VISVESVARAYA TECHNOLOGICAL UNIVERSITY

BELGAUM

A Project Report on
" Robotic Arm For Surveillance"

Submitted in partial fulfillment of the requirements for the award of the Degree of

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In

ELECTRONICS AND COMMUNICATION ENGINEERING

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Submitted by

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CERTIFICATE

Certified that the project work entitled **"**Robotic Arm For Surveillance**"** is carried out by Nikhil Kumar G (1NT16EC092), Mohammed Ayub Modi (1NT16EC082), Mayank Lakhani (1NT16EC076) and Saicharan T (1NT16EC131), bonafide students of NITTE MEENAKSHI INSTITUTE OF TECHNOLOGY in partial fulfilment for the award of Bachelor of Engineering in ELECTRONICS AND COMMUNICATION of VISVESVARAYA TECHNOLOGICAL UNIVERSITY, Belgaum during the year 2019-2020. The project report has been approved as it satisfies the academic requirement in respect of the project work prescribed as per the autonomous scheme of NITTE MEENAKSHI INSTITUTE OF TECHNOLOGY for the said Degree.

Signature of the Guide	**Signature of the HOD**	**Signature of the Principal**
(Ms. Shylaja S)	**(Dr. Ramachandra A C)**	**(Dr. H.C. Nagaraj)**

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Name of Examiners	**Signature with date**
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DECLARATION

We the students of B.E. VIII Semester, Nikhil Kumar G (1NT16EC092), Mohammed Ayub Modi (1NT16EC082), Mayank Lakhani (1NT16EC076) and Saicharan T. (1NT16EC131), studying in Department of Electronics and Communication Engineering at Nitte Meenakshi Institute of Technology, Bangalore hereby declare that the final year project titled "Robotic Arm For Surveillance" submitted to the department in partial fulfillment of degree of Bachelor of Engineering is the original work conducted by us. The information and data given in the report is authentic to the best of our knowledge. We hereby declare that this final year report is not being submitted to any other university for the award of any other degree, diploma and fellowship.

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ABSTRACT

In this paper, we have developed a system for the continuous surveillance and to monitor remote areas with the Tele robotic mechanism to visualize the situation happened in remote areas with internet based communication with the concept of controlling a Tele robotic system with web server to operate with a webpage based controlling automation system. Robotics has useful features and scope in our day to day life. It can make our life easy and fast. But in real life interaction between man and robot-like household or workplace creates a new question about the controlling the robot. It is quite impossible to command a robot through a keyboard or interfaces like this. The problem can be solved by using operating system like raspberry pi and also by using IOT. Raspberry pi has the fastest processor (CPU: quad core 64-bit arm cortex A53 clocked at 1.2GHz) than other processors IOT makes robotic vehicle able to monitor through internet from anywhere. IOT based vehicle has a web camera and a robotic arm mounted on it for hold the camera and moves 90 degree. Python is used as programming language to take thr enemy picture and fire automatic, also send the picture to cloud for storage and monitoring. Arduino Nano is used to control the robotic vehicle automatic and web camera movement. This robotic is fabricated to use in border area (military) in our country.

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Chapter 1

INTRODUCTION

1.1 Robotics

Robotics is one of the important fields in the concern of industrial usage and daily life and the robotics may effect on the various fields in the technological manipulations and that can be intelligent with advancement of various areas like sensors, memories. The early robots are controlled through Infrared Technology, but later the advancement areas in the technology to lead robotics as embedded to the fields of service, security and safety. They can be vastly used in the distributed computer systems, surveillance cameras and these robotic intelligent systems can be used till now in the pick and place, combining subsystems and these systems can be used where the hazardous places to complete the works where human can affect by that work environments. As many of researchers are interested on web-based robotics as these are very new interest. It became an open research to all web based robotics unless for operating in hazardous environments that are traditional tele-robotic areas, Internet robotics has opened up a completely new range of virtual world applications, namely tele manufacturing, tele-training, tele-surgery, museum guide, traffic control, space exploration, disaster rescue, house cleaning, and health care. Automated video monitoring is an important research area in the commercial sector as well.

With the popularity of internet, users can start thinking with widespread of technology advancement to usage of network related applications. Also, users can spent more time on internet compared to their sleep also. It can reflect the design such as applications for purpose of remote surveillance and can reduce the hazardous work environment to humans. Imagine the case where the robot is controlled with remote area accessing through webpage is the advancement of such, technically improve the tasks of controlling from remote end. In the robotic field, tele robotics is such a wonderful platform to improve the usage of robotics in every field. Here, tele robotics is the mechanism of controlling a mobile robot with web server to corresponding visual feedback approach methodology. The Tele-Robotics is the combining a robotic arm and web server with real time visualization of range of distance-based applications. Tele-operation can be effect to improve robotics vastly improve or enhance the quality or value

of the range of practical use or relevance. Tele-robotics is referred to control a robot from remote end. Robotics are used in the field of space, underwater, power plants, hazards handling and medicine. One way of controlling robots through wirelessly by ZigBee technology and Radio frequency. But robot cannot be controlled from remote end. Another method of robotic arm controlled by the haptic technology and it is also referred as tactile feedback technology. This technology is expensive because haptic devices are costlier.

A web server is setup on the single board computer named Raspberry Pi, a web camera is used to take picture in border area, fire automatic also send for firebase for monitoring from remote end. The latest incarnation of the Raspberry Pi, 4 is used here. The Raspberry Pi foundation recently launched the last evolution of the original Raspberry Pi called 'The new Raspberry Pi 4. This Raspberry Pi 4 has 26 GPIO Pins. L293 motor driver used for auto controlling robot and Arm .

1.2 HARDWARE AND SOFTWARE TOOLS USED

1.2.1 Raspberry Pi

Raspberry pi OS is used for making robot wireless and web based. Web cam is interfaced with Raspberry Pi and then videos are transmitted wirelessly from the robotic vehicle to the user's monitor, from where the user can monitor the status of the robotics. Raspberry pi is connected with the wi-fi which enables raspberry pi to transmit signal over the web network .Raspberry pi uses SD card for memory and booting because it doesn't have inbuilt storage. It is powered through USB cable and requires 5V power supply and 700-1000 mA current. It operates at 1.2 GHz. Python is used as a programming language to write code into Raspberry pi.

Introduction to Raspberry Pi

Raspberry Pi is low cost credit card sized single board computer. It packs enough power to run games, word processor like open office, image editor like Gimp and any program of similar magnitude. Pi is based on a Broadcom SoC (System of Chip) with an ARM processor, a GPU and 256 to 512 MB RAM. It uses SD card for booting because it has no hard disk for storage, SD card reader is used to image the OS system. 5V power supply is needed through USB cable, displays information on TV/monitor with DVI /HDMI port, HDMI cable or HDMI to DVI

converter cable is used as display connector, USB mouse/keyboard is used as input, Ethernet cable is used as network connector.

Raspberry Pi 4

The speed and performance of the new Raspberry Pi 4 is a step up from earlier models. For the first time, we've built a complete desktop experience. Whether you're editing documents, browsing the web with a bunch of tabs open, juggling spreadsheets or drafting a presentation, you'll find the experience smooth and very recognisable — but on a smaller, more energy-efficient and much more cost-effective machine.

Figure 0.1.1: Raspberry pi

Specifications

- Broadcom BCM2711, Quad core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz
- 1GB, 2GB or 4GB LPDDR4-3200 SDRAM (depending on model)
- 2.4 GHz and 5.0 GHz IEEE 802.11ac wireless, Bluetooth 5.0, BLE
- Gigabit Ethernet
- 2 USB 3.0 ports; 2 USB 2.0 ports.
- Raspberry Pi standard 40 pin GPIO header (fully backwards compatible with previous boards)
- 2 × micro-HDMI ports (up to 4kp60 supported)
- 2-lane MIPI DSI display port
- 2-lane MIPI CSI camera port

- 4-pole stereo audio and composite video port
- H.265 (4kp60 decode), H264 (1080p60 decode, 1080p30 encode)
- OpenGL ES 3.0 graphics
- Micro-SD card slot for loading operating system and data storage
- 5V DC via USB-C connector (minimum 3A*)
- 5V DC via GPIO header (minimum 3A*)
- Power over Ethernet (PoE) enabled (requires separate PoE HAT)
- Operating temperature: 0 – 50 degrees C ambient

- A good quality 2.5A power supply can be used if downstream USB peripherals consume less than 500mA in total.

1.2.2 WebCam

Figure 1.0.2 Interfcing web cam with Raspberry pi

1.2.2 Operating system

Raspberry pi essentially uses linuxkernel based systems software, but ARM11 can't be working on the popular versions of linux includes ubuntu. Now Raspberry Pi developers can suggest the some supportive software i.e., NOOBS. The NOOBS can include Archlinux ARM, pidora, puppy linux, Raspbian but depending on user's choice exclude the software from Noobs and that can acts as operating system. Raspbian linux operating system is recommended for the robotic applications. Raspbian can be extracted as a image file to write on SD card. SD card can be used as a image file reader and can convert to read image file through SD card Formatter. After completing the formatting, the image file of operating system can be read through win32 Disk imager.

1.2.3 DC gear motor

Introduction

10RPM Centre Shaft Economy Series DC Motor is high quality low cost DC geared motor. It has steel gears and pinions to ensure longer life and better wear and tear properties. The gears are fixed on hardened steel spindles polished to a mirror finish. The output shaft rotates in a plastic bushing. The whole assembly is covered with a plastic ring. Gearbox is sealed and lubricated with lithium grease and require no maintenance. The motor is screwed to the gear box from inside.

Although motor gives 10 RPM at 12V but motor runs smoothly from 4V to 12V and gives wide range of RPM, and torque. Tables below gives fairly good idea of the motor's performance in terms of RPM and no load current as a function of voltage and stall torque, stall current as a function of voltage.

For compatible wheels refer to Wheels and Accessories product category.

