Surveillance Rover

A project report submitted in partial fulfilment of the requirements of the award of the

degree of

BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE AND ENGINEERING BY

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CERTIFICATE

This is to certify that the project report entitled "**SURVELLIANCE ROVER**" is a bonafide work done by **G.Venkata Vineeth(1210314312), A.KrishnaSagar (1210314302), P.Vinay (1210314338) and G.Surya Vamsi (1210314316)** students submitted in partial fulfilment for the award of the Degree of Bachelor of Technology in Computer Science and Engineering during the year 2017-2018.

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DECLARATION

Wehereby declare that the project report entitled **"SURVELLIANCE ROVER"** is an original and authenticate work done in the Department of Computer Science and Engineering, GITAM Institute of Technology, GITAM University, Rushikonda, Visakhapatnam, submitted in partial fulfilment of the requirements for the award of the degree of **Bachelor of Technology** in Computer Science and Engineering. The matter embodied in this project work has not been submitted earlier for award of any degree or diploma to the best of my knowledge.

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ABSTRACT

The main of this project is to give security and control over the perimeter. It can obtain by CC cameras but they are static and fixed to walls. To make them more useful it will increase the cost of security system. The surveillance rover gives access control over the perimeter with less cost.

To control the burglary and robbery we can use rover to visualize what is happening around our personal area, we use passive infrared sensor to detect human presence. If there is any human presence the buzzer will be activated and we can take rover to that particular location and check what is happening over there. Here, all the PIR sensors and buzzer are connected to a ESP. The rover can be controlled remotely from a mobile through RaspberryPi

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1.INTRODUCTION

This project attempts to address the need for a self-contained home security system. Currently, home security systems require many costly components and a complicated installation process. Two basic types of systems are currently available. The first is a wired system. One drawback is that installation of a wired system can take a lot of time and money. Another drawback is that it is a permanent part of the home. If the owner moves, the security system must stay. The second type of system is a wireless one. The components for this are also costly. Wireless systems are more mobile, but they require batteries which must be changed every so often. The purpose of the proposed system will be to eliminate the drawbacks of both wired and wireless systems. The proposed system will consist of a single unit, which will monitor the home for various hazardous conditions and provide video feedback via a web interface. With the number of robberies increasing day by day, it has become important to take over the human and help the mankind.

Surveillance rover, the main aim of this project is to secure the perimeter by identifying or detecting the presence or entry of a person in to our premises or in our premises without authorization. We do this thing using PIR sensor, i.e Passive Infrared rays. It detects the human presence from the heat generated from our body. When PIR sensor detects it send a signal to microcontroller. The micro controller sends a notification to the device through existing Wi-Fi present in home or inside the perimeter.

We connect the rover using raspberry pi microcontroller. We even connect a camera to Raspberry pi. Raspberry pi itself has a camera module to connect. We control the rover using mobile application with live video streaming from rover to mobile application.

2. Literature Review

Patent Search:

Patent No.7436143: Miniature Surveillance Rover is very relevant to this project as it shares a lot of the same concepts that we are hoping to implement. Among them is the concept of a logic controller operating a drive motor to move a rover. This project also includes inputs from various sensors such as proximity, sound, and chemical sensors to make decisions as to where the rover moves to. These are consistent with the patent claims #12 and #13. The surveillance rover should also be able to communicate wirelessly with a network to store the camera footage captured, which is also consistent with various claims of the patent.

IEEE Explorer Article Search:

Publication Number: US 2010/085946 [3] shows how to be able to program a rover or override a robot. The idea is to be able to interact with the rover remotely. In this design we are going to develop an interface to interact with the rover by programming it or controlling it with certain functions. This will help the user to set up the rover easily and efficiently. For part of the marketing requirements a GUI is the best way to setup a rover easily. The idea of the GUI is to keep things simple with the design so the user can have some control. If the costumer or user wants to expand the rover capabilities, they can update the interface for the robot's plug-ins and add-ons.

Other Sources:

Currently there are basically two different types of home security systems. One of them is a wired home security system and the other is a wireless home security system. The wired home security system operates on an electric circuit in which all the sensors and cameras are hard wired to the controlled unit.

Once the alarm is turned on, the circuit will be turned on. In case there are any types of interference, like the wires being cut or the sensor is being triggered, then the alarm will be turned off. As for the wireless system, it pretty much operates similar to the wired system, with the exception of its sensors been linked to the control unit wirelessly. There are advantages and disadvantages to each existing system as will be discussed below.

Presently, the wired system's biggest limitation is its cost. Not everyone can afford this because wired systems are quite expensive and they also require professional installation. Because of this, only wealthy families can afford the installation of these wired security systems. Also, wired systems are not very flexible because they require professional installation. The wires need to run from the control panel to all the sensors and should be placed in an aesthetically pleasing manner and should not be easily noticed. This can be difficult if the building was not prewired to accommodate a home security system.

One of the notable disadvantages of the wireless systems is that they require the periodic replacement of batteries. Additionally, they can be vulnerable to electromagnetic interference in some particular locations. As for their security cameras, the wireless systems fall short, since the cameras run on batteries. The batteries usually not last for an entire day and would need to be charged or replaced often.

3. Methodology

Node MCU:

The Node MCU (Node Micro Controller Unit) is opensource software and hardware development environment that is built around a very inexpensive System-on-a- Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espressif Systems, contains all crucial elements of the modern computer: CPU, RAM, networking (wifi), and even a modern operating system and SDK.

