Multi-Task Surveillance Robot Using IOT

Submitted in partial fulfillment of the requirements
of the degree of

Bachelor of Engineering

in

Electronics and Telecommunication

by

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2018-19

CERTIFICATE

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This is to certify that the project entitled **Multi-Task Surveillance Robot Using IOT** is a bonafide work of **Khan Aamir (15ET25), Khan Abu Sufiyan (15ET26), Shaikh Mohd Musab (15ET43), Itemad hyder (15ET22)** submitted to the University of Mumbai in partial fulfillment of the requirement for the award of the degree of Bachelor of Engineering in Department of Electronics and Telecommunication Engineering.

Supervisor	Examiner
Head of Department	Director

Project Report Approval for Bachelor of Engineering

This project entitled "**Multi-Task Surveillance Robot Using IOT**" by **Khan Aamir, Khan Abu Sufiyan, Shaikh Mohd Musab, Itemad hyder**is approved for the degree of **Bachelor of Engineering in Electronics and Telecommunication** .

Examiner

.....

Supervisor

.....

Declaration

I declare that this written submission represents my ideas in my own words and where others ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Acknowledgement

We have taken efforts in this project. However, it would not have been possible without the kind support and help of many individuals . I would like to extend my sincere thanks to all of them.

We are highly indebted to (Dr. Mujib Abbas Tamboli) for their guidance and constant supervision as well as for providing necessary information regarding the project & also for their support in completing the project.

We would like to express my gratitude towards my parents& Staff of Anjuman-I-Islam's Kalsekar Technical Campus for their kind co-operation and encouragement which help me in completion of this project.

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We My thanks and appreciations also go to my colleague in developing the project and people who have willingly helped me out with their abilities.

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Abstract

Raspberry pi controlled multi-environment robot with live streaming and temperature monitoring. The project aims at monitoring environmental conditions with live streaming and to measure surrounding temperature. The system consist of a small robot, free to move itself in a place is a able to measure surrounding environment quality. It can track temperature in the way to help measuring correct working temperature for machines as well as human beings E.g. In Industries. Also the environment can be visualized through the camera present on the robot. This robot could be used for in commercial spaces, schoolsandhospitals,warehousesandotherchallengingindoorandoutdoorenvironments for live streaming. It will allow people to find the best place for them, for their health and it will imply more places responsible to improve the environment quality outdoor as well as indoor. The project makes use of Raspberry Pi 3 Model B as the main MCU whichisinterfacedwithUSBCamerawhichhelpsinlivestreamingandDHT11temperature sensor module which helps in measuring the surrounding temperature. The Camera captures video and DHT11 sensor helps in monitoring the temperature of theenvironment andthedataisdisplayedontheserverthroughweb.

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Chapter 1

Introduction

1.1 Introduction

The IoT platform is a suite of components that enable: Deployment of applications that monitor, manage, and control connected devices. Remote data collection from connected devices. Independent and secure connectivity between devices. Device/sensor management. Internet of Things (IoT) makes our world as possible as connected together. Nowadays we almost have internet infrastructure wherever and we can use it whenever. Embedded computing devices would be exposed to internet influence. Common instances for embedded computing devices are MP3 players, MRI, traffic lights, microwave ovens, washing machines and dishwashers, GPS even heart monitoring implants or biochip and etc. IoT tries to establish advanced connectivity (with the aid of internet) among these mentioned device or systems or services in order to little by little make automation in all areas. Image that all thing are connected to gather and all information would be interacted to each other over standard and different protocol domain and applications. From baby monitors to automatic climate control, IoT technologies promise a wide array of safety and efficiency benefits for consumers and businesses alike. While consumer-facing devices such as exercise trackers, health monitors, and home safety systems have drawn much of the media attention, Ligado Networks suggested that the most significant value fortheU.S.economyislikelytoresultfromenterpriseIoTapplications,particularlythose that focus on industries such as manufacturing, agriculture, and infrastructure. Broken down by industry, the manufacturing sector appears to have the most to gain from the adoption of IoT, with connected factories increasing productivity, optimizing inventory planning,reducingwaste,andsavingonenergycostsandequipmentmaintenance.In-

dustry is already exploring how connected devices can improve the safety and reliability ofcomplexprocesses,andcanachievegreaterenergyandoperationalefficiencies.30Connected devices are becoming a key tool for providing improved information about supply chains, distribution centers, land, and seaports; for tracking environmental and causal factors; and for helping to secure indoor and outdoor facilities. IoT technology can also helpcompaniesreimaginetheirsupplychains,identifyinginefficienciesorshippingdelays, or confirming product integrity from manufacturing plant to a retail store. These devices arealsoprevalentinprocess-driventasksinwhichinstantaneousfeedbackandcontrolare essential, such as in the energy sector. Businesses can use this improved data to eliminate inefficiencies in industries such as manufacturing, health care, transportation, energy, and retail.

Advancement of IoT and impact on the future of Healthcare and Wellness

By embedding IoT-enabled devices in medical equipment, healthcare professionals willbeabletomonitorpatientsmoreeffectivelyandusethedatagleanedfromthedevices to figure out who needs the most hands-on attention. In other words, by making the most of this network of devices, healthcare professionals could use data to create a system of proactive management as they say, prevention is better than thecure.

- Advancement in defense The upcoming world will constitute of the Internet of Things. The capabilities of the devices that are used in defense can be effective in the detection of mines in coastal regions, it can be used to localize modern diesel electric submarines operating littoral waters, identification and localization of mortars, artillery and small fire arms, the effective measurement of trace concentrations ofexplosives,toxicchemicals,andbiologicalagents,thetrackingofsoldiers,thedetection of snipers, and the management of parametric surveillance in sensitiveareas. The IoT concepts have also been theoretically implemented. These can capture informationfrompeople,equipment,andmaterialsinmilitaryenvironmentsbymeans of sensing devices (i.e., the sensing layer) and shares collected data among military objects, monitoring systems and control centers, through a communication infrastructure. The data from the sensing layer canbe exploited for use in controlling and implementing intelligent militaryapplications.

1.2 Motivation

Currently, the IoT applications in many aspects of our daily life are prosperous, and there is also a growing trend in the applications of health care which can gather and upload biometrics data to cloud. According to Gartner report, by 2020 connected devices across all technologies will reach to 20.6 billion

YEAR	NUMBER OF CONNECTED DEVICES
1990	0.3 million
1999	90.0 million
2010	5.0 billion
2013	9.0 billion
2025	1.0 trillion

Figure 1.1:Staticts

The above chart displays the increase in the number of connected devices till 2025 The increasing demands in the IoT technology and future trends it has motivated ustocontributetowardsregulatingandmonitoringenvironmentthroughIoT

Chapter 2

LiteratureSurvey

- **ASurveyonEffectivein-HomeHealthMonitoringSystem:**Inrecentyears, waiting time in hospitals, emergency admissions, etc., are extremely costlier. It also increases the workload of doctors and medical professionals. Managing the cost, quality of treatment and caring for seniors are important issues in healthcare. These issues have a demand for in-home patient monitoring. Here the human body parameters are fetched by different ways through biosensors, wearable medical devices, and smart textiles. Then the collected details are forwarded to the remote server through the internet. Wearability, security, accuracy, outdoor monitoring and ease of use are some of the aspects in in-home patient monitoring system. This paper reviews the current research and development on in-home patient monitoring. A variety of system implementations were compared and evaluated to identify the technical shortcomings in the present health monitoring systems. The aim of this surveyistoprovidethedirectionforfutureresearchimprovements.

  Review The above system helps in monitoring the health of the patient remotely via attached bio sensors and wearables. This paper contributes towards the field of medical science, thereby saving time. The drawback of this paper could be the cost requirement. The cost requirement of the above mentioned system would be very high thereby monitoring every patient remotely could prove costlier.

- **A Survey on Smart Surveillance System:** This paper deals with thesurvey of Smart surveillance monitoring system using Raspberry pi. Video Surveillance is importantasfarassecurityisconcernedthesedays.Commercialspaces,schools

and hospitals, warehouses and other challenging indoor and outdoor environments require high end cameras. The current technologies require RFIDs which are costly and hence the security domain in all becomes expensive and hence there was a need to work on this. This paper describes the use of low cost single on board computer Raspberry Pi. This new technology is less expensive and in this project it is used as a standalone platform for image processing. It increases the usage of mobile technology to provide essential security to our homes and for other control applications. The proposed home security system captures information and transmits it via a 3G Dongle to a Smart Phone using web application.

