions	8.6x5.4x1.7 cm

3.1 Raspbian OS

Raspbian is the recommended operating system for normal use on a Raspberry Pi. Raspbian is a free operating system based on Debian, optimised for the Raspberry Pi hardware.

Raspbian comes with over 35,000 packages; precompiled software bundled in a nice format for easy installation on your Raspberry Pi.

Raspbian is a community project under active development, with an emphasis on improving the stability and performance of as many Debian packages as possible.

3.2 GPIO

GPIO is short for "General Purpose Input/Output". Your keyboard, mouse and monitor are examples of input and output devices on a computer, but they are for specialized and well-defined tasks. The "General" part of GPIO indicates that you can design your own device

and connect it up to the Raspberry Pi.

This section explains the technicalities of how inputs and outputs are connected and processed by computers. Following that, there is a technical reference of the GPIO capabilities of a Raspberry Pi. I'll finish off with some simple electronic circuits and software that you can build and use on your Raspberry Pi.

There are several types of interface pins on the Raspberry Pi. They can be configured and used for lots of applications. Note that because the pins on the Raspberry Pi board are connected straight into the system on a chip (SOC), it is quite easy to damage your Raspberry Pi or SD card if you are not careful. Make sure you only use 3.3V on the pins, not 5V. For this reason, it is recommended that you use an interface board, such as the Gertboard, between the Raspberry Pi and any circuits you build.

Fig 3.1: Raspberry Pi General Purpose I/O Pins

The maximum permitted current draw from the 3.3V pin is 50mA. The maximum current draw on the 5V pin depends on your power supply – you must leave enough for the Raspberry Pi to run! Pins not listed in the table above are described by type in the sections below. Note that some pins can be configured for more than one type of interface.

3.3 Raspi Cam

Fig 3.2: Raspi Cam

There are three applications provided: raspistill, raspivid and raspistillyuv. Both raspistill and raspistillyuv are very similar and are intended for capturing images, while raspivid is for capturing video. All the applications are command line driven, written to take advantage of the mmal API which runs over OpenMAX. The mmal API provides an easier to use system than that presented by OpenMAX. Note that mmal is a Broadcom specific API used only on Videocore 4 systems.

The applications use up to four OpenMAX(mmal) components camera, preview, encoder and null_sink. All applications use the camera component: raspistill uses the Image Encode component, raspivid uses the Video Encode component, and raspistillyuv does not use an encoder, and sends its YUV or RGB output direct from camera component to file. The review display is optional, but can be used full screen or directed to a specific rectangular area on the display. If preview is disabled, the null_sink component is used to 'absorb' the preview frames. It is necessary for the camera to produce preview frames even if not required for display, as they are used for calculating exposure and white balance settings. In addition it is possible to omit the filename option, in which case the preview is displayed but no file is written, or to redirect all output to stdout. Command line help is available by typing just the application name in on the command line.