It has two key components, An open source ESP8266 firmware that is built on top of the chip manufacturer's proprietary SDK. The firmware provides a simple programming environment based on eLua (embedded Lua), which is a very simple and fast scripting language with an established developer community. For new comers, the Lua scripting language is easy to learn.

A DEVKIT board that incorporates the ESP8266 chip on a standard circuit board. The board has a built-in USB port that is already wired up with the chip, a hardware reset button, wifi antenna, LED lights, and standard-sized GPIO (General Purpose Input Output) pins that can plug into a bread board. Figure 3.1.1 shows the DEVKIT board, and Figure 3.1.2 shows the schema of its pins.

Fig:3.1.1 Devkit

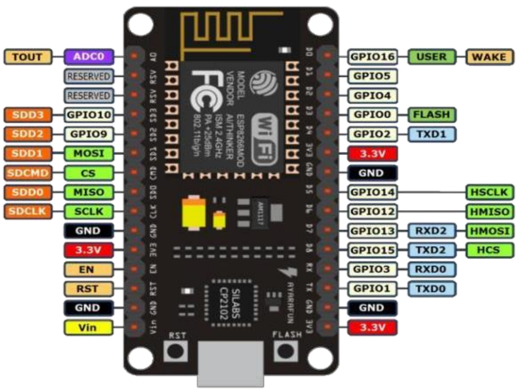

Fig:3.1.2 Pins

Breadboard:

A breadboard is a solder less device for temporary prototype with electronics and test circuit designs. Most electronic components in electronic circuits can be interconnected by inserting their leads or terminals into the holes and then making connections through wires where appropriate. The breadboard has strips of metal underneath the board and connects the holes on the top of the board. The top and bottom rows of holes are connected horizontally and split in the middle while the remaining holes are connected vertically.

Fig:3.2 Breadboard

PIR Sensor:

PIR sensors allow you to sense motion, almost always used to detect whether a human has moved in or out of the sensors range. They are small, inexpensive, low-power, easy to use and don't wear out. For that reason they are commonly found in appliances and gadgets used in homes or businesses. They are often referred to as PIR, "Passive Infrared", "Pyroelectric", or "IR motion" sensors

Fig:3.3 PIR Sensor

PIRs are basically made of a pyroelectric sensor (which you can see below as the round metal can with a rectangular crystal in the center), which can detect levels of infrared radiation. Everything emits some low-level radiation, and the hotter something is, the more radiation is emitted.

Working of PIR Sensor:

PIR sensors are more complicated than many of the other sensors like photocells, FSRs and tilt switches because there are multiple variables that affect the sensors input and output. To begin explaining how a basic sensor works, we'll use this rather nice diagram

The PIR sensor itself has two slots in it, each slot is made of a special material that is sensitive to IR. The lens used here is not really doing much and so we see that the two slots can 'see' out past some distance (basically the sensitivity of the sensor). When the sensor is idle, both slots detect the same amount of IR, the ambient amount radiated from the room or walls or outdoors. When a warm body like a human or animal passes by, it first intercepts one half of the PIR sensor, which causes a positive differential change between the two halves. When the warm body leaves the sensing area, the reverse happens, whereby the sensor generates a negative differential change. These change pulses are what is detected.