ReviewTheabovesystemhelpsinmonitoringcommercialspaces,schoolsandhospitals, warehouses and other challenging indoor and outdoor environments which contributes towards security. This paper helps in creating low cost monitoring system hence proving more efficient. Further implementation can be done by attaching sensors to Raspberry Pi which will help in monitoring other aspects of the environment.

- **A Survey on Industrial Temperature Monitoring System Design:** Inthe industrial field, long running of the equipment easily leads local temperature of the equipment to rise. This is a security risk. For this problem, they have designed a set of remote wireless temperature monitoring system. Based on ZigBee technology, theyhave a remote wireless networking temperature monitoring of a lot of equipment scattered in various locations of factories and enterprises. The sys- tem uses infrared temperature sensor TS118-3 gathering temperature information. After a signal conditioning circuit, they use a wireless RF single-chip CC2530wire- lessly transmitting the temperature of the measured target to the receiving node. The receiving node uploads the data to a computer by RS232.PC software displays real-time temperatureinformation.

  Review The above system helps in monitoring real time temperature in industries which helps in long running of the equipment and also contributes towards the health of the workers in industries. Further implementation can be done by adding video monitoring system along with temperature sensing. Based on the reviews of above research ideas we have come up with an IoT based project which will carry

out live streaming as well as temperature monitoring. The Raspi Camera captures video and DHT11 sensor helps in monitoring the temperature of the environment and the data is displayed on the server through web.

2.1 Existing DesignMethod

- Wireless Controlled Surveillance robot: This idea presents a wireless controlled robot system for surveillance purpose. It works towards the use of Android smartphones, new innovations and ideas that can be generated enhancing its capabilities. The robot makes use of Android smartphone which will capture the scenario and transfer images on theserver.
- Raspberry pi Based Smart Supervisor using Internet of Things (IoT): This idea presents a real time digital video monitoring system. The image is captured through USB camera and the data is sent through internet to display H.264 video data in realtime.ItmakesuseofBCM2835asthemainMCU.
- Application of Raspberry Pi and PIR Sensor for Monitoring of Smart Surveillance System: This idea represents the design and implementation of smart surveillance monitoring system using Raspberry pi and PIR sensor for mobile devices. It increases the usage of mobile technology to provide essential security to homes and other control applications. The proposed house security system captures information and transmits it through a 3G modem to a smart phone using web application. Raspberry pi operates and controls motion detectors; video camera for remote sensing, surveillance, streams live video and records it for future playback. Infrared sensor detects the locatedpersons.

2.2 ProblemStatement

Regulating and monitoring environment for scientific research needs to be done which will help to create a baseline for the impacts of pollutants in the air, land and water. Poor surrounding environmental quality has a direct effect on health issue.

2.3 ProjectOverview

The Project aims at monitoring environmental conditions with live streaming and to measure surrounding temperature. Environment monitoring or management helps in assessing workplace conditions to evaluate health risks to workers in industries which makes use of hazardous substance such as heavy metals. The chemical, metalworking and pharmaceutical industries can generate a great amount of hazardous waste. Environmental monitoring help to prevent the disposal of untreated residues in the soil, air or water, avoiding wildlife and human contamination. The use of biodegradablecompoundsisalsopartofanefficientenvironmentalmonitoringstrat- egy and can reduce the contaminants in industrial waste waters. The need for monitoring is fulfilled via Pi camera and the temperature is measured through DHT11 temperature sensor contributing to the above mentioned solutions and further applications. The movement of robot is controlled via two DC gear motor and camera angleissetupwithservomotorsthroughserver.

Chapter 3

Hardware Design

3.1 Practical Function of theDesign

- **Movement:**Thesubjectiverobotisabasic3wheeledrobotconsistingof2wheels at back and a front castor wheel for support. Two DC motors are used to drive the robot. The angular velocities are identical in terms of both values and direction i.e. both the wheels are driven at same speed and same direction. The complete turn capability is one of the greatest advantages of the subjective robot. If one of the wheels rotate and other stays still then the robot is able to make a 90 deg turn, thereby robot is likely to follow a left or right path. The movement of robot is carried out by 2 standard robot wheels used at back which can run front and back. The angle between the robot frame and the wheel is constant while the center of the wheel is fixed to the robot frame. Dimension of the wheels: Radius 3.5cm.
- **Manipulation:** The control of the subjective robot is assigned to the server. Proper handling of the robot is done through the physical buttons provided on the web page. Manipulation of other objects in the environment can be done through the Pi-Camera connectedon-board.

- **Energy:** The subjective robot is powered by a DC battery which acts as the main energy source. Two DC batteries are used out of which one is used to drive the motorsandotherprovidingpowersupplytothemainSoC.
- **Intelligence:**Theconceptofrobotsfreelymovingaroundinthesameenvironment as humans is only now beginning to happen, the subjective robot is able to make the decisions about moving safely in the environment. The Pi-Camera acts as vision fortherobot,therebyhelpingtheuserinselectingasafepath.
- **Sensing:** The subjective robot is able to figure out the environmental quality with the help of attached sensors. The temperature sensor, noise sensor and light sensor helps the user to decide the surrounding environment quality which helps in classifyingtheplacepleasantornastyforhumansorotherlivingorganisms.

3.2 Basics tools for constructing arobot

Construction tools are the things you use to fashion the frame and other mechanical parts of the robot. These include such mundane things as a screwdriver, a saw, and adrill

- MeasureTape
- ScrewDrivers
- Hammer
- Hacksaw
- ElectricDril
- DrillBits
- Screw andNuts
- Marker

3.3 Making theBase

The robot chassis base is constructed of thick acrylic plastic material. There are twolayers viz. Top and Lower measuring 5*7overall.

Cutting the Frame:

- Usehacksawtocuttheacrylicsheetinarectangleshape,measuring5*7.
- Modifytheframeasperthecuttingguideshowninthebelowfigure.

Precautions:

- Makesurethatsawbladesandaresharpforsmoothcuttingoftheframe.
- Wear eye protection when using hacksaw to prevent stray debris from striking our eyes.
- Wear appropriate hand protection to avoid cutting.
- Useappropriateclampstoholdtheframewhilecutting.
- Dont apply to much weight to avoid cracking of the frame. Frame allows us to make larger but lighter robots. The frame provides the overall skeletal structure of the bot, and over the frame we can place light materials to support the components of our machine. We have stack of 2 multiple frames on top of one another, with the equivalent of pillars betweenthem.

3.4 Drilling Holes inFrame:

Most of the robots will need some holes drilled into them so we can mount things like battery holders, motors, and SoC etc. Regardless of the material (wood, plastic, metal), the basic concepts of drilling are the same: put a bit into the drill (hand or power), mark the hole, and drill there.

Good drilling involves following some simple procedures, covered below:

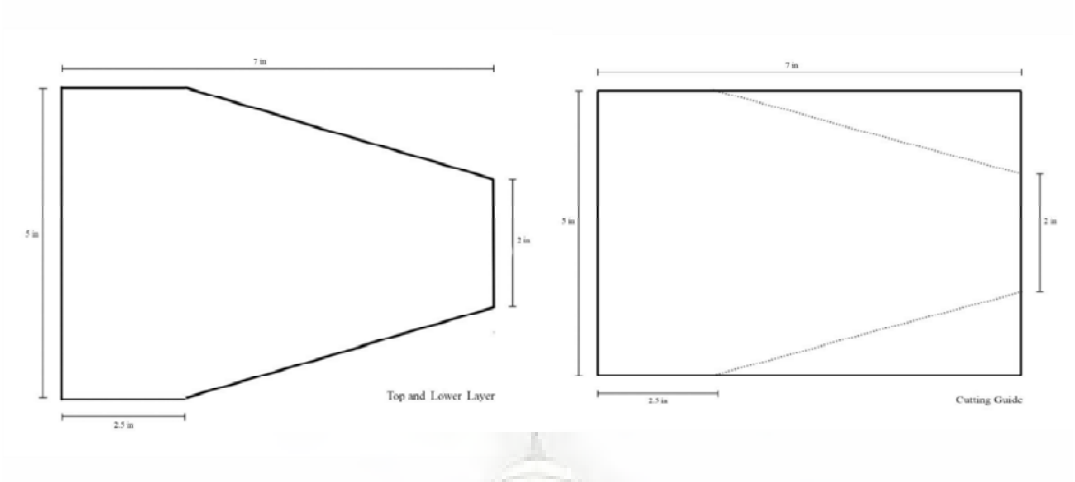


Figure 3.1: Cutting Guidelines of theFrame

Proper use of drill chuck:

The chuck is the mechanical jaws that hold the bit in the drill motor. While some electric drills use an automatic chuck system, most chucks are operated using a chuck key: insert the key into one of the holes in the side of the chuck, and loosen ortightenthejaws.Keepthefollowinginmindwhenusingthedrillchuck:

- Insert only the smooth shank of the bit into the chuck and none of the flutes. Otherwise, the bit might bedamaged.
- Be sure the bit is centered in the jaws of the chuck before tightening. If the bit is evenslightlyoff-center,theholewillcomeouttoolargeanddistorted.
- Dontovertightenthechuck.Tootightmakesithardertoloosenwhenyouwantto remove thebit.
- Tighten the chuck using at least two key holes. This evens out the torque applied to the chuck and makes it easier to loosen the chuck when weredone.