You can also mount this motor on the chassis using Motor Mount for Centre Shaft Economy Series DC Motor

For adding Position Encoder, refer to Encoder Kit for Centre Shaft Economy Series DC Motor

Specifications

- DC supply: 4 to 12V
- RPM: 10 at 12V
- Total length: 46mm
- Motor diameter: 36mm
- Motor length: 25mm
- Brush type: Precious metal
- Gear head diameter: 37mm
- Gear head length: 21mm
- Output shaft: Centred
- Shaft diameter: 6mm
- Shaft length: 22mm
- Gear assembly: Spur
- Motor weight: 100gms

Inside view of Centre Shaft Economy Series DC Motor

Figure 1.0.3 Geared DC Motor

Motor Mounting Clamp and Position Encoder Kit for Centre Shaft Economy Series DC Motor

Figure 1.0.4 Series DC Motor

Motor performance in terms of RPM and no load current as a function of input voltage

Voltage (V)	RPM (No Load)	Current (A)
4	12.4	0.023
5	13.4	0.024
6	13.9	0.025
7	14.2	0.026
8	14.5	0.027
9	14.7	0.027
10	15	0.028
11	15.2	0.029
12	15.4	0.030

Motor performance in terms of RPM and no load current as a function of input voltage

Voltage (V)	Stall torque (Kg/cm)	Stall Current (A)
4	1.999	0.101
5	2.644	0.132
6	3.139	0.157
7	3.332	0.170
8	3.526	0.216
9	3.689	0.240
10	3.999	0.262
11	4.368	0.288
12	4.730	0.314

Note: Motors's data can vary by ±10%

1.2.4 Servo motor

A Servo motor is a rotary actuator that allows for precise control of angular position, velocity and acceleration. Servos are found in many places: from toys to home electronics to cars and airplanes. If you have a radio-controlled model car, airplane, or helicopter, you are using at least a few servos. Servos also appear behind the scenes in devices we use every day. Electronic devices such as DVD and Blu-ray Disc™ players use servos to extend or retract the disc trays.

Servo vs PWM

PWM stands for Pulse Width Modulation. PWM is the process of turning ON and OFF digital voltage quickly to simulate a range of voltage. For example... If the digital output pin of a micro is 3.3v, and the PWM is set for a 50% duty cycle, the output voltage would be approx 1.65v. This is because the microcontroller is turning ON and OFF the digital 3.3v pin real quick, which is producing a simulated lower voltage. You can use PWM to vary the brightness of an LED, for example.

A servo uses PWM as well. The "frame" of a servo PWM signal is 20ms. Many controllers, such as Arduino libraries do not maintain the 20ms specification defined for servos. Because of this, challenges have been introduced to servo manufacturers when decoding incoming PWM signals. This has caused the need for servos to be "Smarter" by adapting to the unusual PWM transmitted by poorly written libraries which do not adhere to the servo PWM Standard. The EZ-B does adhere to servo PWM standards.

How does a servo motor work

The simplicity of a servo is among the features that make them so reliable. The heart of a servo is a small direct current (DC) motor, similar to what you might find in an inexpensive toy. These motors run on electricity from a battery and spin at high **RPM** (rotations per minute) but put out very low **torque** (a twisting force used to do work— you apply torque when you open a jar). An arrangement of gears takes the high speed of the motor and slows it down while at the same time increasing the torque. (Basic law of physics: work = force x distance.) A tiny electric motor does not have much torque, but it can spin really fast (small force, big distance). The gear design inside the servo case converts the output to a much slower rotation speed but with more torque (big force, little distance). The amount of actual work is the same, just more useful. Gears in an inexpensive servo motor are generally made of plastic to keep it lighter and less costly. On a servo designed to provide more torque for heavier work, the gears are made of metal (such as with EZ-Robot Servos) and are harder to damage.

Figure 1.5 Servo motor

With a small DC motor, you apply power from a battery, and the motor spins. Unlike a simple DC motor, however, a servo's spinning motor shaft is slowed way down with gears. A positional sensor on the final gear is connected to a small circuit board. The sensor tells this circuit board how far the servo output shaft has rotated. The electronic input signal from the computer or the radio in a remote-controlled vehicle also feeds into that circuit board. The electronics on the circuit board decode the signals to determine how far the user wants the servo to rotate. It then compares the desired position to the actual position and decides which direction to rotate the shaft so it gets to the desired position.

1.2.5 Python

Python is a broadly utilized abnormal state programming dialect for universally useful programming. Translated dialect, python has an outline theory which underlines code coherence (quite utilizing white space to delimit code squares as opposed to wavy props or catch phrases), and a sentence structure which enables developers to express ideas in less lines of code than conceivable in dialects, e.g. c++, java. The dialects gives builds planned to empower composing clear projects on both a little and expansive scale.

1.2.6 Opencv

OpenCV (open source computer vision) is a library of programming capacities for the most part gone for ongoing pc vision. Originally created by Intel’s exploration focus in Nizhniy Novgorod (Russia), it was later upheld by willow garage and is presently kept by Itseez. The library is cross-stage and free for use under the open source BSD permit.

1.2.7 Firebase

Firebase is a mobile and web application development platform developed by Firebase, Inc. in 2011, then acquired by Google in 2014.As of March 2020, the Firebase platform has 19 products, which are used by more than 1.5 million apps. The various services provided by the FireBase are:

- Google Analytics
- Firebase Cloud Messaging
- Firebase Authentication
- Firebase Realtime Database
- Cloud Firestore
- Firebase Storage
- Firebase Hosting
- ML Kit

1.2.8 Arduino nano

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328PThe Arduino Nano is programmed using the Arduino Software (IDE), our Integrated Development Environment common to all our boards and running both online and offline.The Nano board weighs around 7 grams with dimensions of 4.5 cms to 1.8 cms (L to B).

The Nano board doesn't have a DC power jack as other Arduino boards, but instead has a mini-USB port. This port is used for both programming and serial monitoring. The fascinating feature in Nano is that it will choose the strongest power source with its potential difference, and the power source selecting jumper is invalid.

Microcontroller	Atmega328p/Atmega 168
Operating Voltage	5V
Input Voltage	7 – 12 V
Digital I/O Pins	14
PWM	6 out of 14 digital pins
Max. Current Rating	40mA
USB	Mini
Analog Pins	8
Flash Memory	16KB or 32KB
SRAM	1KB or 2KB
Crystal Oscillator	16 MHz
EEPROM	512bytes or 1KB
USART	Yes

Arduino Nano Specifications

Figure 1.6 Arduino Nano specifications

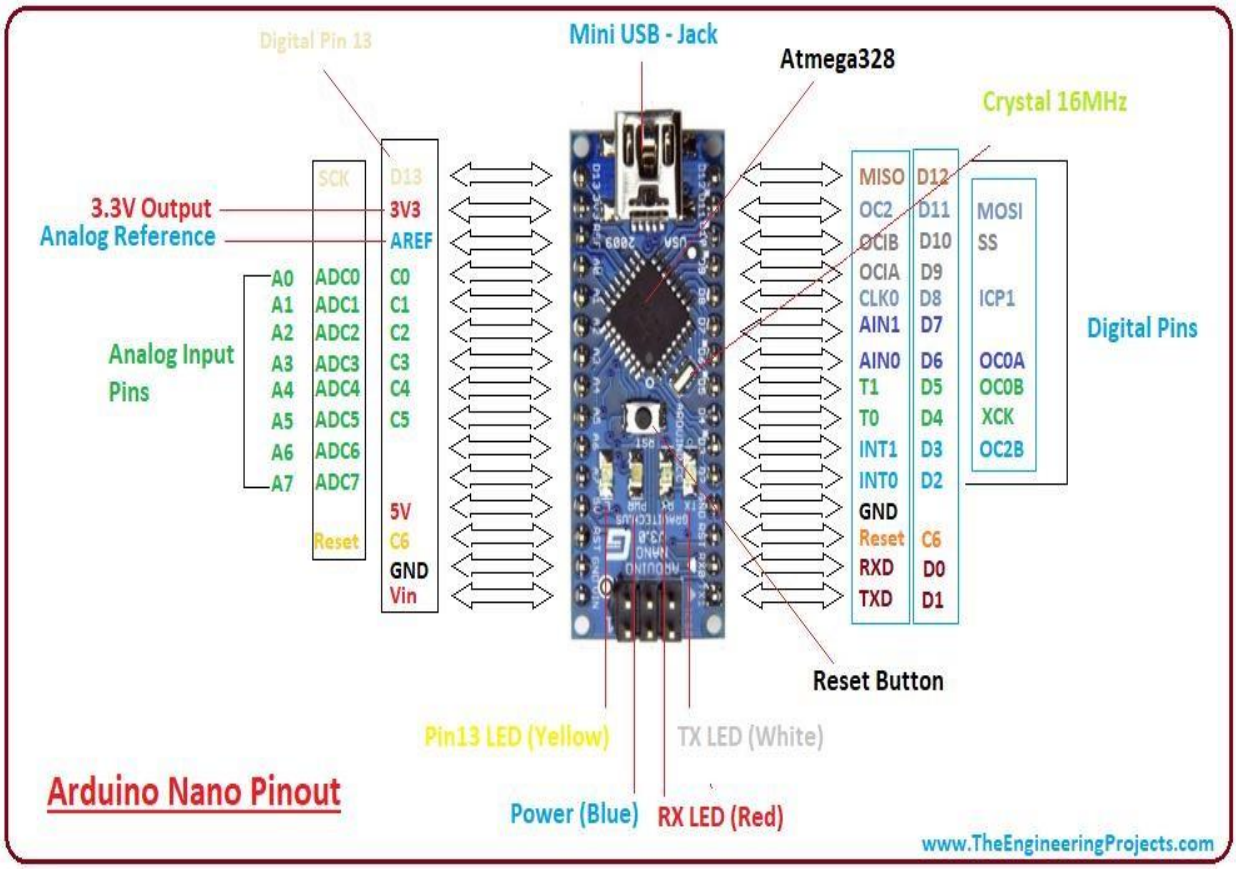

Figure 1. 7 Arduino Nano Pinout

1.3 Selection of microprocessor

Raspberry Pi is a Microprocessor and it is not microcontroller. It is a mini computer with GPU, Wifi, etc….Raspberry Pi cannot run on it's own it needs Operating System to perform tasks. Here, the operating systems include Raspbian OS,Windows 10 IoT Core, Debian and so on.