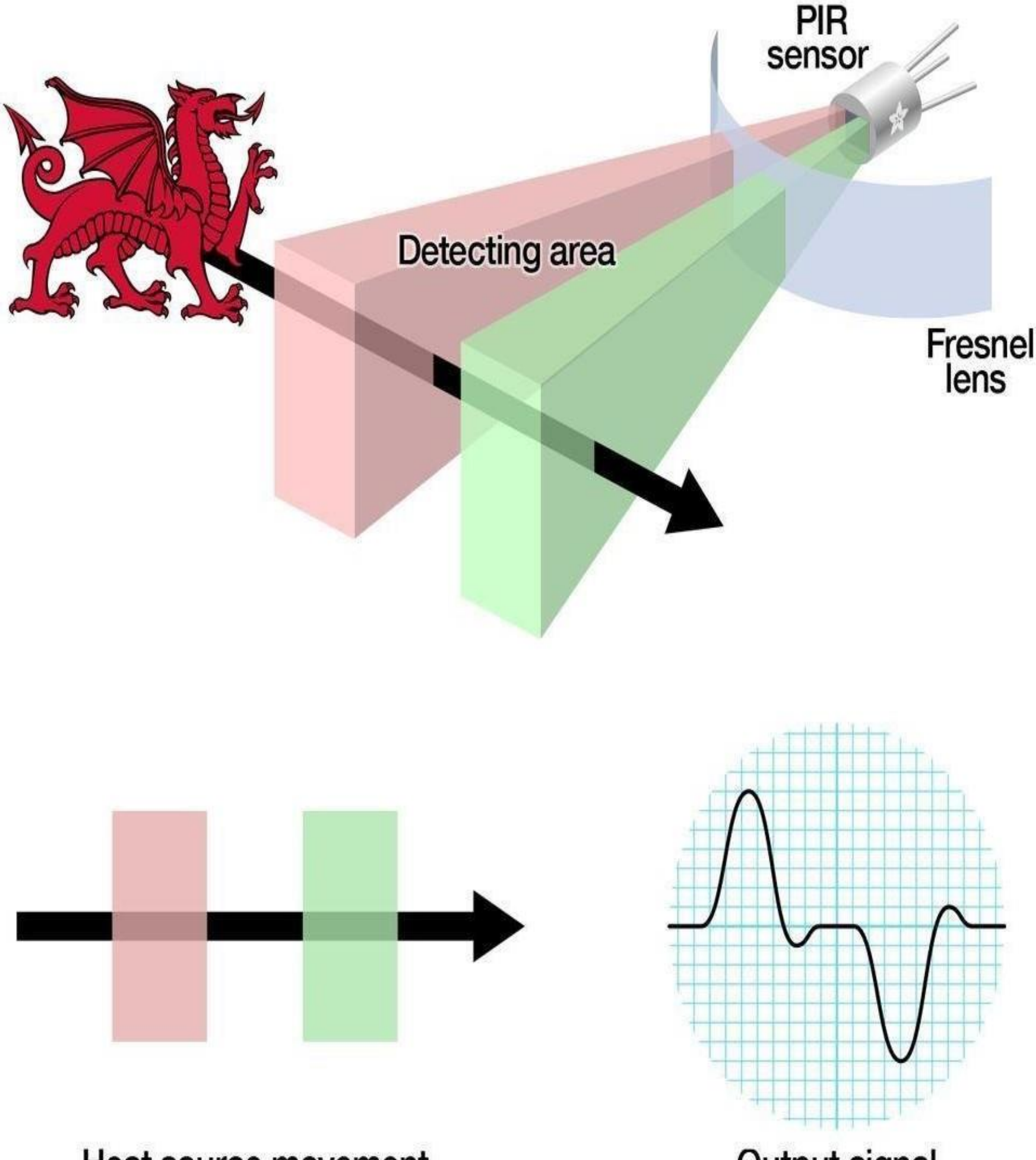

Fig:3.3.1 Working of PIR

Jumper Wires:

A jump wire is an electrical wire or group of them in a cable with a connector or pin at each end which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering. Individual jump wires are fitted by inserting their "end connectors" into the slots provided in a breadboard, the header connector of a circuit board, or a piece of test equipment.

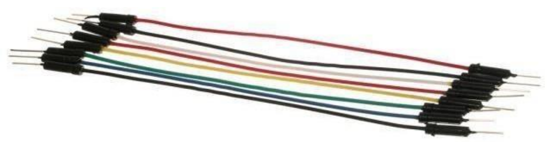

Fig 3.4 Jumper Wires

There are different types of jumper wires. Some have the same type of electrical connector at both ends, while others have different connectors. Some common connectors are:

Solid tips – are used to connect on/with a breadboard or female header connector. The arrangement of the elements and ease of insertion on a breadboard allows increasing the mounting density of both components and jump wires without fear of short-circuits. The jump wires vary in size and colour to distinguish the different working signals.

Crocodile clips – are used, among other applications, to temporarily bridge sensors, buttons and other elements of prototypes with components or equipment that have arbitrary connectors, wires, screw terminals, etc.

Banana connectors – are commonly used on test equipment for DC and low- frequency AC signals.

Registered jack (RJnn) – are commonly used in telephone (RJ11) and computer networking (RJ45).

RCA connectors – are often used for audio, low-resolution composite video signals, or other low-frequency applications requiring a shielded cable.

RF connectors – are used to carry radio frequency signals between circuits, test equipment, and antennas.

Raspberry Pi Single Board Computer:

A single board computer is a small but complete and fully functional computer that has all necessary components on a single circuit board. Most of the single board computers use a Linux based operating system and have various input and output options. A major advantage is that these small computers can be operated with batteries as they use low power components. The Raspberry Pi is developed by the Raspberry Pi Foundation. The idea is to offer a low cost computer that, for example, can be easily used in schools and universities. For this specific remote controlled car project all Raspberry Pi models can be used. Generally speaking, other single board computers like the Odroid C1+ from Hardkernel or a model from the Arduino family can be used. In this project we are using the Raspberry Pi 2 Model B as it offers a high performance that is necessary for live video streaming. Additionally the Raspberry Pi community provides a broad knowledge base and is a source for new ideas. For ease of reading Raspberry Pi is used instead of Raspberry Pi 2 ModelB.

Fig:3.5.1 Raspberry Pi 2

One powerful feature of the Raspberry Pi is the row of GPIO (general purpose input/output) pins along the edge of the board, next to the yellow video out socket.

Fig:3.5.2 Raspberry Pins

From the above fig(3.5.2), These pins are a physical interface between the Pi and the outside world. At the simplest level, you can think of them as switches that you can turn on or off (input) or that the Pi can turn on or off (output). Seventeen of the 26 pins are GPIO pins; the others are power or ground pins.