CHAPTER 4 :FLOWCHART

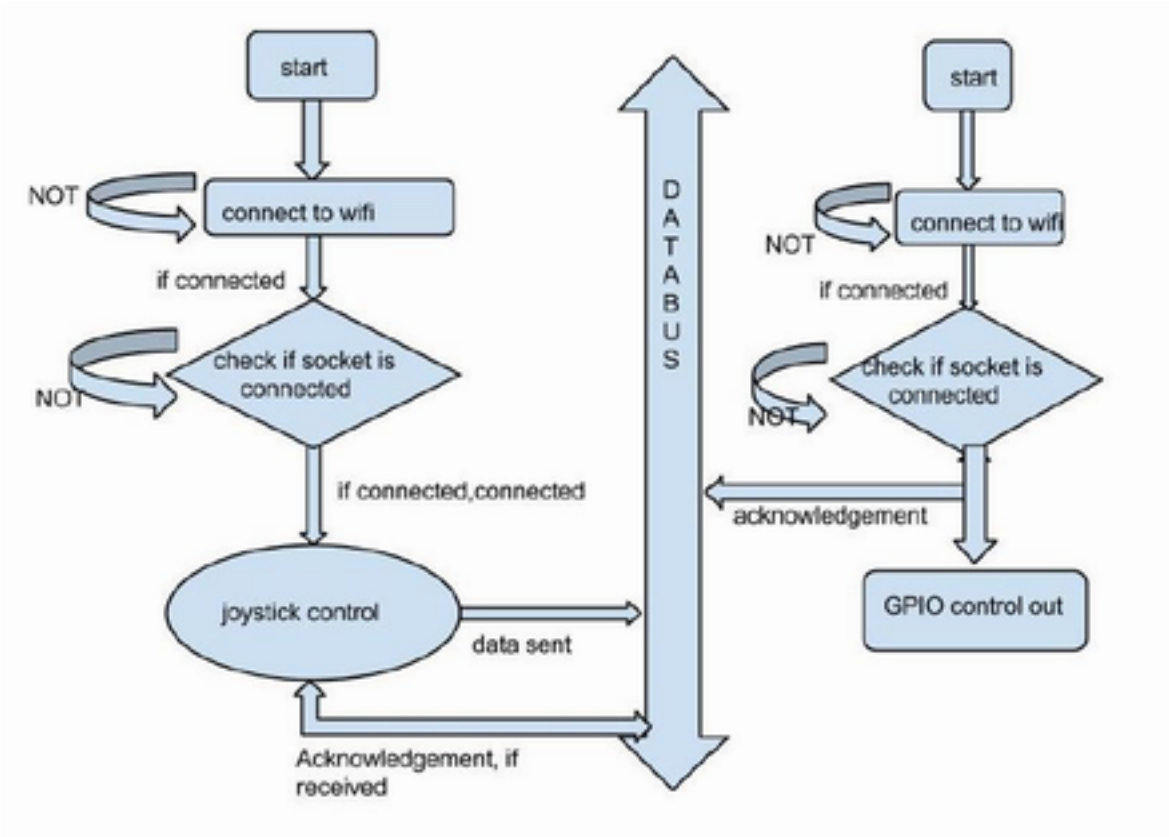

Fig 4.1: Flowchart

As we start the program it is programmed to connect to a wifi network, which we have named as "BSNL_AP" along with a password. On connection with the wireless network, the main program tries to make a socket in order to transfer files. If the socket is not connected, it tries itself to connect as a loop till it get a socket assigned. Using the joystick, we have got different buttons, which we have assigned certain tags for identification. On a button press, corresponding value will be generated and transferred to the raspberry pi. The program in the raspberry pi analysis the received data and find the respective assignment for the General Purpose Input Output Pins. The Raspberry pi then sends back the acknowledgment to the main program

CHAPTER 5 :PCB DESIGN & FABRICATION

The printed circuit boards usually termed as PCB are used to avoid most or all the disadvantages of conventional breadboard. These are smaller in size, more efficient in performance. The only disadvantage is that once the board is prepared, no changes are possible. It gives all the information on the board. The fabrication of PCB involves the following steps:

1. Preparation of Layout

2.Transferring Layout to Copper Clad

3.Etching the Board

4.Tinning

5.Drilling

6.Component Placing

7. Soldering

This board includes the microcontroller and its related components and almost all mode selection switches, LEDs, power supply, port connection etc... The extra connections are done using wires thus closing the circuit.

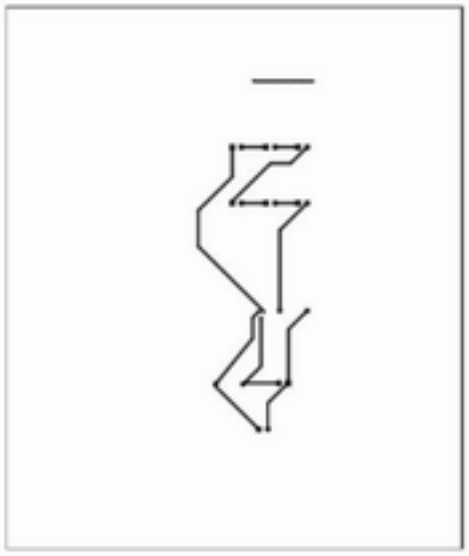

Fig 5.1: PCB Layout

CHAPTER 6 :CHALLENGES FACED

6.1 Coding difficulties

We have met some difficulties while programming in python in raspberry pi. The difficulties were setting the data transfer with socket programming and GPIO controls.

6.2 PCB Design difficulties

Arranging the components such that, it utilizes less space on the board was one of the difficulties. Then making the Layout of the PCB was a difficult one.

6.3 Soldering difficulties

Component soldering was a difficult process, because while soldering the IC's, it should be very quickly, otherwise the IC will burn out. Another problem is that too much time contact of the soldering iron on the PCB will cause to burn the small printed lines. This will yield never ending connections. Therefore soldering should be done very carefully.

CHAPTER 7 :APPLICATION

- Perform dismounted operations like surveillance / reconnaissance
- Dexterous manipulation of objects
- Easily climbs stairs and overcomes obstacles
- Rugged design operates in all weather conditions
- Lightweight and compact
- Game style hand controller reduces training time
- Keep personnel and civilians at safe standoff distances
- Camera enables day and night surveillance

CHAPTER 8 :CONCLUSION & FUTURE SCOPE

We were able to successfully complete our project and we were able to implement the following as per our aim:

- movement of robot with joystick (including climbing)
- distance measurement using ping sensor
- surveillance using camera

Also we were able to implement arm with which we can pick objects .At a broad level this can be used for bomb disposal. From doing this project we were able to familiarize with raspberry pi and python programming

REFERENCES

[1] 310 ,*iRobot SUGV,* www.irobot.com/~/media/Files/Robots/Defense/SUGV/

[2] Light sensor circuit,

http://www.buildcircuit.com/ldrengineer/#sthash.A23tlVLx.dpuf

[3] raspberrypi,*CAS,*http://pi.cs.man.ac.uk/download/Raspberry_Pi_Education_Manual.pdf

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