A microcontroller is best used for simple repetitive tasks: opening and closing a garage door, reading the outside temperature and reporting it to Twitter, driving a simple robot.

Raspberry Pi is best used when you need a full-fledged computer: driving a more complicated robot, performing multiple tasks, doing intense calculations (as for Bitcoin or encryption)
Pi is faster than Arduino by 40 times in clock speed. Pi has ram 128000 times more than Arduino.So Raspberry Pi is more powerful than Arduino. Arduino has 32kb of storage on board. This is used for storing the code.hence to ease the process of computing and running advanced algorithms Raspberry Pi is the best choice.

Chapter 2

LITERATURE SURVEY

M. Meena 1, P. Thilagavathi (2013)

The surveillance robot is widely used in mostly applications like industrial application (automation), home automation, hospitals, space exploration; military (defence) etc for this purpose continuous surveillance is required. In this study automatic docking system (ADS) is purposed with recharging and battery replacement process. The robot can return ADS whenever battery is low. The charging duration is important regarding this to overcome this difficulty battery replacement is a better solution. The robot can come to ADS when battery is low and get replaced with new battery within 30 seconds, so that the robots need not to be turned off whenever replacement is there. System design can work in three modes: (1) patrolling mode (2) first response modes (3) remote control mode whenever voltage level of ion battery is below the threshold level a message is sent to docking station. After receiving message robot automatically moves to the docking station. There are two units to check whether the robot enters to docking station, one is I sensor and other is electrode unit on the oscillating bar. With this design it only takes 30 seconds to accomplish the battery exchanging process. [1]

K.Aruna, A.SriRamsagar, G.Venkateswarlu(2013)

Robot is controlled by a mobile phone that makes a call to the mobile phone attached to the robot. In this call if any key is pressed corresponding tone is heard at the other end of the call by using dual tone multiple frequency (DTMF). The robot perceives the DTMF tone with the help of phone stacked in it. The received tone is processed by the atmega32 microcontroller with the help of DTMF decoder MT8870. Decoder decodes the DTMF tone into its equivalent binary digit and this binary digit is send to micro controller. The microcontroller is pre-programmed to take decision for any input or output to motor drivers for forward, backward motion or return. The primary function of the mobile operated robot with DTMF decoder is to move that places where man can’t move. The robot perceives the DTMF tone with the help of phone stack in the robot. [2]

Mayank Dharaskar, Vatan Gupta, Priyanka Kale, ReetaChopade, Aayush Jaiswal, Prof. SharadkumarGhadale (2016)

This study is base on IOT based robotic car which uses raspberry pi, USB camera, two dc motors and robotic chassis to built this robotic car setup. It has a web camera mounted over it, through which we can get live video feedback and interesting part is one can control it from the web browser using internet. A page is built in HTML which has left, right; backward, forward links by clicking the links one can move it in any direction. Two terms are used one motion and other flask motion for getting live video signal from USB camera and flask for sending commands to raspberry pi using python to move the robotic vehicle. The web cam will capture the live data and then send to desired device through internet and the user will be observing this data on the monitor at the users end.

L298N motor driver can control two dc motors at a time so it is easy to use it. SSH is secured shell without it raspberry pi wouldn't be detected by windows. With the help o raspberry pi the range of operation of robotic car is not limited it can remote large areas. One can easily control as well as monitor the activity of the robotic unit. [3]

Dr. Shantanu K. Dixit, Mr. S. B. Dhayagonde (2014)

This study helps us to detect living bodies with the help of PIR sensor and to control the robot with the help of internet. The camera mounted robot is able to move horizontally and vertically around its vertical axis. Camera movement is controlled through the webpage by the user and providing with enhanced view of the surroundings. PIC 16F877 is used for controlling dc motors which is used for collecting data from PIR sensor for detecting living being. This technology gives helping hand to our security forces for detecting intruders. Also, used in finding the injured persons during disasters such as earthquakes, collapsing of buildings, in mining fields and can be used as a spy robot. [4]

Aaruni Jha, Apoorva Singh, Ravinder Turna, Sakshi Chauhan (2015)

This is RF based spying robot attached to wireless camera that can reduce human victim. This robot sends signal to the base station using wireless camera. Android phone is used to control the movement of the robot. The robot sends the signal to RF receiver mounted on the robot via RF transmitter at the base station, with this feature robot can transmit real time videos with night vision capabilities and can't be identified by the enemies. It uses 8051 microcontroller which controls the motor and wireless camera as well as receiver and transmitter unit. The aim of the

paper is to view things accurately that are happening in the surrounding area, to all this control is needed where controls RF signals are used. By using this signal encoding is done and signal is sent to the transmitter which gives input to drive the motor it is used as short distance spy robot. [5]

Md NorozzamanJiko, Mahmudul Hasan Shayket, Ashraful Ghani Bhuiyan, and Golam Rabby (2016)

This paper represents rescue robot which can run on any rough surface including staircase. It can also floats on water as well as dive under water. IOT based rescue robot uses new technology which makes it unique. As it is IOT based so it can be easily monitored by android or computer. For sensing environment various sensors are installed in it. Its flexible structure provides it to be modified and updated for expanding it to be used in various applications. There are six wheels in total, using V-belt as tank tracks, made from ebonite sheet (wheels).three servo motors and six dc motors are used. Arduino controller is used to control the motors. A Bluetooth module HC-05 is connected with Arduino controller to communicate with the smart phone. Temperature sensor, pressure sensor, humidity sensor and gas sensor are connected with Arduino controller to sense the environment. Two Li-Po batteries are used one for driving motor and other for powering the Arduino controller. Two android phones are used one placed at the front and other inside the robot. In this amphibious robot smart technologies are used for communication via internet. It can run on the rough surface, staircase, underwater and on water. [6]

Kena Patel and Bhavna K. Pancholi (2017)

This project is designed to develop a fire fighting robotic vehicle using android application. Robotic vehicle is loaded with water tanker and a pump which is controlled by wireless communication to sprinkle water to extinguish fire. An AVR Atmega-32 is used for desired operation. Remote operation is achieved by any smart phone/tablet etc with android OS, upon a GUI based touch screen operation. Android is using XML and functioning is defined in JAVA . It has mainly two modules (1) navigating module (2) fire extinguisher module. Navigating module (transmitter) is used to navigate robotic vehicle, it consists of android phone with android application. Fire extinguisher module is a whole fire fighting robotic vehicle (receiver) which has water sprinkler to extinguish fire. Next part of fire extinguishing module is to detect flame which detects flame near to robotic vehicle. Feature of obstacle detection is added which is

use to protect the robotic vehicle from obstacle. Upon both of above inconvenience alert is given the form of buzzer. The developed system decreases risk factor involved in job of fire fighting. [7]

Satish Kumar Ojha, Vishal Singh, Priyank Sharma, Swaraj Dash (2017)

This is a system for unmanned mission which will help in exploration of viable planetary options that can support human life. The project has two robotic systems: base station and rover the base station is already docked on the planet and rover is unmanned mission sent to planet. It involves wireless communication between two systems. This automated technology helps in reducing risk of human lives but also reduces cost of space mission. Base station is coded with embedded c upon Arduino IDE when base station boots up it connects to the wifi network under MQTT broker hosted by raspberry pi. An input supply of 5V and 2A is provided to raspberry pi from 6000 mAhpowerbank operating for two hours. Camera on pi draws a power of 1250 mw. [8]

Supantha Mandal, Suraj Kumar Saw, Shilpi Maji,Vivek Das , SravanthkumarRamakuri, Sanjay kumar (2016)

This paper focus on path following two wheeled compact portable robot using Arduino as central driving functional unit with wifi control and Bluetooth module with collision detection avoidance and control features which provides unique ability of danger avoidance , falling from a height with improved stability and precision control. The design is integrated with infrared sensors, bluetooth module, and wifi module control with dc gear motors which controls the speed of vehicle and avoid collision in the path of the robot. A low cost robust portable design using GUI control has been implemented with advanced features which makes it very unique and attractive for commercial productions. [9]

Kevin I-Kai Wang, Opender Singh, Eu-Lee Teh, Kean Aw (2016)

This study seeks to address the issues by developing an untethered unmanned ground vehicle with a multitude of sensors to map its 3D path coupled with GUI to fascillatetwo way communications with raspberry pi micro controller. In this paper wireless communication is achieved by TCP over a wifi connection. Dead reckoning has been used as a technique to process proprioceptive sensor data. The raspberry pi is an OTS (open testing data) was chosen as microcomputer for this study because of its superiority. Motor controls are done with the help of python script which uses motor controller and sensors onboard vehicle. In the following research

a prototype of 3D terrain mapping vehicle that can make its own path was successfully developed using off the shell components. A sensible 3D path of vehicle was successfully constructed by combining multiple sensor data including odometry, pitch angle and heading of the vehicle. [10]

Mohammad Salah Uddin and Mario Gianni (2017)

This study introduces a long range internet connected robot teleoperation system based on internet of things (IOT). The aim of study is to support operators during remote teleoperation of robotic systems in situations where operators loose connections due to damaged caused to that particular vehicle. IOT allows connecting remote and mobile things or machines. It also assets through the use of wireless communication and low cost sensors, computing and storage devices. System architecture consists of a pioneer 3AT mobile robot endowed with a notebook computer. It is connected to computer via USB serial port. The notebook is connected to internet via 4G modem. Internet connection is also mandatory since we are interesting in controlling robot via IOT. On top of ROS architecture an application that receives command from IOT cloud and convert them to velocity commands for robot. It reduces the cost of deployment currently it moves blindly to some extent. [11]