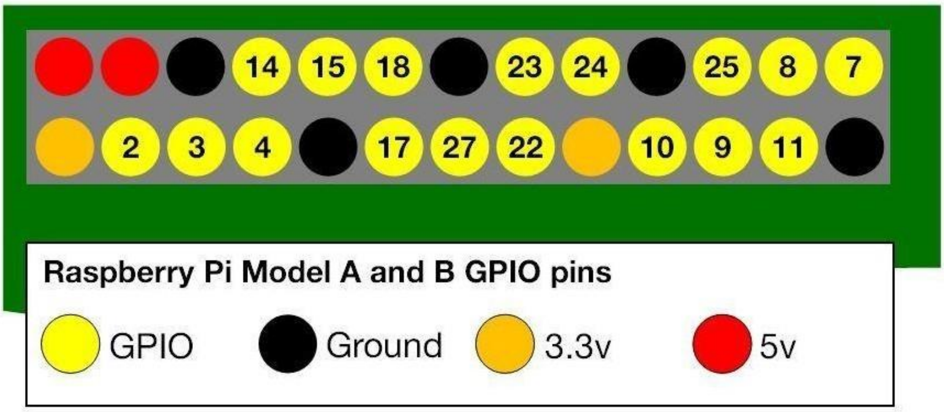

Fig:3.5.3

What are they for? What can I do with them?

You can program the pins to interact in amazing ways with the real world. Inputs don't have to come from a physical switch, it could be input from a sensor or a signal from another computer or device, for example. The output can also do anything, from turning on an LED to sending a signal or data to another device. If the Raspberry Pi is on a network, you can control devices that are attached to it from anywhere and those devices can send data back. Connectivity and control of physical devices over the internet is a powerful and exciting thing, and the Raspberry Pi is ideal for this.

Raspberry Pi Performance:

The Raspberry Pi 3, with a quad-core ARM Cortex-A53 processor, is described as 10 times the performance of a Raspberry Pi 1.This was suggested to be highly dependent upon task threading and instruction set use. Benchmarks showed the Raspberry Pi 3 to be approximately 80% faster than the Raspberry Pi 2 in parallelized tasks.

Raspberry Pi 2 V1.1 included a quad-core Cortex-A7 CPU running at 900 MHz and 1 GB RAM. It was described as 4–6 times more powerful than its predecessor. The GPU was identical to the original. In parallelized benchmarks, the Raspberry Pi 2 V1.1 could be up to 14 times faster than a Raspberry Pi 1 Model B+.

While operating at 700 MHz by default, the first-generation Raspberry Pi provided a real-world performance roughly equivalent to 0.041 GFLOPS. On the CPU level the performance is similar to a 300 MHz Pentium II of 1997–99. The GPU provides 1 Gpixel/s or 1.5 Gtexel/s of graphics processing or 24 GFLOPS of general-purpose computing performance. The graphical capabilities of the Raspberry Pi are roughly equivalent to the performance of the Xbox of 2001. The LINPACK single node compute benchmark results in a mean single precision performance of 0.065 GFLOPS and a mean double precision performance of 0.041 GFLOPS for one Raspberry Pi Model-B board. A cluster of 64 Raspberry Pi Model B computers, labelled "Iridis-pi", achieved a LINPACK HPL suite result of 1.14 GFLOPS (n=10240) at 216 watts for c. US$4000.

Relays:

It is not possible to put very high voltage through the CPU that operates the electro motors. Therefore, relays must be used. When some small voltage is put on the relay, it opens a connection between the 4xAA batteries of the car and the electromotor. When current stops to flow through the coil in the relay, a little additional current might suddenly flow back to the opposite (bad) direction and it might damage the Raspberry Pi. Therefore, it is recommended to make use of some relay protection. Diodes just provide a solution for this issue. Diodes allow current to flow only in one direction.

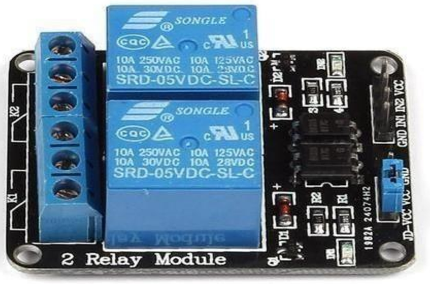

Fig:3.6.1 Relay

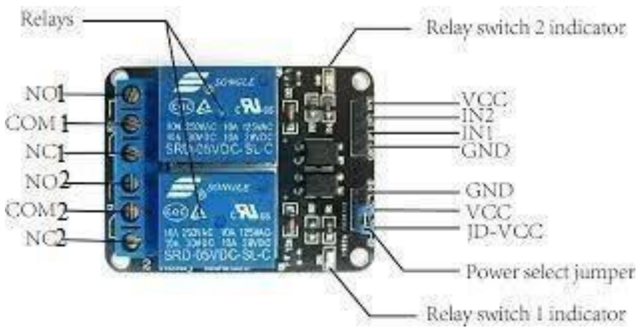

Fig:3.6.2 Relay Pins

Input: VCC, connected to the 5V current on the Arduino Board, GND, connected to the ground and 2 digital inputs. (In1 & In2)

Output: The 2channel relay module could be considered like a series switches: 2 normally Open (NO), 2 normally closed (NC) and 2 common Pins (COM)

NC- Normally Closed, in which case NC is connected with COM when INT1 is set low and disconnected when INT 1 is high.

NO- Normally Open, in which case NO is disconnected with COM when INT1 is set low and connected when INT 1 is high.

Battery:

The used components in the remote-controlled car require different voltages in order to work properly. The Raspberry Pi needs 5V supply voltage at 1.2A current. The gear motors need a supply voltage between 3V and 6V but much less current than the Raspberry Pi. If you want to equip your car with LED's, supply voltages below 3V are required. A typical AA rechargeable battery has a voltage of 1.2V at 1800mA. Using six of them a voltage supply of 7.2V at 1800mA can be ensured for the remote controlled car.