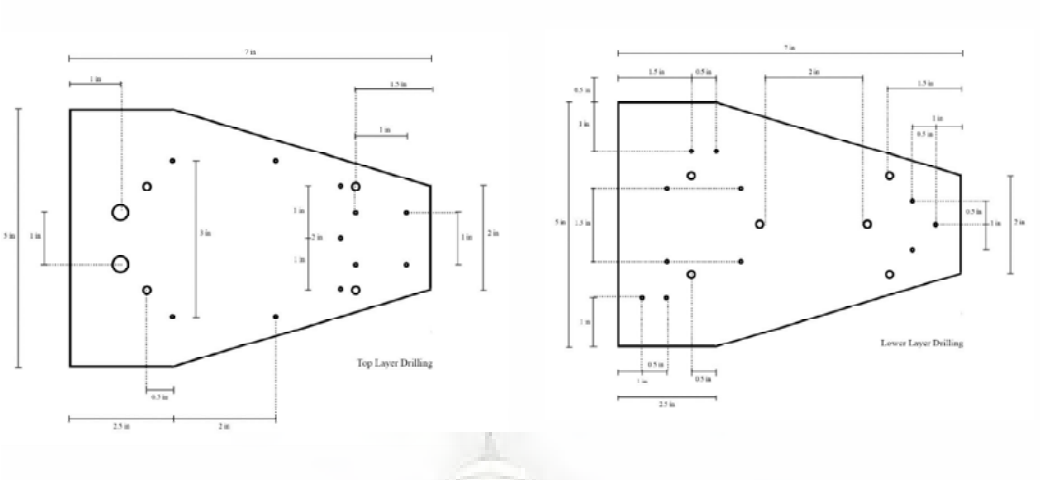


Figure 3.2: Drilling holes for component mounting, passing wires etc. for top and lower layer of the frame.

3.5 AligningHoles:

Drilling with any handheld tool will naturally produce a certain amount of error. Even the most skilled worker cannot always drill a hole that is at exact right angles to the surface of the material. When precisely aligned holes are a must, use a drill press or drill- alignment jig. The drill press is the much better tool for ensuring alignment.

Precautions:

- Make sure the drill chuck is fittedproperly.
- Handle drill machine at properangle.
- Insertthedrillbitproperlyatalignedholestoavoidslipofdrillbit.
- Apply required pressure whiledrilling.
- Useextramaterialunderthetheframetocontrolthedepthofdrilling.

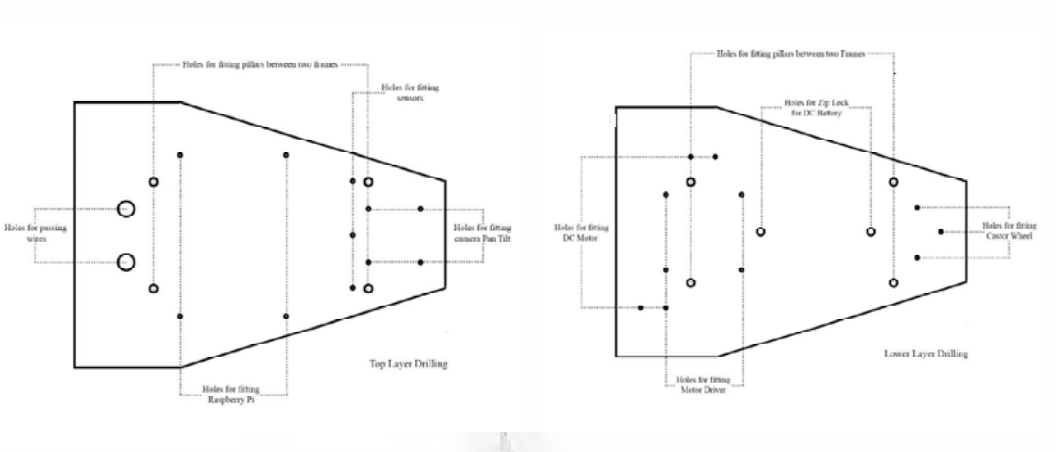


Figure 3.3: labeling for the drilled holes for component mounting, passing wires etc. for top layer of theframe.

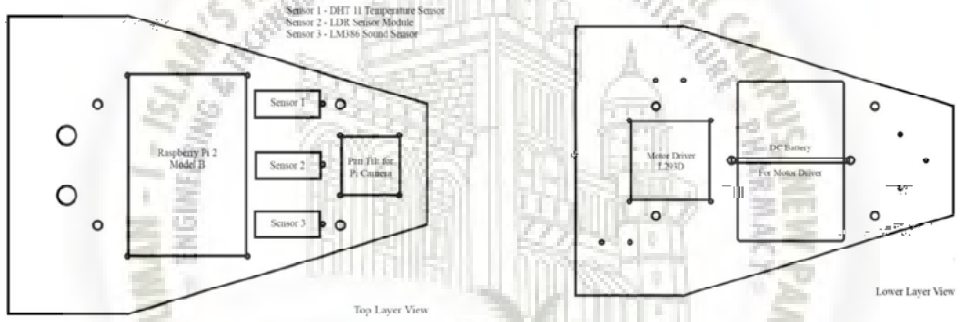


Figure 3.4: Top and Lower Layer after mounting of thecomponents.

3.6 HardwareInterface

Pi Camera Module v2

- Connecting the camera module Make sure the raspberry pi is switched off when connecting the camera module. Connect the camera module to raspberry pis camera port. The camera board attaches to the Raspberry Pi via a 15-way ribbon cable. There are only two connections to make: the ribbon cable needs to be attached to the camera PCB, and to the Raspberry Pi itself. We need to get the cable the right way round, or the camera will not work. On the camera PCB, the blue backing on thecableshouldfaceawayfromthePCB,andontheRaspberryPiitshouldface

towards the Ethernet connection. Although the connectors on the PCB and the Pi are different, they work in a similar way. On the Raspberry Pi itself, pull up the tabs on each end of the connector. It should slide up easily, and be able to pivot around slightly. Fully insert the ribbon cable into the slot, ensuring it is set straight, then gently press down the tabs to clip it into place. The camera PCB connector also requires you to pull the tabs away from the board, gently insert the cable, and then push the tabs back. The PCB connector can be a little more awkward than the one on the Piitself.

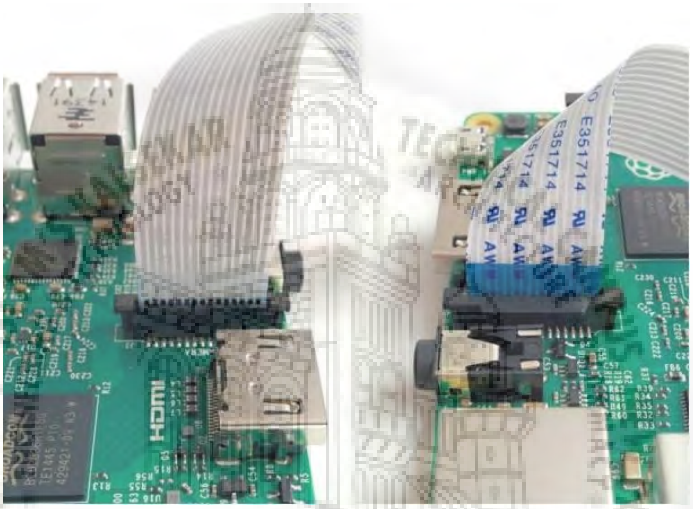


Figure 3.5: Interfacing Camera Module

- Start up thePi
- Open Raspberry Pi configurationTool from the main menu
- Ensure the camera software isenabled

  If the camera software is not enabled, enable it and then reboot Pi to begin. The camera is now connected and the software is enabled.

  Servo Motor SG90

- Connecting the servo motors Black, red and yellow wires are ground, power and signal wiresrespectively.

  Power Use the raspberry pi to power the servo motors.