Mr. Lokesh Mehta, Mr. Pawan Sharma (2014)

This paper reveals it as a spy robot which is controlled by keyboard of the computer. It can give live telecast of audio and video signals from surroundings and can be sent to remote station by RF signal and also able to give signal whenever there is darkness in the surroundings because it has extra circuitry which detects darkness and automatic flash light is on. Its maximum range is 200 meters. When a key is pressed from the keyboard of monitor it firstly converts the signal into machine language by Arduino board through USB port represents it as cmos logic. Now signal from Arduino board is converted into RF signal by RF module. At the remote section signal is received from RF module in the form of radio frequency which is converted into binary. From RF module, signal is transmitted to microcontroller, which makes the decision according to command described in programming. Ultrasonic sensor detects the distance and data sent to microcontroller output is generated as per decision of the microcontroller and display on LCD(16x2) and also displays on LCD monitor and LDR detects the light using microcontroller

makes a decision either flash light is off or on. Following favourable results are based on robot as live telecast, night vision, obstacle detector and distance measurement. [12]

Mohammed Rubaiyat Tanvir Hossain,Md. Asif shahjalal, Nowroz Farhan Noor(2017)

In this paper web controlled partial robotic vehicle system is purposed. The idea is to control a robotic vehicle from any where through Internet over a secured web server. The main purpose is to minimise the risk of human life and ensure high safety during drive. The car can be remotely control through Internet using web server, in case of no connectivity it can act autonomously depending on good weather condition. Purposed study consists of complex computer vision algorithms and live transmission of video with the internet. Raspberry Pi and Arduino are used to built this prototype. Raspberry Pi streams the video to internet. A user can access the streaming video through internet. Although Raspberry-Pi is a powerful tool yet we need more powerful tool to implement this idea on a real car. [13]

Chapter 3

DESIGN MODELLING AND SIMULATION

3.1 Functional Block diagram.

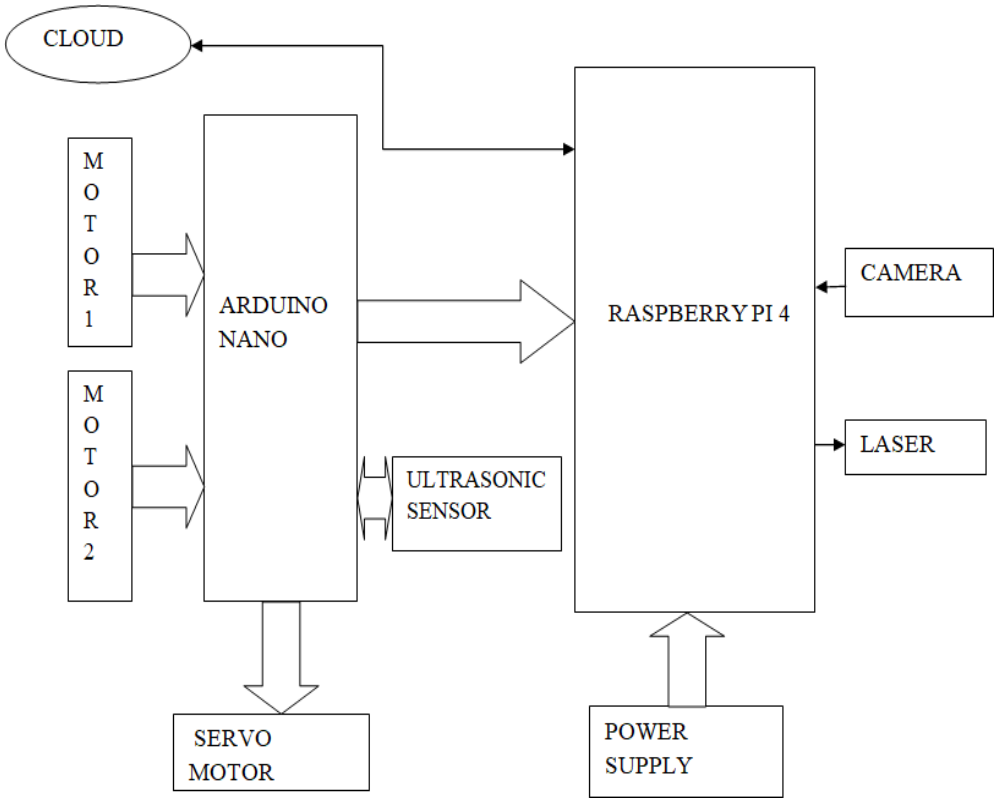

Figure 3.1 Block diagram

The Raspberry Pi is connected via cloud known as firebase (Google firebase). Web camera is used for the purpose of visual feedback to control robotic arm through webpage. All are working according to user inputs with a network medium. We make of raspberry pi in order to capture images using haar cascade classifier, haar cascade classifier is basically an XML file where used for face detection purpose. So, if the robot detects that it is a person the image is send through Google firebase then further it is been sent to the required system. Here we make use of 2 motors, DC geared motor and Servo motor. DC motor is used for linear movement and servo

motor is responsible for angular movement of the robot. Both the motors are controlled by Arduino NANO where we make use of a motor driver(L293D). The Robot uses Raspberry Pi 4 and an Arduino NANO. Two motors (DC Geared and Servo) are connected to Arduino NANO which inturn is connected to Raspberry Pi 4. The robot is using DC GEARED motors to move front or back.The camera is mounted on the servo motor which rotates 180 degree. The laser is placed on the camera. As we know servo motor is responsible for angular movement. So once the camera detects a person an interrupt is sent to pin No.2 of Arduino NANO. This interrupt stops both the motors which were in motion the camera also captures a photo and this photo is sent to the firebase cloud. The person using firebase cloud decides whether to shoot the target or not if he chooses "yes" then the Laser is activated and the target is shot. Here we make use of Ultrasonic sensor for the robot to take deviations as soon as it detects an obstacle. The basic working of ultrasonic sensor is, they work by emitting sound waves at a frequency too high for humans to hear. They then wait for the sound to be reflected back, calculating distance based on the time required. This is similar to how radar measures the time it takes a radio wave to return after hitting an object. Ultrasonic sensors are used for distance measuring applications. These gadgets regularly transmit a short burst of ultrasonic sound to a target, which reflects the sound back to the sensor. The system then measures the time for the echo to return to the sensor and computes the distance to the target using the speed of sound within the medium.

3.2 Ultrasonic Obstacle Detection

Ultrasonic sensors are used to detect the presence of targets and to measure the distance to targets in many robotized processing plants and process plants. Sensors with an ON or OFF digital output are available for detecting the presence of objects and sensors with an analog output which changes relatively to the sensor to target separation distance are commercially available. The basic working of an ultrasonic sensor is as follows:

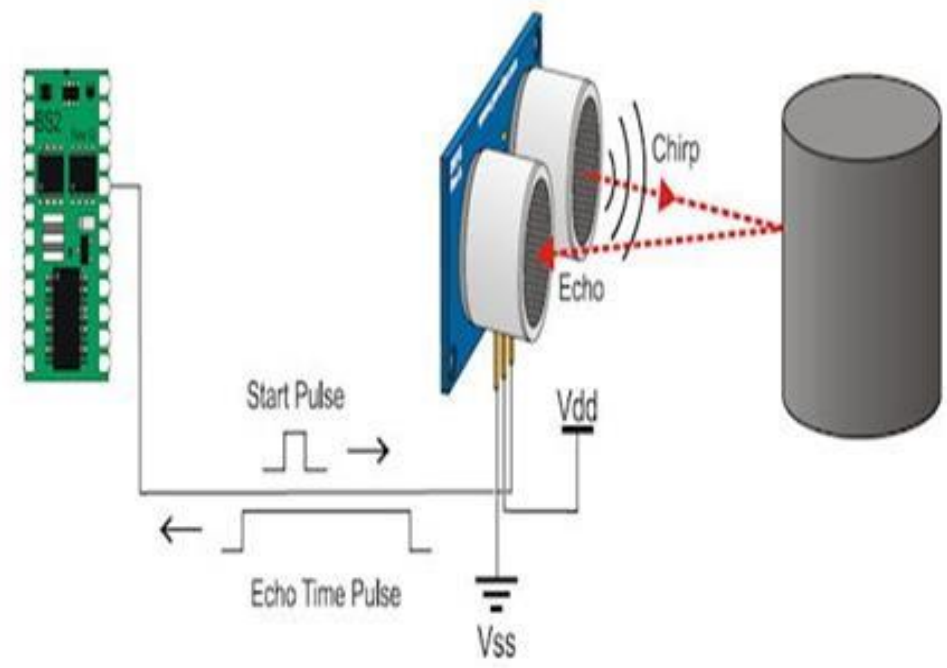

Figure 3.2 : Ultrasonic sensor working

Ultrasonic obstacle sensor consists of a set of ultrasonic receiver and transmitter which operate at the same frequency. The point when the something moves in the zone secured the circuit's fine offset is aggravated and the buzzer/alarm is triggered. Different sorts of transducers are utilized within industrially accessible ultrasonic cleaning devices. An ultrasonic transducer is affixed to a stainless-steel pan which is filled with a solvent and a square wave is applied to it, conferring vibration energy on the liquid. The most common type of ultrasonic sensor used for distance measurement is given below.