Fig:3.7 Batteries

Camera module:

In the Raspberry Pi camera module, there is a camera attached to the CSI port. This camera can be used to capture high-definition video as well as still images. There is also a standard application which provides built-in commands for capturing images. Raspistill and rastpstillyuv are for capturing still images, and raspivid is for video.

Fig:3.8 Camera Module

RC Car Chassis:

RC Car needs chassis which has a good ground clearance with minimum of two gear motors which attached to the wheels. These motors need a sufficient amount of supply voltage so it produces a good amount of torque and the rover moves.

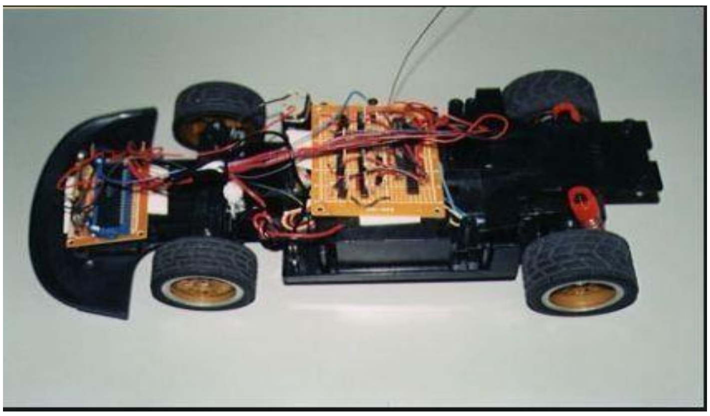

Fig:3.9 Car Chassis

Stepper motor:

It is a brushless electromechanical device which converts the train of electric pulses applied at their excitation windings into precisely defined step-by-step mechanical shaft rotation. The shaft of the motor rotates through a fixed angle for each discrete pulse. This rotation can be linear or angular. It gets one step movement for a single pulse input.

Fig:3.10 stepper motor

The angle through which the stepper motor shaft turns for each pulse is referred as the step angle, which is generally expressed in degrees. If the step angle is smaller, the greater will be the number of steps per revolutions and higher will be the accuracy of the position obtained. The step angles can be as large as 90 degrees and as small as 0.72 degrees, however, the commonly used step angles are 1.8 degrees, 2.5 degrees, 7.5 degrees and 15 degrees.

The direction of the shaft rotation depends on the sequence of pulses applied to the stator. The speed of the shaft or the average motor speed is directly proportional to the frequency (the rate of input pulses) of input pulses being applied at excitation windings. Therefore, if the frequency is low, the stepper motor rotates in steps and for high frequency, it continuously rotates like a DC motor due to inertia

Android Studio:

It is the official integrated development environment (IDE) for the Android platform. Based on JetBrains IntelliJ IDEA software. Android Studio is designed specifically for Android development.

- While starting a new project app name, company domain, SDK have to be given accordingly. We will have app (manifests, java, res), Gradle scripts as two main folders in android studio.
- Manifest file includes information about all the activities.
- We will have to select which aspects are essential for our purpose for Layout in design part of XML and information about that aspects can be included in text part. Java code is written in .java file.

Python:

Python is an interpreted high-level programming language for general- purpose programming. Python features a dynamic type system and automatic memory management. It supports multiple programming paradigms, including object-oriented, imperative, functional and procedural, and has a large and comprehensive standard library.

- This project consists of some hardware components which needs to be programmed by the raspberry Pi.
- Python is used to access and control.

4.Experimental setup and Output

Circuit Connection of PIR Sensor with ESP-8266:

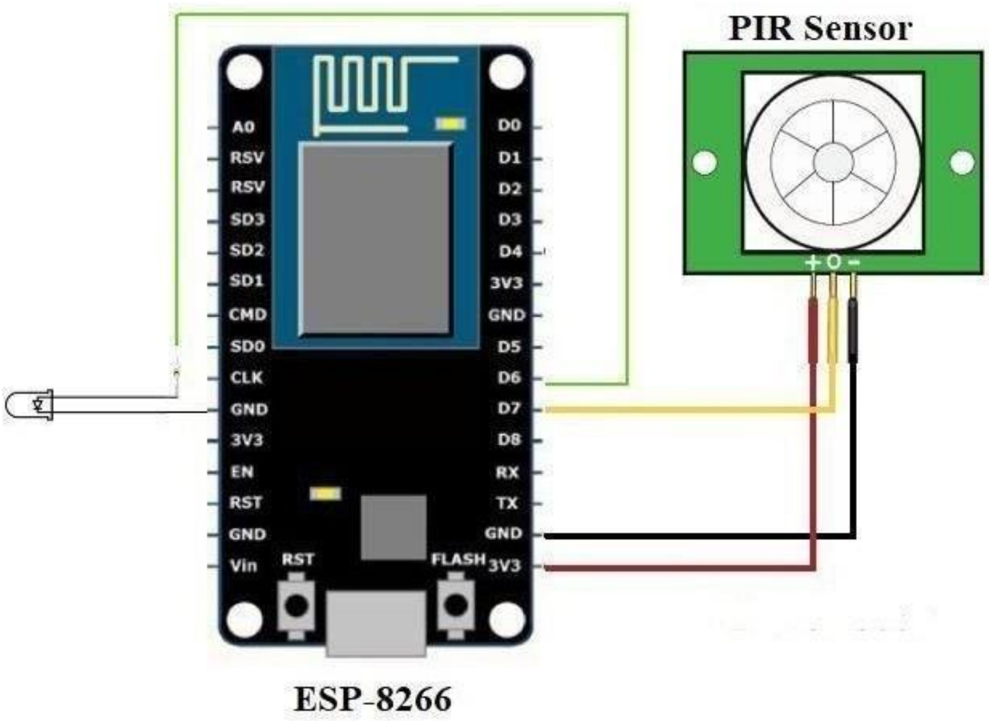

Fig:4.1 Circuit Diagram

The ESP-8266 is a 30-pin set with two additional buttons RST and FLASH. The pins D1,D2,D3,D4,D5,D6,D7 are the input-output pins. The PIR Sensor contains 3 terminals (Positive, Ground, Negative). The Positive terminal i.e., the Red color wire in the above circuit diagram is connected to 3voltage pin in the ESP-8266. The ground terminal of the PIR

Sensor is connected to the D7 pin which is an input-output pin. The negative terminal is grounded to the ESP-8266. A LED is also connected to the ESP it glows high when the PIR Sensor detects any motion else it glows low. The entire code of this setup is run on AurdinoIDE.

System Architecture:

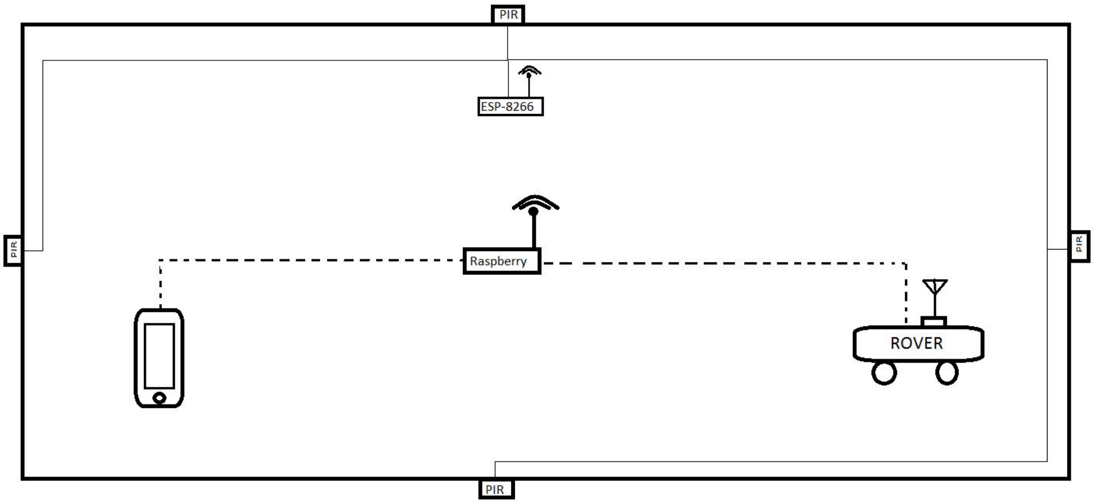

Fig:4.2 System architecture

The PIR sensors are attached to the boundary walls of the house and are connected to the house wiring along with ESP-8266 to sense the motion objects. The rover and smart phone are connected to the Raspberry Pi.

Connecting Rover to the Raspberry Pi:

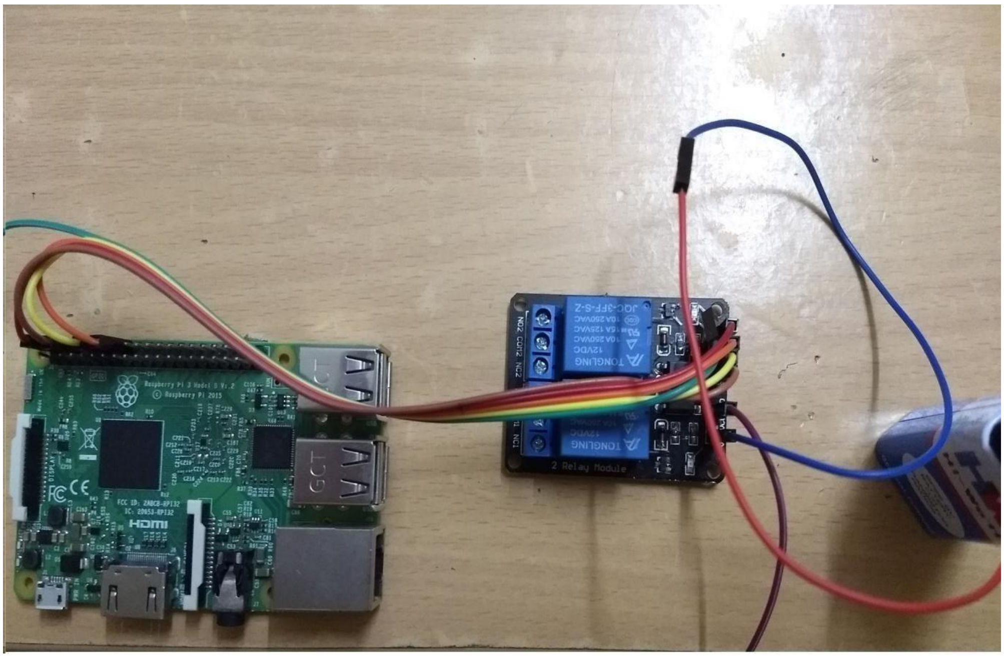

Fig:4.3 Raspberry Pi Connection with relay

Raspberry connection with Relay:

The 2-channel relay contains seven terminals (JD-VCC, VCC, GND, IN1, IN2, VCC, GND). The positive end of the 9V battery is connected to the JD-VCC, the Negative terminal is connected to the GND. These connections are made on the three terminals set side.