Figure 3.6: Raspberry piconfiguration

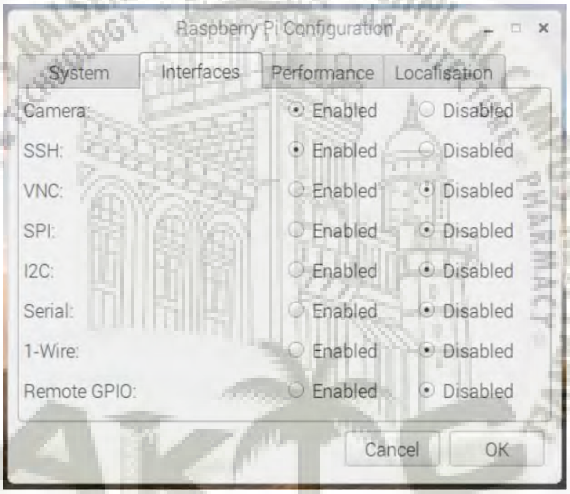


Figure 3.7: Enabling CameraSoftware

DC Motor

- Connecting DC Motors

DHT11 TemperatureSensor

- Connecting TemperatureSensor

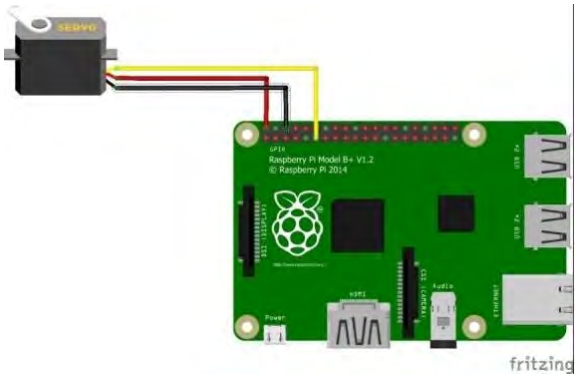


Figure 3.8: Interfacing ServoMotor(A)

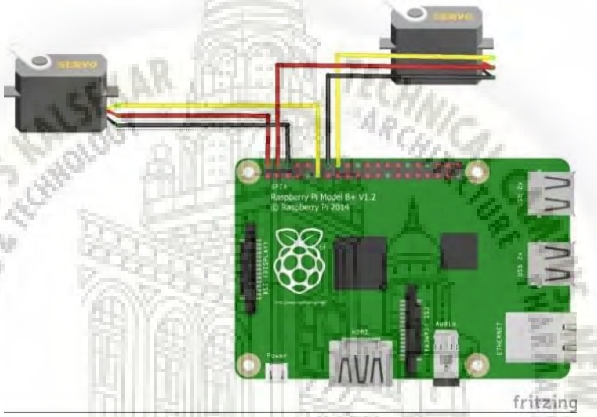


Figure 3.9: Interfacing ServoMotor(B)

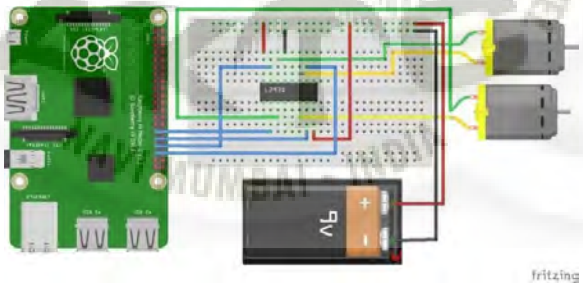


Figure 3.10: Interfacing DC Motors

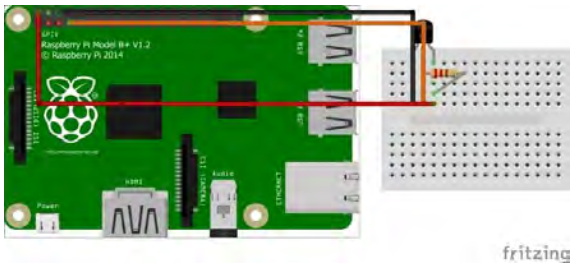


Figure 3.11: Interfacing DHT11 Temperature Sensor

Chapter 4

Software Design

- **InstallingOS(NOOBS)onRaspbeerryPi**A.GetNOOBS

  There are two common methods to getNOOBS

- Buy a pre-installed SDcard

  SD cards with NOOBS preinstalled are available, list can be found on Raspberry pi website. If you bought pre-installed SD card, directly follow Booting step in Installation.

- DownloadNOOBSfromRaspberrypiwebsiteNOOBSisavailablefordownloadon Raspberry piwebsite.

  B. Setting up **Essentials:**

- RaspberryPi
- SD Card (16GB class 10 Preferred / 8GB Class 4 may alsowork)
- HDMItoVGA/HDMIcable(connectingtoDisplaye.g.MonitororT.V.)
- Keyboard andMouse
- Power Supply (Micro USB e.g. phonecharger)

  C. Installation **Instructions: Download**

- We will need a computer with an SD cardreader.
- Download NOOBS installer fromhttps://www.raspberrypi.org/downloads/noobs/.

- There are two options available NOOBS and NOOBSLite

  NOOBS - Offline and network install NOOBS Lite - Network install only It is preferred to download NOOBS over NOOBS Lite.

Format SD Card

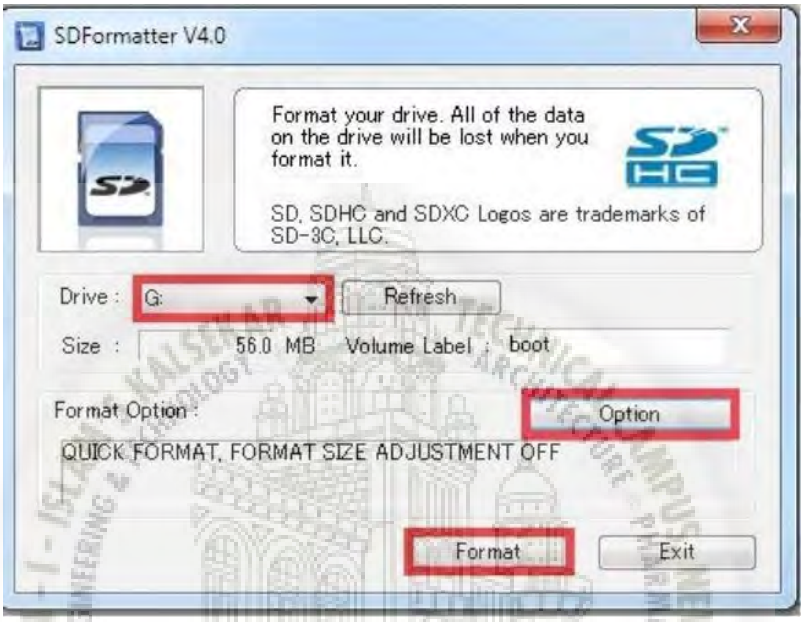


Figure 4.1: Selection for SD Card Formatting

- Format SD card using SD CardFormatter.
- InsertSDcardintotheSDcardreaderconnectedtocomputer.
- Check the drive letter allocated to it,e.g. G:/
- Set FORMAT SIZE ADJUSTMENT option to ON in the Options menu to ensure thattheentireSDcardvolumeisformatted.
- Click on Format button to format SDcard.

NOOBS files on SD Card

- Extract the downloaded NOOBS zip file in SD card and make sure the extracted file is not present infolder.
- ThefileswillbetransferredintoSDcard.

- SafelyejecttheSDcardandinsertitintoRaspberryPi.

Booting first time

Figure 4.2: Selection of Raspbian OS from list

- Insert the SD card in Raspberry Pi, connect the Mouse, Keyboard and HDMIcable.
- Connect USB cabled Power supply acrossit.
- Raspberry Pi will boot, and a window will appear with a list of different operating systems that you caninstall.
- Install Raspbian as DefaultOS.
- Once the install process has completed, it may ask for date and time. Set them as per ourregion.

  ** Logging in**

- ThedefaultloginforRaspbianisusernamepiandpasswordraspberry.
- Though wont ask by default, we can change it later. D. Update We can update Raspberry Pi by typing the following commands on terminal. It assures you run the latest builds and fixes for smoothoperation. Type

```
sudo apt−g e t update
```

and

```
sudo apt−g e t upgrade
```

to run latest build. We have successfully installed NOOBS in your Raspberry Pi!

- ## Flask Setup in Raspberry Pi for Controlling Robot through Webpage:

Here, we have created a web server using **Flask**, which provides a way to **send the commands from webpage to Raspberry Pi** to control the Robot over the network. Flask allows us to run our python scripts through a webpage and we can send & receive data from Raspberry Pi to web browser and vice versa. Flask is a microframework for Python. This tool is Unicode based having built-in development server and debugger, integrated unit testing support, support for secure cookies and its easy to use, these things make it useful for the hobbyist.