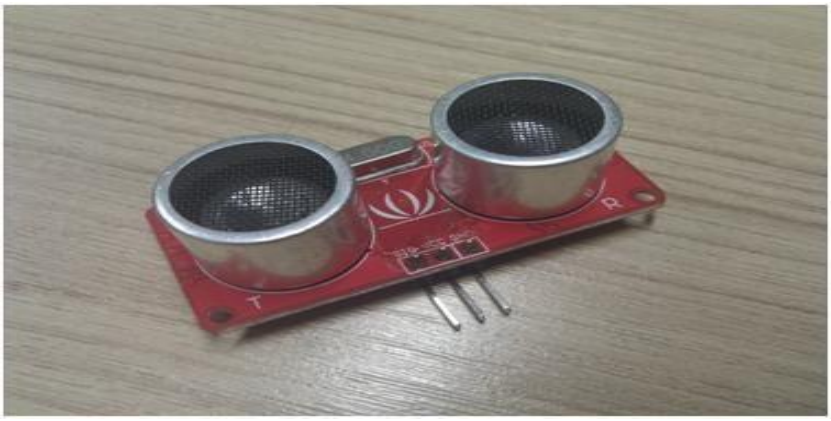

Figure 3.3 Ultrasonic sensor

3.3 Installing Raspbian on Raspberry Pi:

Raspbian is the recommended operating system for normal use on a Raspberry Pi. Find help with installing Raspbian on your Pi in our online Getting started guide. You can browse basic examples to help you get started with some of the software available in Raspbian, find more detail about the Raspbian operating system, or read information on fundamental Linux usage and commands for navigating the Raspberry Pi and managing its file system and users.

Capturing image uses a webcam in Raspberry Pi

To interface a USB camera and Wi-Fi with Raspberry Pi.It also to capture the image.

- Basic image capturing usage.
- Set specify a resolution.
- Set full a resolution with no banner.
- Bash script.
- Python with Bash script.

3.4 Image Processing with OpenCV

Visual information one of the most important type of information perceived, processed and interpreted by human brain. Image processing is a method to perform some operations on an image, in order to extract some useful information out of it. An image is nothing more than a two-dimensional matrix (3-D in case of colored images).

Image processing with Python & Open-CV aims at providing an overview of Open-CV library, itsfunctions, application & capabilities along with getting your hands adept withit. Image processing basically means performing processes on an image with the help of software. The goal of applying processes like smoothing, sharpening, contrasting, stretching etc. on an image can be to increase its readability or to enhance its quality or even transform the image.

3.4.1 Installing Libraries and Packages

In the above build project, we have used Raspberry Pi model 3 B+ with latest version of Raspbian having an OpenCV inside virtual environment with OpenCV3 correctly installed in it.

In the new terminal lets enter into the virtual environment:

```
source ~/.profile
```

```
workon cv
```

Inside virtual environment enter Python interpreter and confirm that you are running the 3.5 (or above) version.

```
python
```

Inside the interpreter import the OpenCV library and check for OpenCV version which appears 3.3.0 or any superior version.

```
import cv2
```

```
cv2.__version__
```

3.5 Face Detection:

The first step of our project in order to capture a person's image is to detect it. The most common way to detect a face (or any objects), is using the Haar Cascade classifier Object Detection using Haar feature-based cascade classifiers is an effective object detection method proposed by Paul Viola and Michael Jones in their paper, "Rapid Object Detection using a Boosted Cascade of Simple Features" in 2001. It is a machine learning based approach where a cascade function is trained from a lot of positive and negative images. It is then used to detect objects in other images.Here we will work with face detection. Initially, the algorithm needs a lot of positive images (images of faces) and negative images (images without faces) to train the classifier. Then we need to extract features from it. The good news is that OpenCV comes with a trainer as well as a detector. If you want to train your own classifier for any object like car, planes etc. you can use OpenCV to create one. If you do not want to create your own classifier, OpenCV already contains many pre-trained classifiers for face, eyes, smile, etc. This Phase involves capturing of a

set of images which adds to the data set so as to compare the faces which are recognized in phase 3.The most common way to detect a face (or any objects), is using the **Haar Cascade classifier**. Object Detection using haar feature-based cascade classifiers is an effective object detection method. It is a machine learning based approach where a cascade function is trained from a lot of positive & negative images and OpenCV comes with a trainer as well as a detector.

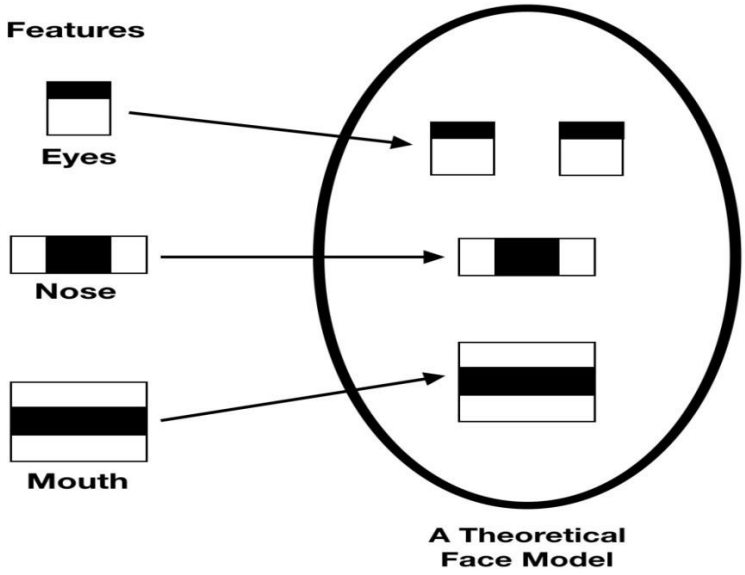

Figure 3.4 Haar cascade Basic principle

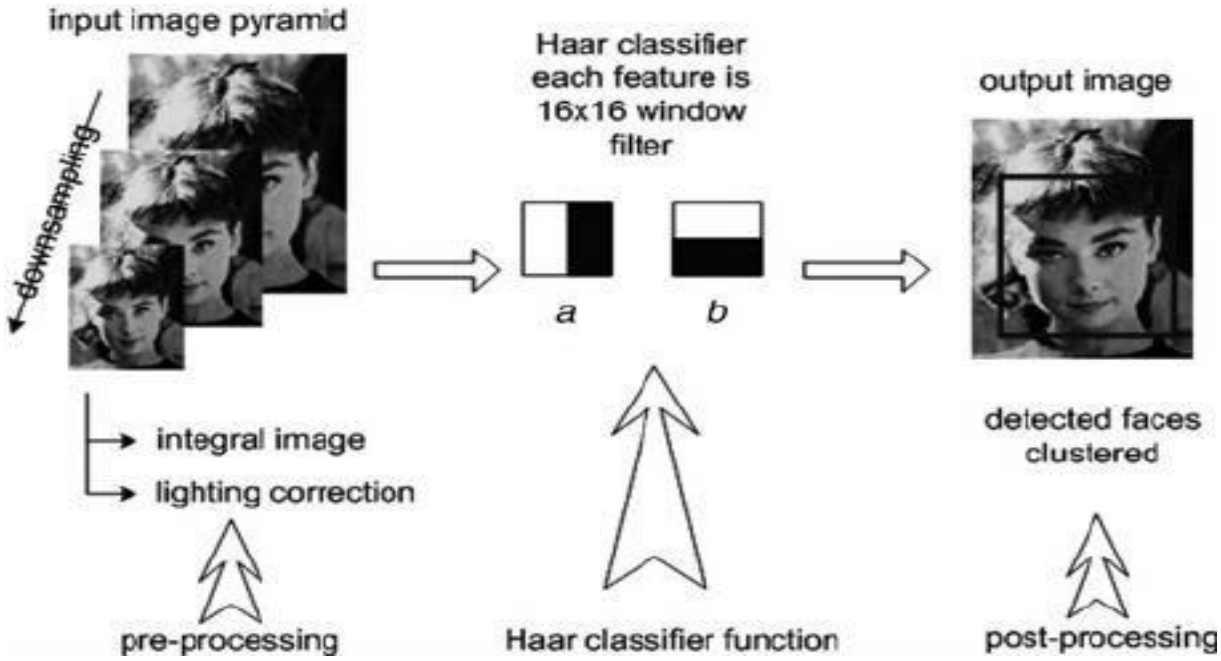

Figure 3.5 Haar cascade algorithm working

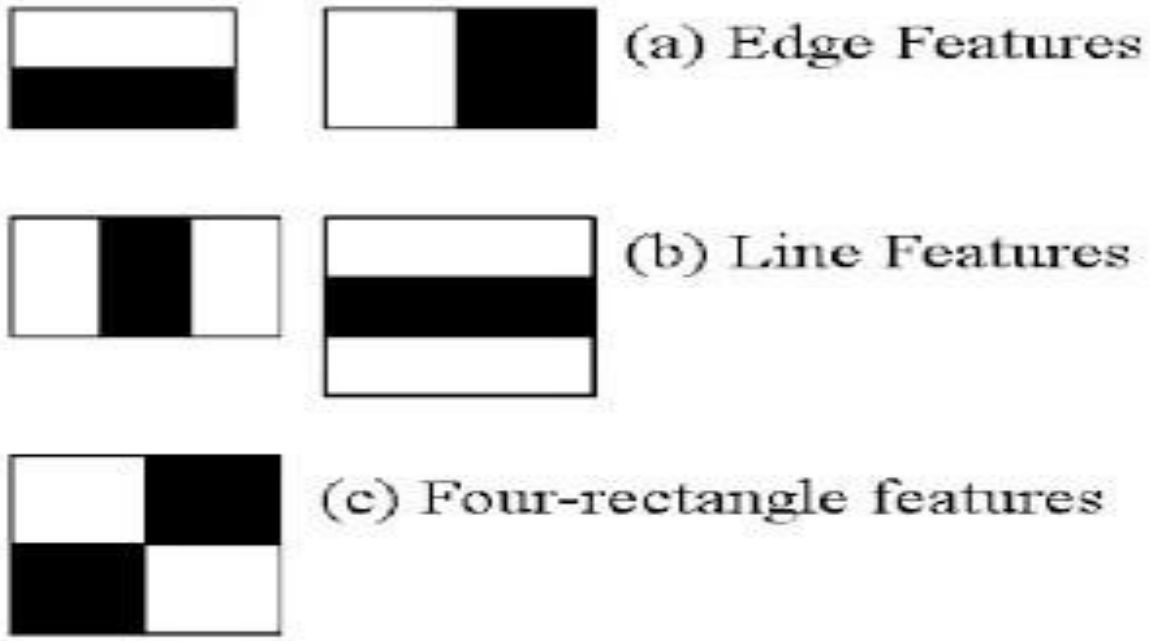

Figure 3.6 Creating Sub windows

3.6 FLOW CHARTS

- As we enable the Raspberry pi the next immediate task of the robot is to turn on the motors.
- Here, we make use of 2 sets of motors, DC geared and servo motor.
- The servo motor is responsible for angular rotation and similarly DC motor is responsible for linear motion of the robot.
- The servo motor rotates 180 degree the whole time.
- Likewise, the DC geared motor also runs and is responsible for linear motion.
- Now we initialize the ultrasonic sensor to sensing the obstacles.
- Requirement here is in such a way that every time the ultrasonic sensor detects the obstacle it turns left since the camera is mounted on the right side of the robot.
- This is done because the requirement is satisfied as it covers an entire region which is closed area for instance, we can assume a rectangle of a closed loop where is robot is suppose to guard the entire loop in which is bounded by border in all directions.
- As the person is detected both the motors stop working, an interrupt is sent to Arduino (Pin no 2) from the raspberry pi.