The four terminals are connected to the Raspberry Pi to receive the electrical signals. The GND terminal of the relay is connected to the GND terminal of the Raspberry Pi. The IN1 of the two-channel relay is connected to the to the GPIO pin of the Raspberry Pi. Similarly, the IN2 is connected to the other GPIO pin on Pi. The VCC terminal of the relay is then connected to the 5v pin of the Raspberry Pi. Whenever we connect the Raspberry Pi to the power the relay starts working.

Rover Connections Withbatteries:

From the below fig of 2-channel relay (4.3.2), the No1 terminal of the relay is connected to the 9vbattery1 negative terminal, COM1 is connected to Steppermotor1 positive end. The negative terminal of the Stepper motor1 is connected to the positive end of the battery1. The NC1 terminalis unused.

The NO2 terminal of the relay is connected to the 9vbattery2 negative terminal, COM2 is connected to one other Steppermotor2 positive end. The negative terminal of the Stepper motor2 is connected to the positive end of the battery2. The NC2 terminal is unused.

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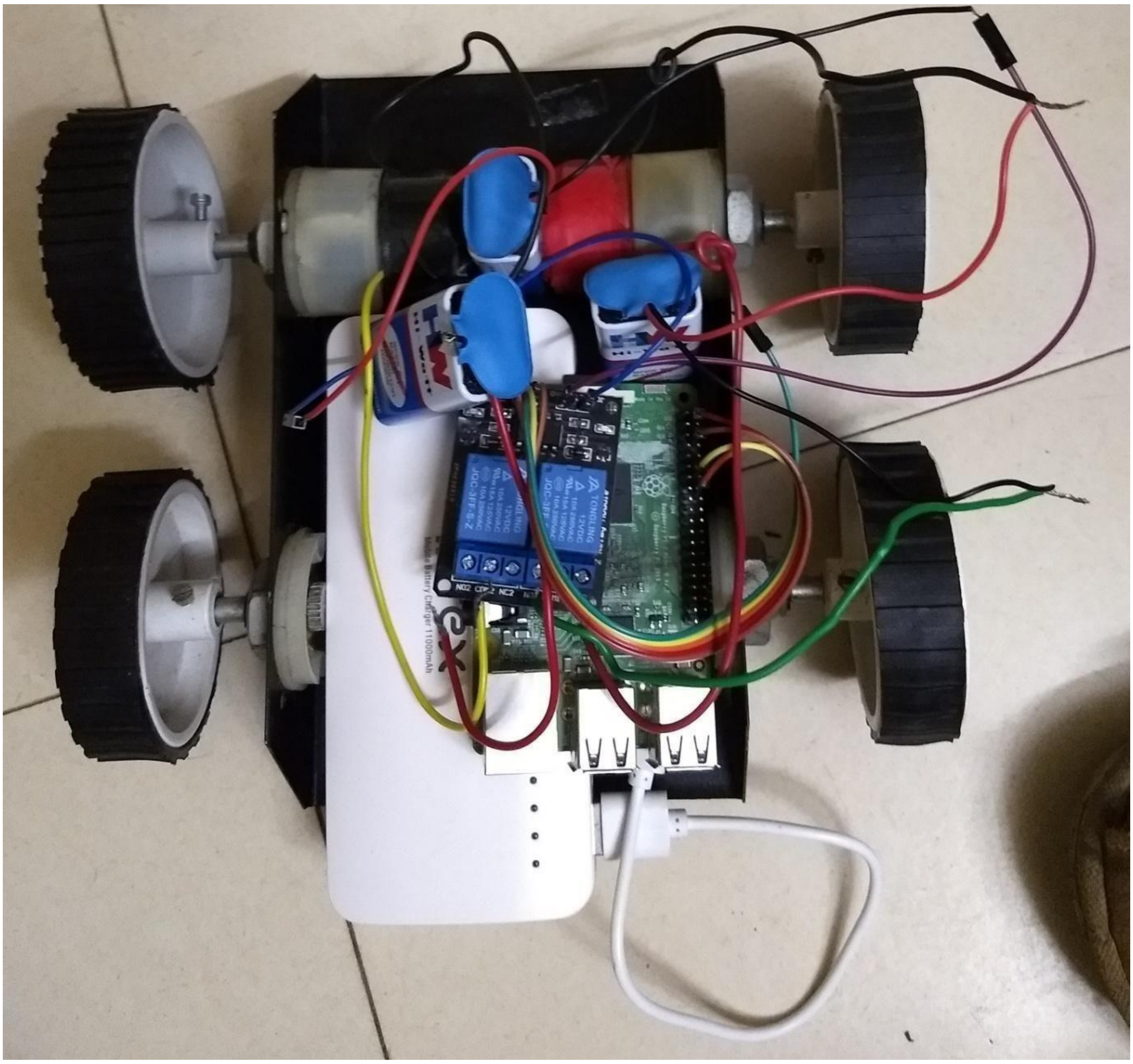