Install a flask support package into the Raspberry Pi by using given command:

```
$ pip install Flask
```

Then we can use the Flask by just importing it in our program, like we have imported following packages of flask for this project:

```
from flask import Flask

from flask import Flask, render_template, request
```

- **HTML code for webpage:**

We have created a web page using HTML language for displaying control links (Left, Right, Forward, backward) to move the Robot from web browser. We have used **jQuery script to call the functions in our Python Program.** There are five functions in Python Code to move the Robot Left, Right, Forward, Backward and to stop it. Complete Python Code has been given at the end. These functions will be executed by clicking on the Control Links on webpage and motors will move depending on the link being clicked. Here we have written the code in such way that Robot will move in certain direction while **clicking and holding the link**, and as soon as we **release the mouse button Robot will stop**. Below is the HTML code for webpage including the jQuery:

```
<html>

<head>

<script src="https://ajax.googleapis.com/ajax/libs/jquery/3.1.1/jquery.min.js"></script>

</head>

<body>



<imgsrc="http://192.168.43.199:8081" /><!--Enter the IP Address of your Raspberry Pi-->

<div style="float:right">



</div>

<div style=" height:400px; width:300px; float:right;">

<center>

<h1><span style="color:#5C5C5C;">AIKTC</span><span style="color:#139442">
PANVEL</span></h1>

<h2>Surveillance Robot</h2><br><br>

<a href="#" id="up" style="font-size:30px;text-
decoration:none;">&#x1F881;&#x1F881;<br>Forward</a><br><br></center>

<a href="#" id="left" style="font-size:30px;text-
decoration:none;">&#x1F880;&#x1F880;Left</a>       &nb
sp;

<a href="#" id="right" style="font-size:30px; text-decoration:none;"> Right
&#x1F882;&#x1F882;</a><br><br>

<center><a href="#" id="down" style="font-size:30px;text-decoration:none;">
Backward<br>&#x1F883;&#x1F883;</a></center>

</div>
```

```
<script>
$( document ).ready(function(){
    $("#down").on("mousedown", function() {
$.get('/down_side');
     }).on('mouseup', function() {
$.get('/stop');
    });
    $("#up").on("mousedown", function() {
$.get('/up_side');
     }).on('mouseup', function() {
$.get('/stop');
    });
    $("#left").on("mousedown", function() {
$.get('/left_side');
     }).on('mouseup', function() {
$.get('/stop');
    });
    $("#right").on("mousedown", function() {
$.get('/right_side');
     }).on('mouseup', function() {
$.get('/stop');
    });
});
</script>
</body>
```

```
</html>
```

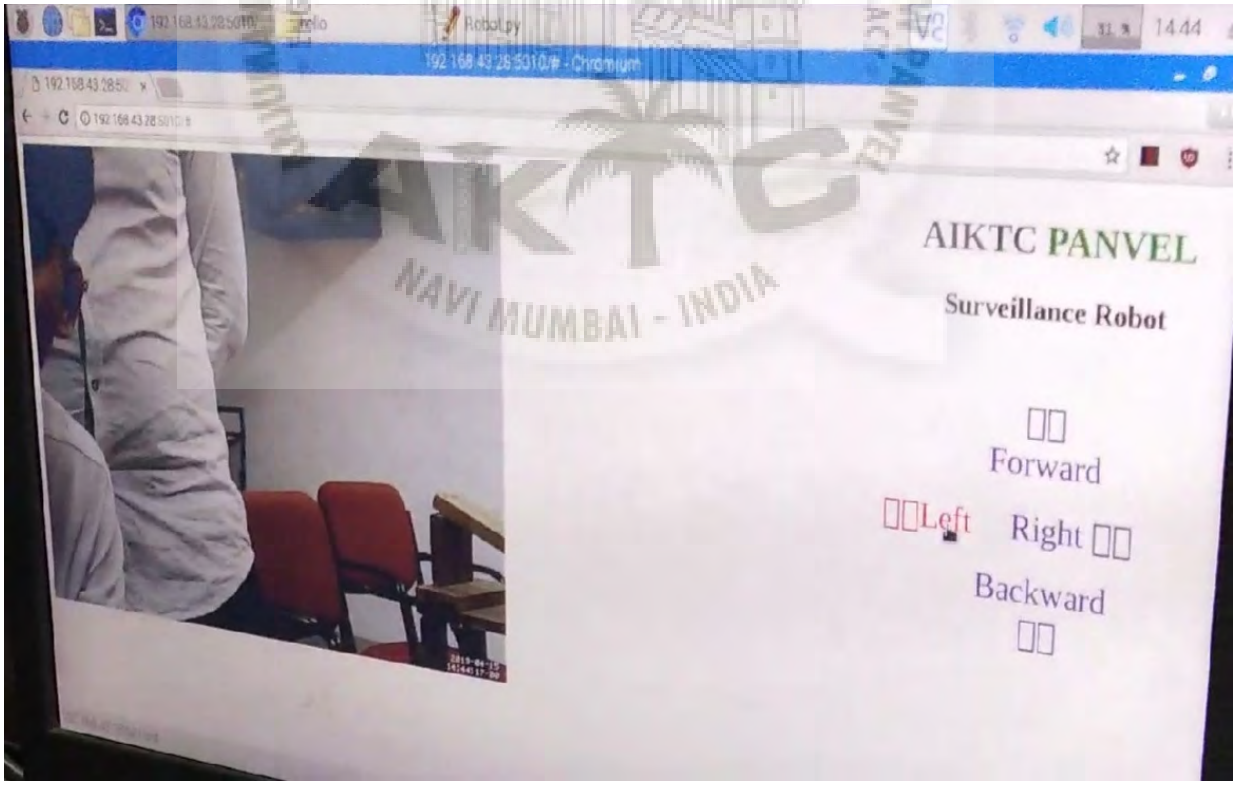
Here you can see the we have embed the IP address, on which the Video is streaming, into the webpage by using imgsrc tag. Change the IP address according to your Raspberry Pi but keep the port same.

```
<imgsrc="http://192.168.43.199:8081" /><!--Enter the IP Address of your Raspberry Pi-->
```

User needs to copy-paste the above given HTML code in some text editor (notepad) and save the file with .HTML extension (robot.html). Then **put this HTML file in the /templates folder with respect to your python script location**. Means you need to create a folder named templates, where you have put your Python Code file for this **Raspberry Surveillance Robot**, then put robot.html file in this templates folder. This step is important, otherwise our project won't work. You can directly open the robot.html file by double clicking on it to see how your control links will look. Further check the whole process in **Demonstration Video** at the end. After we have done with the programming and all, we can just run the Python code in Raspberry Pi and open the IP_address_of_your_Pi:5010 in web Browser (like http://192.168.43.199:5010)

You can check the IP address of your Raspberry Pi by using *ifconfig* command:

```
ifconfig
```



- **Setting up MySQL Database on Raspberry Pi**

Before getting started weneed to install MySQL server on Raspberry Pi For installing MySQL server do the following

```
sudo apt−get installmysql−server sudo
apt−get i n s t a l lphp5−mysql
```

The php5-mysql install adds the mysql libraries to allow PHP to access the mysql database.

Accessing MySQL from the command line First connect to the database and specify a user:

```
mysql −u r o o t −p
```

Thenentertheuserspasswordwhenprompted.Itshouldnowhaveamysql¿prompt.

Exiting MySQL connection / command linelogin

```
q u i t
```

Restarting The MySQL service

```
sudo s e r v i c e mysql r e s t a r t
```

Creating A Database Fist connect to the database using ”mysql -p -u root”. To create a database:

```
CREATE DATABASE d a tab t ;
```

Adding A User

Login to mysqlusing ”mysql -p -u root” and then create a new user to avoid using root:

```
CREATE USER ’MY USERNAME’@’ l o c a l h o s t ’ IDENTIFIED BY
’MY-PASSWORD’ ;
```

Accessing a database

Local Access For security reasons, by default access to the MySQL server via the mainIPaddressisdisabledintheMySQLconfig.Youcanconnectlocallyusing:LocalHost127.0.0.1ortheinternalsocketconnectionon"/var/run/mysqld/mysqld.sock"

Creating Tables in a database

```
CREATETABLE sensors (SrNo Int (5),
Temperature Int (5), Humidity Int (5), Date &Time
Varchar(20));
```

Accessing and displaying values from a database

```
Use Database ;
Select□ from sensors;
```

- **SettingupPiCameraSoftware**Executethefollowinginstructionsonthecommandlinetodownloadandinstallthelatestkernel,GPUfirmware,andapplications. We need an internet connection for this to workcorrectly.

```
sudo apt−get upgrade
sudo apt−get upgrade
```

Now we need to enable camera support using the raspi-config program we will have used when you first set up your Raspberry Pi.

```
sudo raspi−config
```

Use the cursor keys to move to the camera option, and select 'enable'. On exiting raspi-config, it will ask to reboot. The enable option will ensure that on reboot the correct GPU firmware will be running with the camera driver and tuning, and the GPU memory split is sufficient to allow the camera to acquire enough memory to run correctly.