Pattern of Obstacle avoidance by ultrasonic sensor

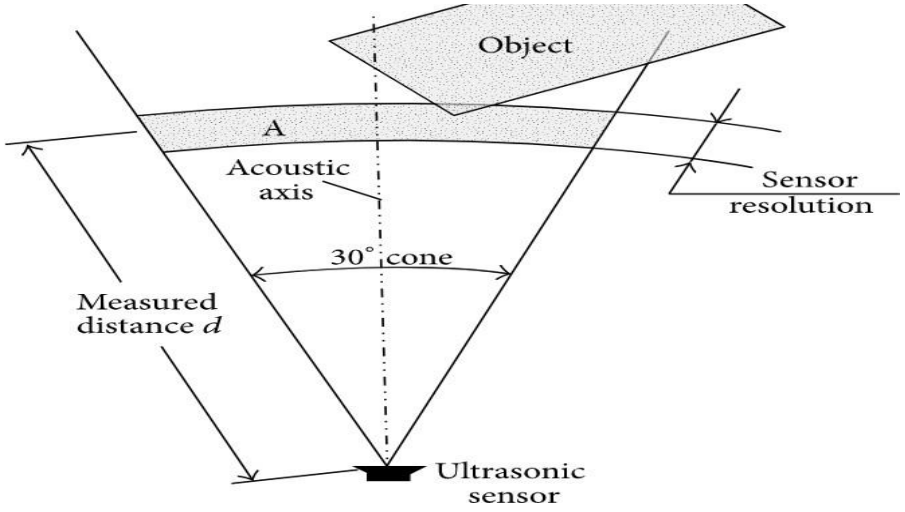

Figure 3.7 : Pattern of obstacle avoidance

To understand DC and SERVO Motor operations:

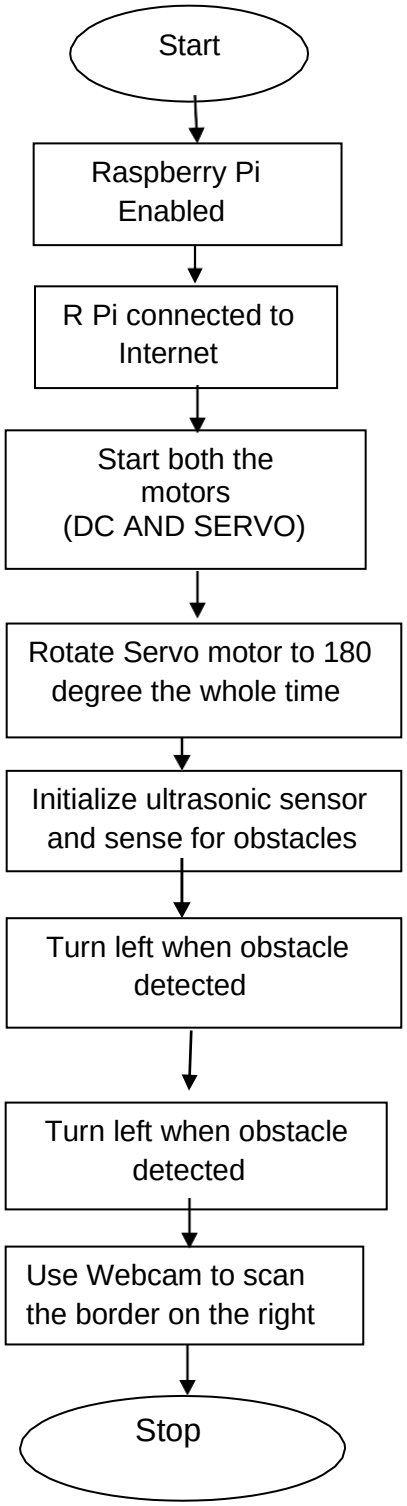

Figure 3.8: Flow chart of DC motor and Servo motor

To understand Webcam operations:

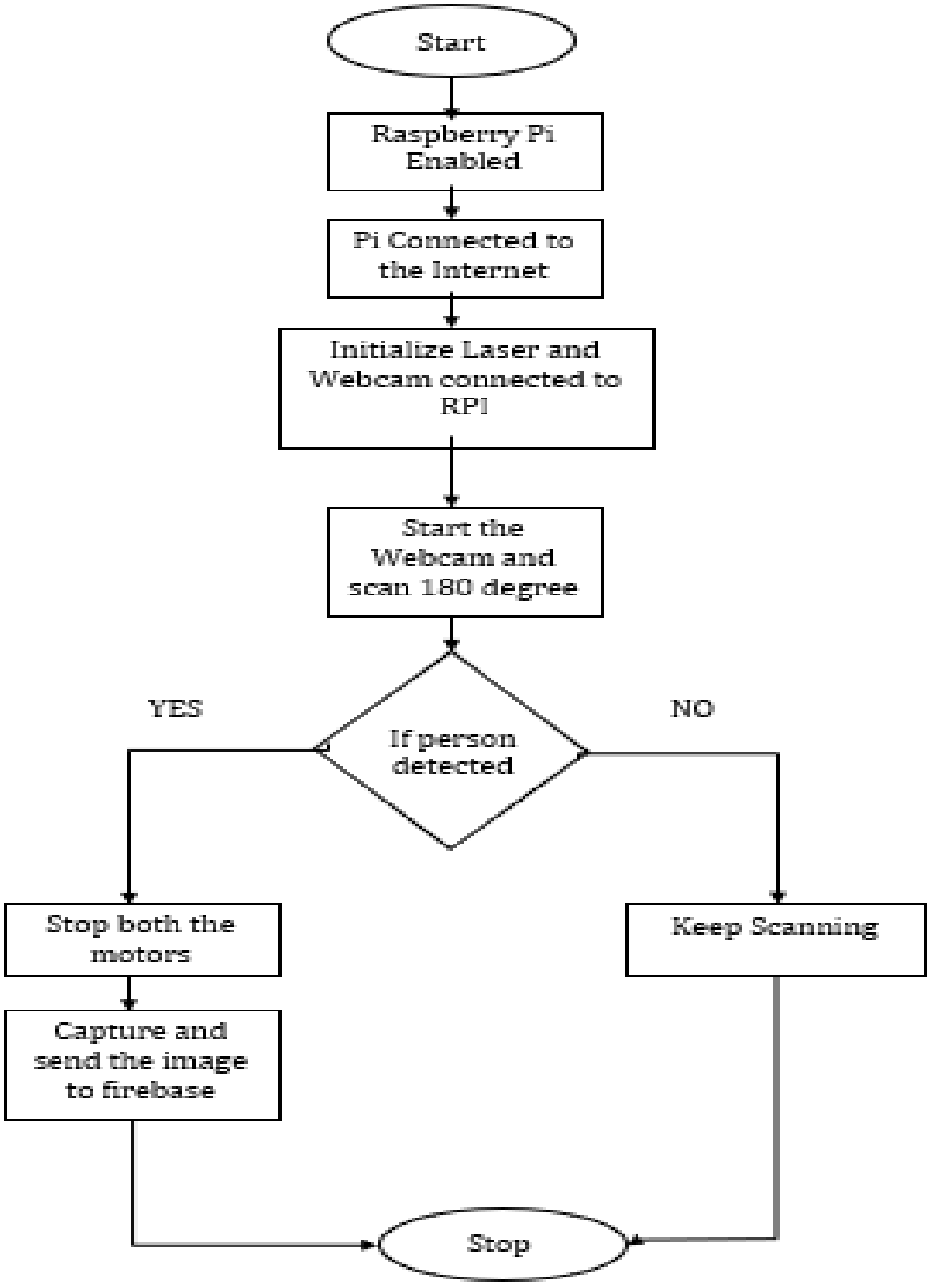

Figure 3.9 Flow chart of Webcam

- After the Raspberry Pi is enabled, it connects to the internet first and two vital components of the project are then initialized.
- The first one being the Webcam and the other one is the LASER.
- The Webcam is mounted on the Servo motor which covers an area of 180 degree continuously.
- The Webcam keeps scanning the area to detect any person on the right side of the robot, while the robot is patrolling around a plot of land, securing it by continuously taking left turns and forming a closed loop around it.
- Upon the Webcam, resides the LASER which is used to fire when we command it.
- If the Webcam detects any person trying to trespass, the robot stops right there, i.e., both the motors stop and a picture is captured which is sent to the firebase.
- Based on the command received either the LASER shoots the suspect or ignore it and the robot continues its motion and keeps scanning.

Stages explaining how the Webcam detects a person by collecting a number of positive and negative images using Haar Cascade classifier.