To test that the system is installed and working, try the following command:

```
raspistill v o test.jpg
```

The display should show a five-second preview from the camera and then take a picture, saved to the file test.jpg, whilst displaying various informational messages.

- **InstallingMJPEGstreameronRaspberryPi***A.Essentials*

Requirements:

- RaspberryPi
- Raspberry Pi CameraModule

B.ConnecttheCameraModule C.InstallingMJPGStreamer Installdevversionof libjpeg:

```
sudo apt-get install libjpeg62-turbo-dev
```

Install make:

```
sudo apt-get installcmake
```

Download mjpg-streamer with raspicamplugin:

```
git clonehttps://github.com/jacksonliam/
mjpg-streamer.git~/mjpg-streamer
```

Change directory:

```
cd ~/mjpg-streamer/mjpg-streamer-experimental
```

Compile: make clean all Replace old jpg-streamer:

```
sudorm rf/opt/mjpg-streamer
sudomv~/mjpg-streamer/mjpg-streamer-experimental
/opt/mjpg-streamer
sudorm rf~/mjpg-streamer
```

D. Start Streaming To Begin streaming type:

```
LDLIBRARYPATH=/opt/mjpg-streamer/
/opt/mjpg-streamer/mjpgstreamer-i
```

```
"input_raspicam.so -fps 15 -q 50 -x 640 -y 480" -o
"output_http.so -p 9000 -w /opt/mjpg-
streamer/www"
```

You will see something like this

```
MJPG Streamer Version: 2.0 i:
    fps ..........: 15
i: resolution.....: 640 x480
i: camera parameters .............:
Sharpness 0, Contrast 0, Brightness 50, Saturation 0,
ISO 400, VideoStabilisation No,
Exposure compensation 0
Exposure Mode 'auto', AWB Mode 'auto',
Image Effect 'none', MeteringMode 'average',
ColourEffectEnabled No with U= 128, V= 128 Rotation 0,
                hflip No, flip No
www-folder-path...: /opt/mjpg-streamer/www/
HTTP TCP port.....: 9000
username : password.: disabled
commands .....: enabled
Starting Camera
Encoder Buffer Size 81920
```

Now type the following url in your browser

To find IP address type

```
sudo ifconfig
```

It will be something like this 192.168.43.100 IpAddress:9000/stream.html E. Stop Streaming To stop streaming type:

```
kill -9 pidof mjpg_streamer
```

Chapter5

ProjectOperation

5.1 Working ofProject

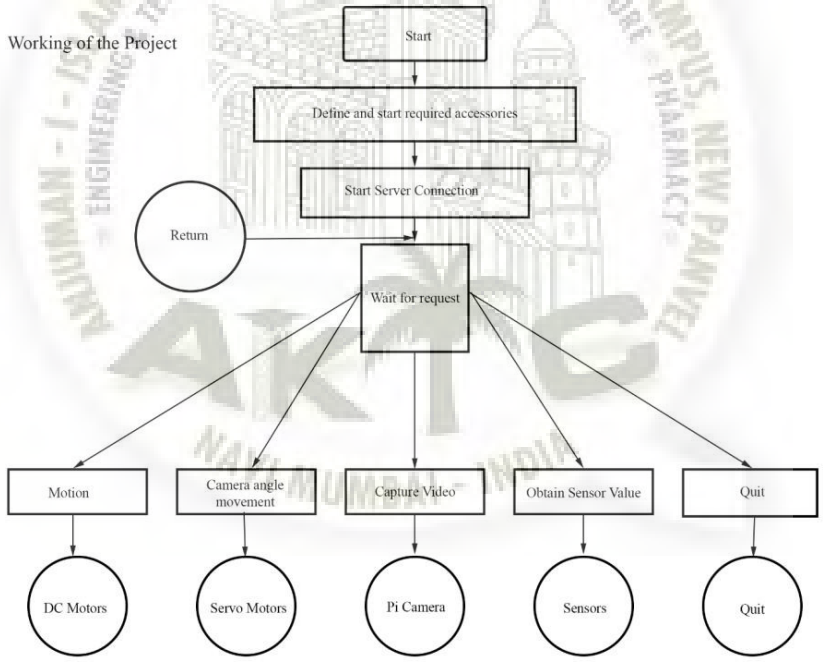


Figure 5.1: Basic working of Project

The above figure explains the Initial Commands require for the Working of the Project.

- Start Check pin connections, Power up the system Raspberry Pi, Dc Motors etc., Start PiCamera.

- Define and start required accessories Connect the robot to the server, Assign default valuesforpositionandcameraangleoftherobot.
- Start Server Connection Once the connection is set up between robot and server we can perform the necessary requiredtasks.
- Motion The movement of the robot is controlled by giving commands to it through the web page. The motor driver drives the DC Motor thereby making the robot move in the requireddirection.
- Camera angle movement The servo motors attached at the top helps in adjusting thecorrectangleofthecamerabygivingcommandsthroughthewebpage.
- Capture video The Pi Camera attached at the top with servo motors helps in capturing the video data of the surroundings. Once the data is collected it is sent viainternettotheserverandvideoisdisplayedonthewebpage.
- Obtain Sensor Value DHT11 sensor is attached on the robot to measure the surroundingtemperature.Oncethedataiscollecteditissentviainternettotheserver and the value is displayed on the webpage.

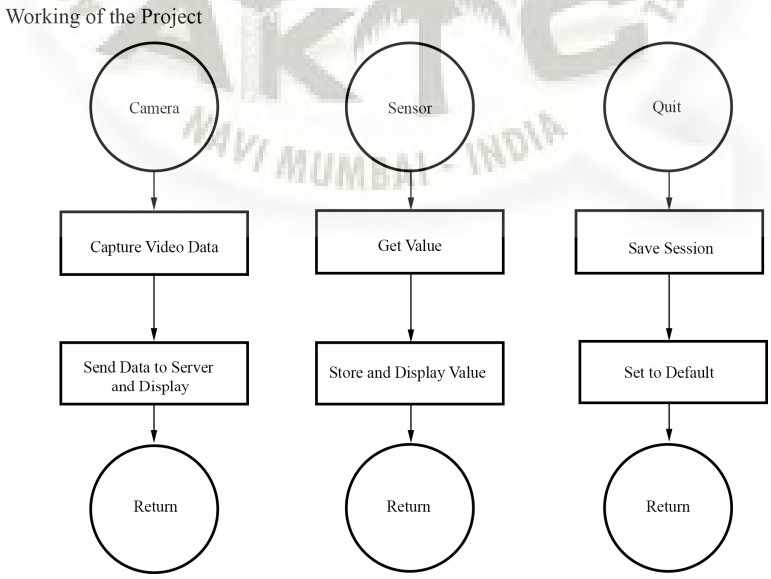


Figure 5.2: Basic working of Project

The above figure explains the camera and sensor working and restoring default values.

- Camera The Pi Camera attached with the servo motors at the top collect the video data of the surrounding which is sent to the server and user can watch livestreaming on the webpage.
- Sensor The DHT11 temperature sensor measures the surrounding temperature. Once the value is measured it is stored and sent to the server where the value is displayedonthewebpage.Thevalueisrefreshedateverycertainperiod.
- Quit Once the session is complete all the values are restored to default and the processcanberepeatedinthesameway.

5.2 Controlling Movement of theRobot

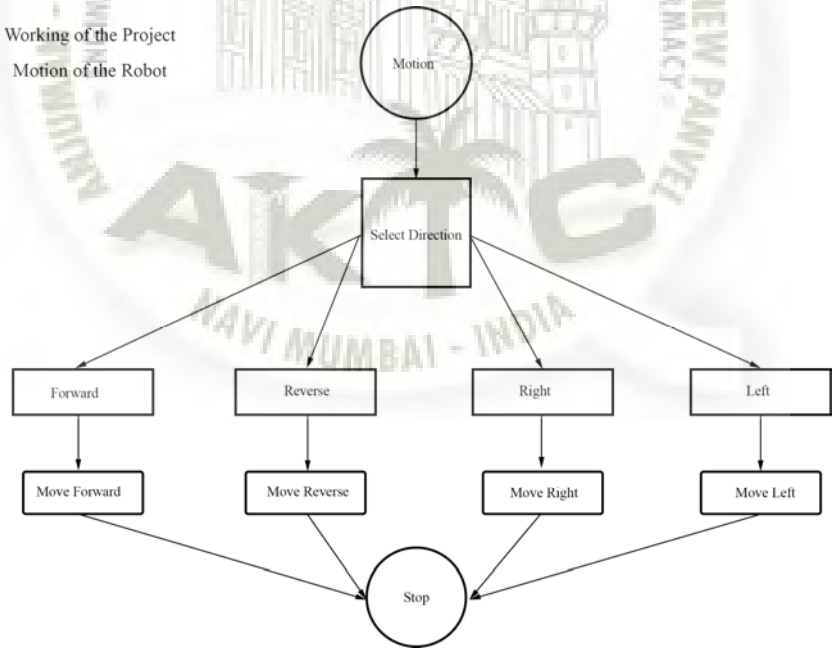


Figure 5.3: Motion of Robot

The above figure explains the movement of the robot in the required direction.

- Motion The movement of the robot is controlled through the physical buttons available on the web page. User can select the required direction for the movement ofrobot.

- Select Direction The user can move the robot through the physical buttons available for assigning the directions in forward, reverse, right or left direction. Once the button is pressed the robot continuously moves in the selected direction until changed.

- Stop User can stop the robot anytime through stop command when moving in any of thedirection.

5.2.1 Controlling CameraAngle

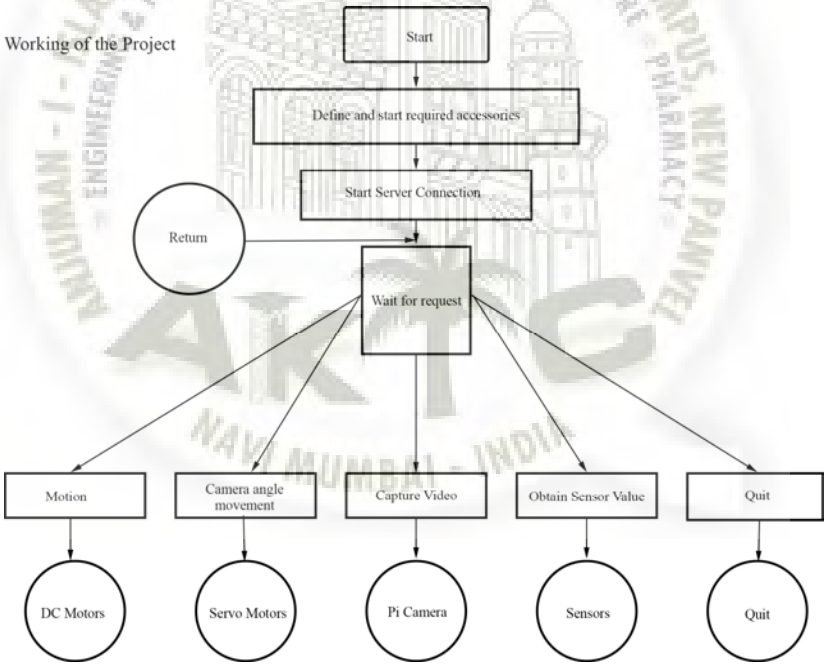


Figure 5.4: Motion of Robot

The above figure explains setting up of the camera angle.

- CameraAngle The Pi Camera is attached with the servo motors at the top to collectvideodataofthesurrounding.Usercanselectthedesireddirectionofthe

camera by adjusting servo motors through the physical buttons available on the web page.

- Select Direction - The user can adjust the angle of the camera by selecting the physical buttons available to move the servo in left, right, upward and downward direction. Every angle is divided in two parts, through which one can adjust the camera in a desiredmanner.
- Default Once the default button is pressed by the user the servo angle is restored todefault.

5.2.2 Hardware content for theProject

System on Chip Raspberry Pi 2 Model B

BeagleBone	Raspberry Pi 2 Model B	Banana Pi
Cortex A-8 Processor	Quad Core ARM Cortex-A7 CPU	Arm Cortex A7 Dual Core
1GHz Processor	1GHz Processor	1 GHz Processor
512MB Ram	1GB Ram	1GB Ram
4GB Storage + Exp.	SD Card Storage	SD Card Storage
GPIO 65+7	40 GPIO Pins	GPIO 26
1 USB Port	4 USB Ports	2 USB Ports
Ethernet Port	Ethernet Port	Ethernet Port

Figure 5.5: SoC Comparision

Preferring Raspberry Pi over BeagleBone and Banana Pi

The above chart displays the specifications for BeagleBone, Raspberry Pi and Banana Pi. Clearly the BeagleBone stands out in terms of Storage capacity and GPIO. One of the reasons for choosing Raspberry Pi over BeagleBone and Banana Pi is thenumberofUSBPortsandRammemoryrequiredforthesubjectproject.

The processor for BeagleBone is nearly twice as fast as the processor for Raspberry Pi but Raspberry Pi fulfills the requirements for the project perfectly over both of the other mentionedSoC.

As the project focuses on live streaming of the environment, Raspberry Pi wins with a solid margin when compared with integrated videocore graphics processor providing 24 GFLOPS whereas BeagleBone and Banana Pi provides 1.6 and 6.3 GFLOPSrespectively.

Weight comparison for all the three boards are nearly same, it can be easily carried anywhere for performing requiredtasks.

Raspberry Pi comes at a lower rate when compared with BeagleBone and Banana Pi.

All the three boards comes with a single Ethernet port with Banana Pi providing maximum speed up to 1000MBps but Raspberry Pi fulfills the requirement of the subject project.

Other than the specifications for the above mentioned boards Raspberry Pi gets better media coverage and overall exposure, Raspberry Pi still generates 13 times more web traffic. Considering all these points Raspberry Pi clearly stands out by a long shot over the other two boards which is the reason we have chosen Raspberry Pi 2 Model B for ourProject.

Preferring Raspberry Pi 3 Model B over other models of Raspberry Pi

Figure 5.6: Raspberry Pi Details

The Raspberry Pi 3 Model B is the second generation Raspberry Pi. It replaced the original Raspberry Pi 1 Model B+ inFebruary 2015.

Compare to Raspberry Pi 1 it has:

- A 900MHz quad-core ARM Cortex-A7CPU
- 1GBRAM

Like the Pi 1 Model B+ it also has:

- 4 USBports
- 40 GPIOpins
- Full HDMIPort
- EthernetPort
- Combined3.5mmaudiojackandcompositevideo
- Camera interface -CSI
- Display Interface -DSI
- VideoCore IV 3D graphicscore

BecauseithasanARMv7processor,itcanrunthefullrangeofARMGNU/Linux distributions,includingSnappyUbuntuCore,aswellasMicrosoftWindows10.

The Raspberry Pi 3 has an identical form factor to the previous (Pi 1) Model B+ andhascompletecompatibilitywithRaspberryPi1.

Raspberry Pi camera Module V2

The Raspberry Pi Camera Module is a 5 megapixel custom designed add-on for Raspberry Pi, featuring a fixed focus lens. It's capable of 2592 x 1944 pixel static images, and also supports 1080p30, 720p60 and 640x480p60/90 video. It attaches to Pi by way of one of the small sockets on the board upper surface and uses the dedicatedCSiinterface,designedespeciallyforinterfacingtocameras.

The board itself is tiny, at around 25mm x 23mm x 9mm. It also weighs just over 3g, making it perfect for mobile or other applications where size and weight are important. It connects to Raspberry Pi by way of a short ribboncable.

Thecameramoduleisusedtotakehighdefinitionvideo,aswellasstillphotographs. The camera works with all models of Raspberry Pi 1, 2 and 3. It can be accessed through the MMAL and V4L APIs, also there are numerous third-party libraries builtforit,includingPicameraPythonlibrary.