Figure 3.10 3 stages of face detection

To understand how firebase is interacting with the robot :

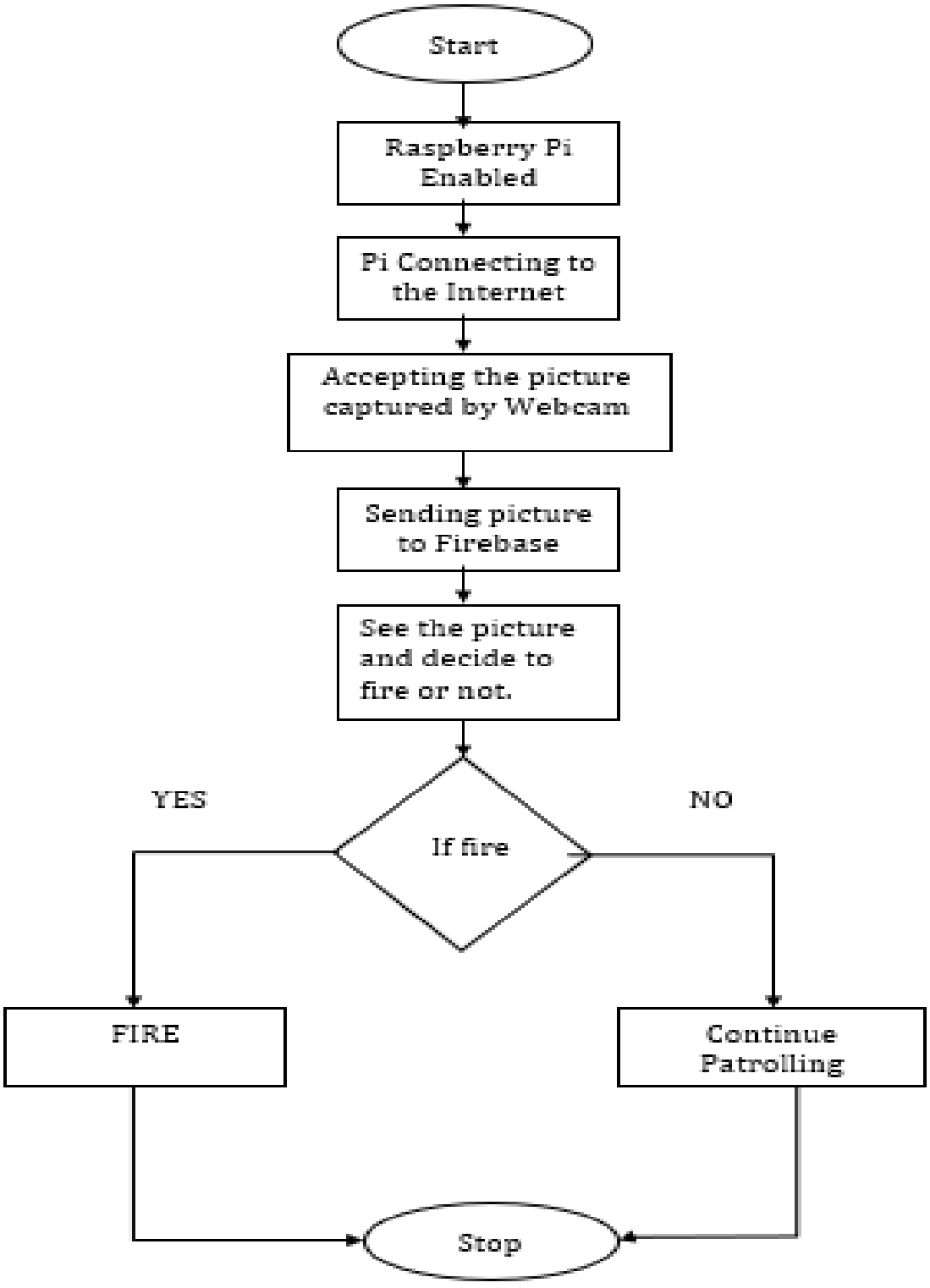

Figure 3.11 Flow chart of Google Firebase

Chapter 4

RESULTS AND ANALYSIS

Following are the snapshots of the robot:
The DC Motor is connected to robot in order to generate linear motion