Specifications:

- Weight 3Grams

- Hazardous No
- Length 5inch
- Width 3inch
- Height 1.25inch

SG90 Servo Motor

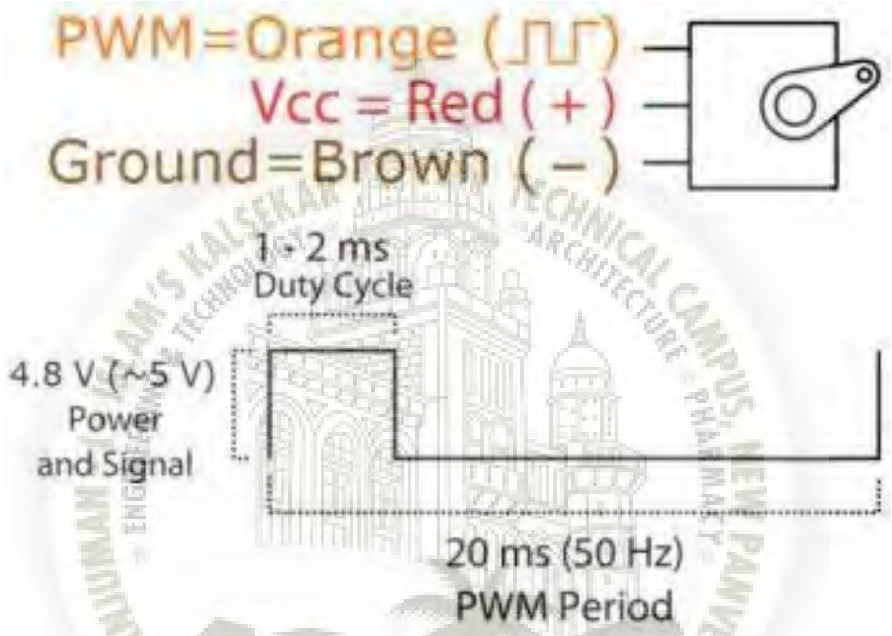


Figure 5.7: Servo Motor Pulse Width

Specifications:

- Weight 9Grams
- Dimensions 22.2 x 11.8 x 31 mmapprox.
- Stall torque 1.8kg-cm
- Speed(sec)0.1
- Operating speed 0.1 s/60degree
- Operating voltage 4.8V app5V
- Dead band width 10micro-sec

- Temperature range 0 Deg C to 55 DegC

L293D Motor Driver

Working:

There are 4 input pins for L293D, pin 2, 7 on the left and pin 15, 10 on the right. Left input pins will regulate the rotation of motor connected across left side and right input for motor on the right hand side. The motors are rotated on the basis oftheinputsprovidedacrosstheinputpinsasLOGIC0orLOGIC1.

DC Gear Motor

Specifications:

- Length80mm
- Torque1.5kg-cm
- Shaft Diameter6mm
- Weight 130Grams

DHT11 Temperature Sensor

Preferring DHT11 Temperature Sensor over others

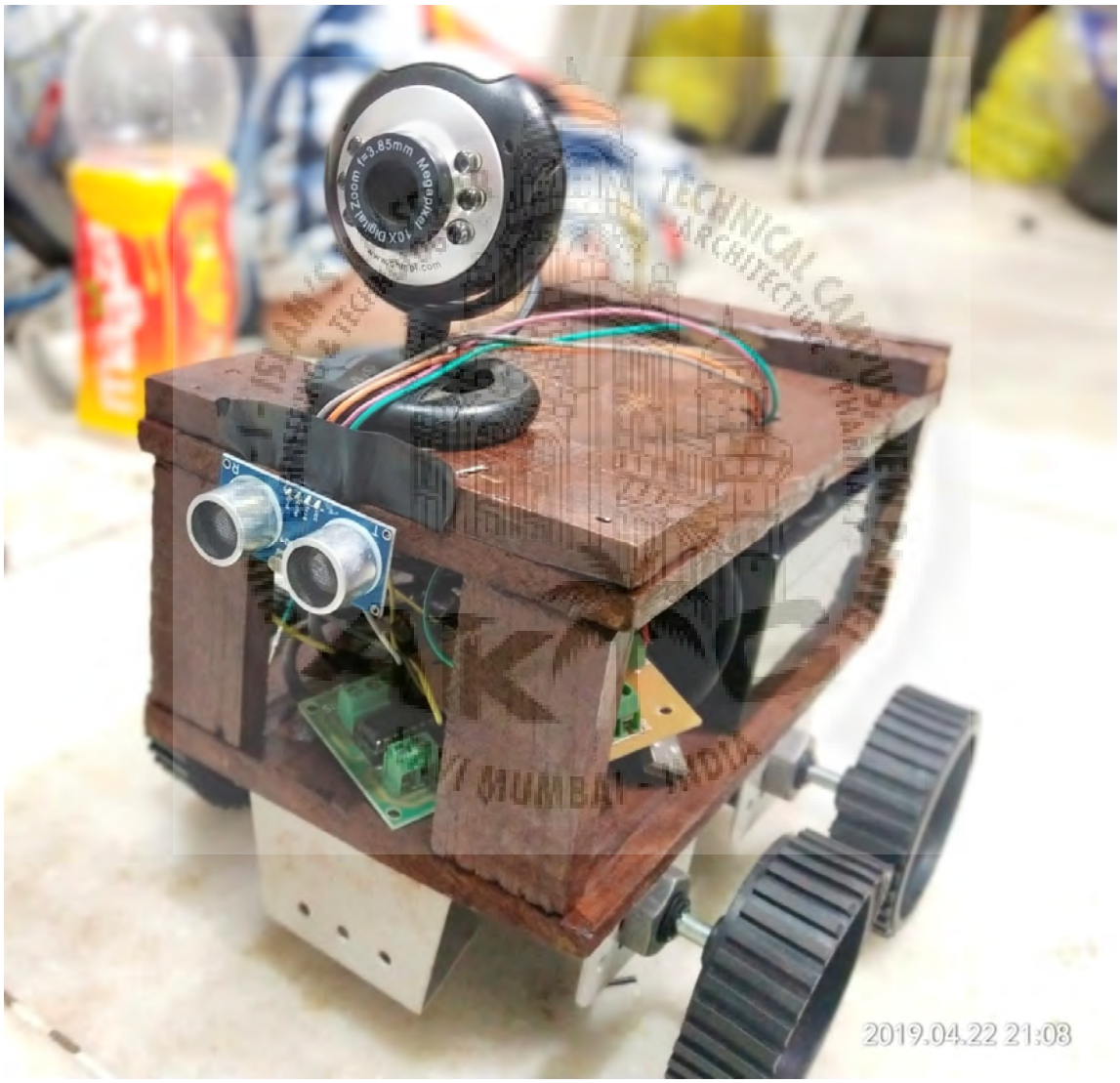
The DHT11 Temperature Sensor provides a better accuracy point between +-2 deg C which is comparatively the same and better when compared with others. Also DHT11 sensor is available in the market easily at a lower rate.

Specifications:

- Measurement Range 20-90 % RH, 0 to 50 degC
- Humidity Accuracy +-5 %RH
- Temperature Accuracy +-2 degC
- Resolution1
- Package 4 Pin Single

Chapter 6

Result & Conclusion



Report contains detailed information for controlling a robotic vehicle guided via internetand measuring surrounding temperature. Thuswe have designed smart supervisor sys-tem capable of capturing Video/Images and device operation like temperature sensing ofthe environment.The Controlled Wireless communication can be achieved using Wi-Finetwork or internet.It is advantageous as it offers reliability and privacy on both sides.Necessary action can be taken in short span of time in the case of emergency conditionslike increase in surrounding temperature. The controlling of robot and camera angle iseasy as the various buttons are available on the web page specifying the various actions. Faster communication will ensure that wecan send high quality,high resolutionimages with minimal delay or latency.This will help reduce delay in execution of com-mands providing real time access to the robot. It will be of great use for monitoring illegal activities occurring around us. It will also be useful in disaster affected areas tofind and rescue injured people.It would also be used for spy bot.It will also be usefulto evaluate health risks to workers in industries which makes use of hazardous substance

such as heavy metals

Future Scope

At present this project consists of few applications such as observing the surrounding through camera, gas detection, temperature sensor etc. but there is availability for increasing the enhancement of the project by including more applications with extra features. The distance of communication can increased by using high level RF Tx & Rx pair. Increase in the distance may require high investment. If the distance is increased we can send the robot for longer distance in sewages of also in war time to know about the traps. It can be used to detect humidity or water flow. One of the disadvantages is if the gas is detected or to know the temperature we have to turn the camera to the sensor placed and observe the changes. But we can improve by giving an additional Tx & Rx pair to transmit the changes or values, and by using a 16 X 2 LCD display we can program to display the changes in the temperature and detections with commands given to the robot also. Also by using the GSM/GPS we can locate the robot whereabouts i.e. where the robot is located at that instant and it should be controlled to come back to us which can be done only if the location is known and also the tracing path of the robot is necessary to locate it back. Conclusively more applications can be added for this project for better performance and to give better results with less space and less cost. And it can also be configured to control through different means like gesture, voice, keypad or joystick which will be flexible for the user

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