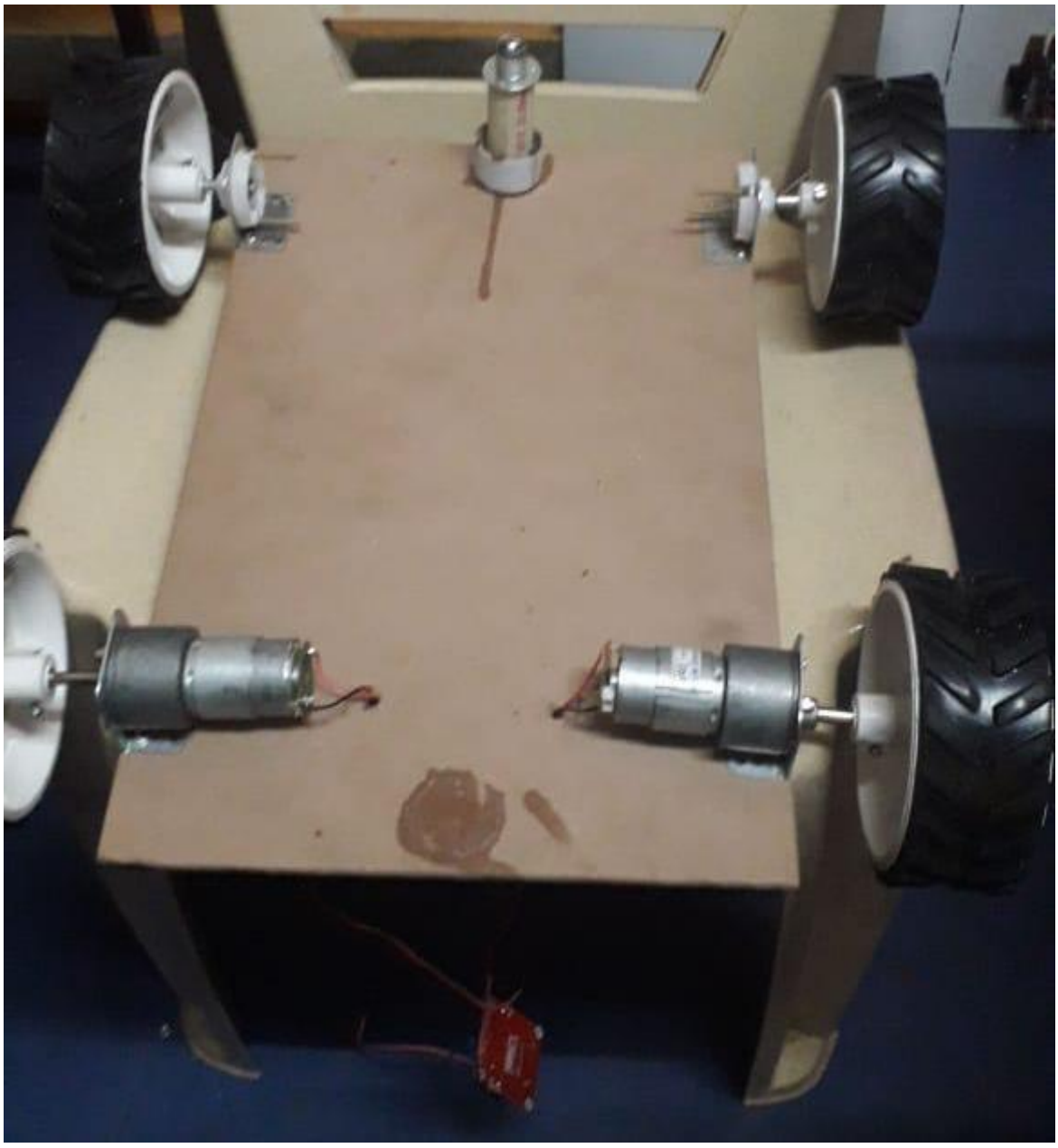

Figure 4.1 DC Motor connection

Webcam is Mounted on servo motor as shown in the figure

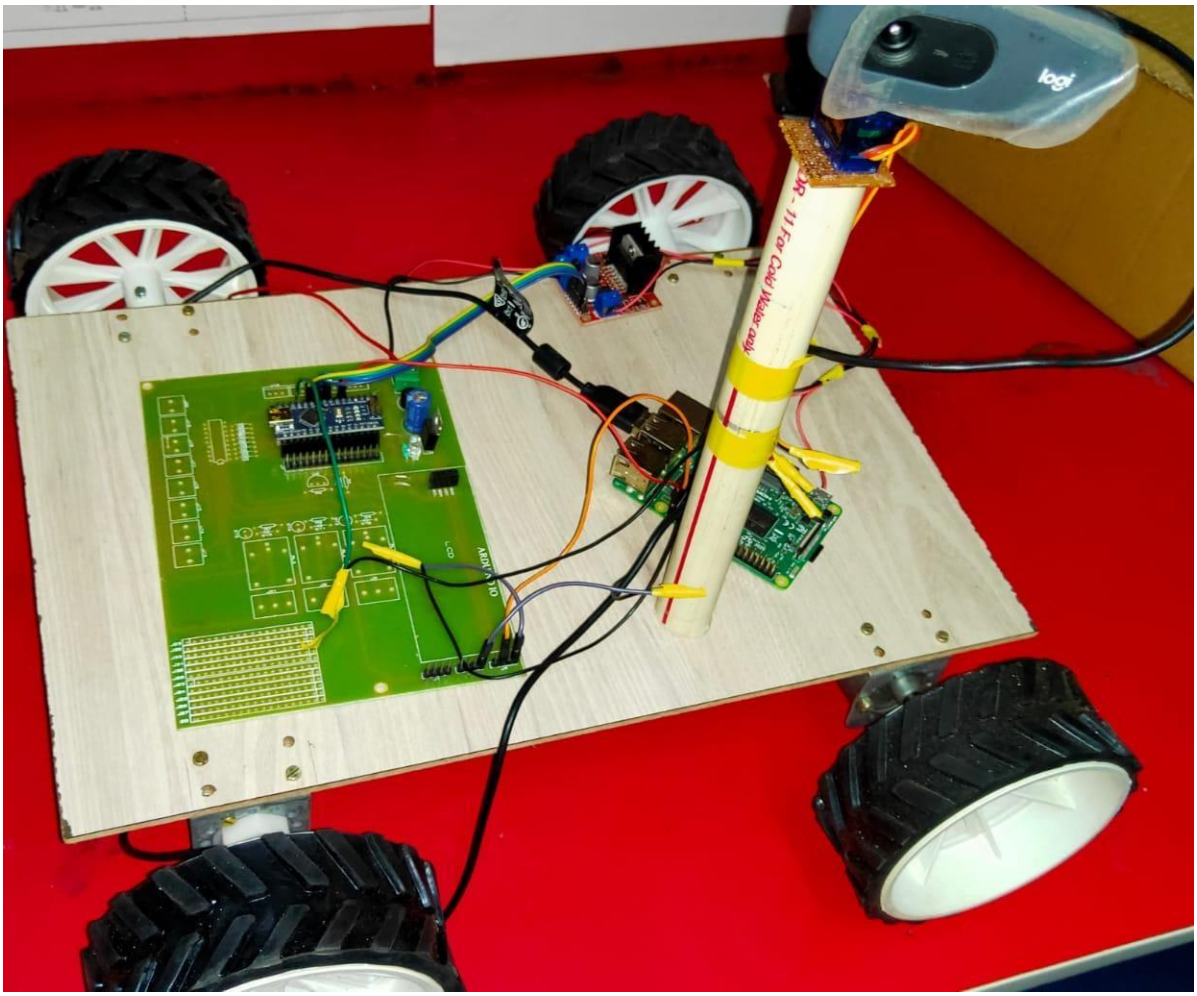

Figure 4.2 Robot Side view

The arm of the robot constitutes of a 5MP camera which is the eye of the robot and it is mounted on a servo motor which serves the purpose of motion of the camera in the plane parallel to the ground . The servo motor is connected to the arduino nano which serves as the communication bridge to the Raspberry Pi. The Raspberry Pi creates a interface to the cloud service used , in this case Google FireBase.

The chassis of the robot is mounted on a dc motor which fulfills the forward and backward movement of the robot. the arduino nano also serves as the communication bridge between the dc motor and the Raspberry Pi. On the chassis we have a ultrasonic sensor placed so as to detect any obstacle in its path.

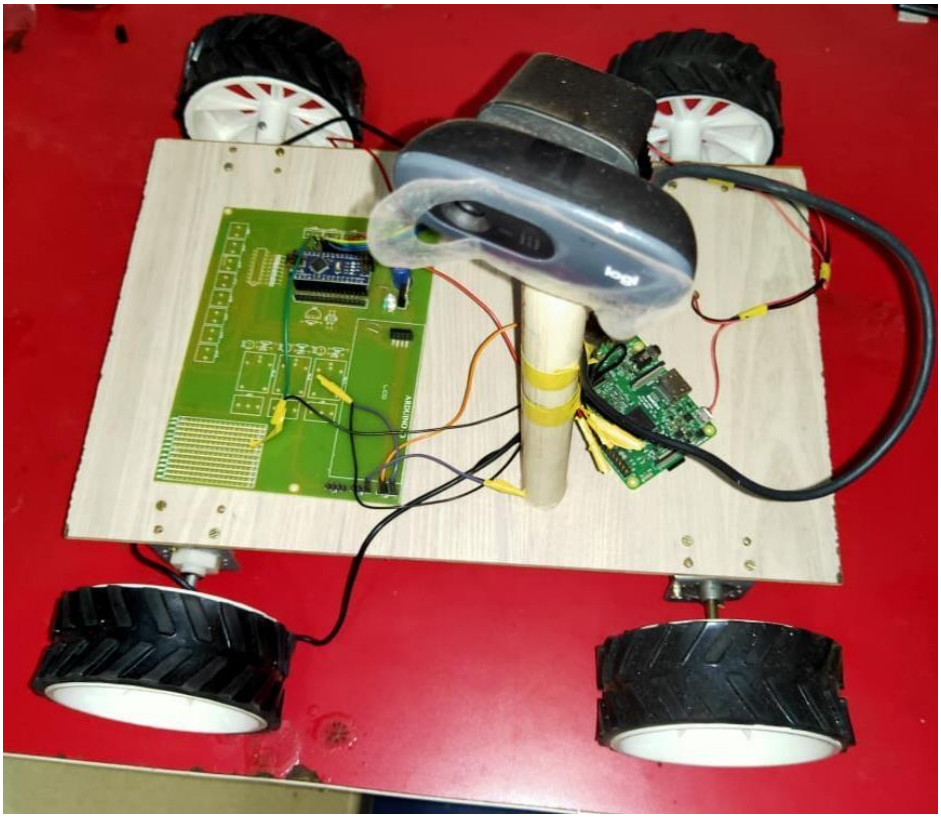

Figure 4.3 Robot top view

Chapter 5:

CONCLUSION

5.1 Conclusion

This paper describes an automatic controlled robotic and robotic arm from webpage with continuous surveillance of actions done by the tele robotic arm. Mobile robot connected through wireless dongle or Wi-Fi and the telerobotic can be visualize the acknowledgement with continuous response from remote end with monitoring via webpage. Also, use port forwarding methodology to use anywhere. In future work by making this project with extension of GPS to navigate based on the locations given through the network, we can move tele robot to the multipurpose actions among remote surveillance.

In this project we used raspberry pi working on Raspbian OS. As the communication is done with the help of internet so limitation of range of operation does not arise and thus we can monitor any remote areas. One can easily monitor as well as control the activity of the robotic unit.

5.2 FUTURE SCOPE:

There are lots of improvements that can be made on the current design and technology and lots of additional feature scan be added. We can use different types of sensor so that we can use robot in different field i.e. Temperature Sensor, Pressure Sensor, Heat Sensor, Position Sensor, Proximity Sensor. A multipurpose robot can be made by wireless network, ranging from surveillance and home security to industrial applications where the user need not be present at the work place in person but can do it from his home itself.

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APPENDIX

PYTHON CODE:

```
#import libraries of python opencv
import RPi.GPIO as GPIO
GPIO.setmode(GPIO.BCM)
GPIO.setwarnings(False)
import cv2
import numpy as np
#import urllib
#import json
from firebase import firebase
#from functools import partial
import pyrebase
config = {
   "apiKey": "AIzaSyDPCEo-qZYMUEchmUxpiPwtXCF7t9EOCvc",
   "authDomain": "fir-c651c.firebaseapp.com",
   "databaseURL": "https://fir-c651c.firebaseio.com",
   "projectId": "fir-c651c",
   "storageBucket": "fir-c651c.appspot.com",
   "messagingSenderId": "272063783768",
   "appId": "1:272063783768:web:27d7f2ac3a277fabbabb2d"
}


#create VideoCapture object and read from video file
cap = cv2.VideoCapture(0)
#use trained cars XML classifiers
car_cascade = cv2.CascadeClassifier('/home/pi/Desktop/haarcascade_frontalface_alt.xml')
cap.set(3,160)
cap.set(4,120)
#read until video is completed
firebase1 = firebase.FirebaseApplication('https://fir-c651c.firebaseio.com/', None)
firebase=pyrebase.initialize_app(config)
storage=firebase.storage()
GPIO.setup(21, GPIO.OUT)
while True:
   #capture frame by frame
   ret, frame = cap.read()
   #convert video into gray scale of each frames
   gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)
i=True
```

```
print('Record Updated=')
   #print(result1)

   if i==True:
GPIO.output(21, True)
   else:
GPIO.output(21, False)
       cv2.imwrite(filename='/home/pi/Desktop/img.jpg', img=frame)
img_new = cv2.imread('/home/pi/Desktop/img.jpg', cv2.IMREAD_GRAYSCALE)

img_ = cv2.resize(img_new,(1920,1080))
       cv2.imwrite(filename='/home/pi/Desktop/img_.jpg', img=img_)
path_on_cloud="foo.jpg"
path_local="/home/pi/Desktop/img_.jpg"
storage.child(path_on_cloud).put(path_local)
       result = firebase1.get('/solger_tracking/reply/', '')
       print(result)


   #display the resulting frame
   cv2.imshow('video', frame)
   #press Q on keyboard to exit
   if cv2.waitKey(25) & 0xFF == ord('q'):
       break
#release the videocapture object
cap.release()
#close all the frames
cv2.destroyAllWindows()
```

ARDUINO CODE:

```
int sw=0,sw1=0;
#include <Servo.h>

Servo myservo; // create servo object to control a servo
// twelve servo objects can be created on most boards

int pos = 0;    // variable to store the servo position

void setup() {
myservo.attach(9); // attaches the servo on pin 9 to the servo object
pinMode(2,INPUT);
pinMode(3,INPUT);
}

void loop()
{

  for (pos = 0; pos <= 180; pos += 1)
{ // goes from 0 degrees to 180 degrees
   // in steps of 1 degree
sw=digitalRead(2);
   while(sw==HIGH)
sw=digitalRead(2);;
myservo.write(pos);              // tell servo to go to position in variable 'pos'
delay(10);                       // waits 15ms for the servo to reach the position
  }
  for (pos = 180; pos >= 0; pos -= 1)
{ // goes from 180 degrees to 0 degrees
sw=digitalRead(2);
   while(sw==HIGH)
sw=digitalRead(2);;

myservo.write(pos);              // tell servo to go to position in variable 'pos'
delay(10);                       // waits 15ms for the servo to reach the position
  }
}
```