Fig:4.3.1 Rover connections with batteries

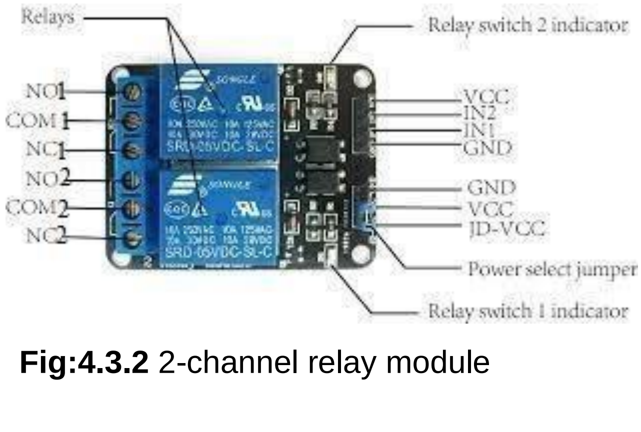

Fig:4.3.2 2-channel relay module

Working:

Our system consists of a smart phone, PIR sensor and a rover. The rover is controlled by a user sitting inside home, over the Wi-fi generated by micro controller. The rover consists of a smart phone running the Android operating system, an Raspberry pi 3 microcontroller to control the rover's motion, and the requisite hardware (motors, chassis, power supply, etc.)

The user controls the rover after he receives a signal from PIR sensor microcontroller to a smart phone as a notification. Then we start controlling the rover by connecting the smart phone application to the wifi generated by the Microcontroller, i.e Raspberry Pi. Which allows us to control the rover in the required direction. The camera on the rover is used to send live streaming video feedback to the remote user simultaneously. This enables the user to control the rover remotely, without seeing directly.

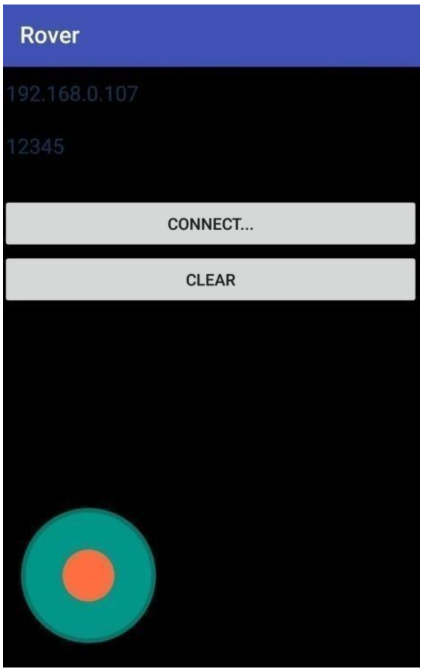

Fig:4.4

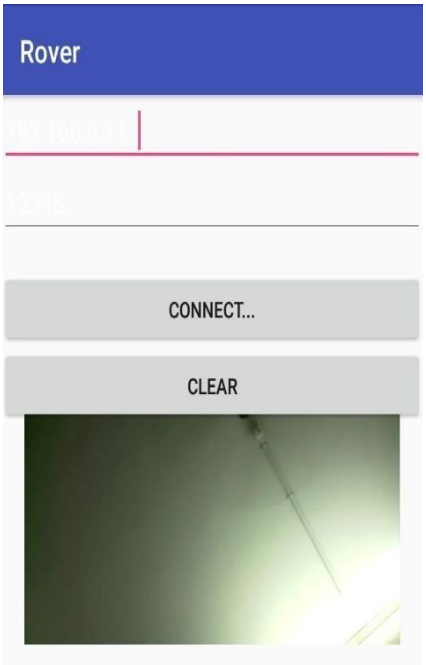

Fig:4.4.1

As seen in the figures (**4.4**,**4.4.1**) the circular navigation button is used to control the rover. There is also a window showing the live video streaming from the rover. When we enter the IP address and port number and click on "connect", then the rover is connected to the microcontroller. If we want live stream video then we have to click on "Clear", so that live streaming video starts.

5. CONCLUSION

When I started this project, I had a quite brief idea how what would be implemented. The main aim for me was to use and practice my skills in using those technologies involved. I have learned a lot about working with Java and Android.

I have also gained some experience in telecommunication. It is quite certain that I did not manage to do everything perfectly, I have still developed a lot. Fortunately, these mistakes were not deadly, but they rather had a constructive effect. All in all, I am proud of my work and all the efforts that I invested into it.

The key points where this project could be mainly improved:

1. The communication protocol between the Raspberry Pi and the client platform could be more platform independent

2. The socket program language is python. However, not all microcontrollers support running a Java Runtime Environment. That being said it would not be possible to run the same code e.g. on an Arduino for example.

3. Running the client application is also quite strictly bound to Android. It was written directly with Android Studio, which means that this code is hard to port into other platforms, such as Apple iOS, or Windows (Either with PC or Mobile). A solution to this could have been to implement the application using a platform independent developing environment. Xamarin could be a way to go.

4. Of course, the existing functionalities could be improved by more sensors and functionalities, such as an infrared lamp for night vision, or by security mechanisms, such as to automatically stop when an object is too close.

5. A better user interface is also optional, for example introducing a turn-by-tilting, joystick/wheel support, or even more, a virtual reality support. Although it would be quite an expensive hardware for a thesis project at this point, it would probably increase the user experience a lot.

6. Smoother image reception. At this point a video transition happens so that one picture is sent each second. It would be better to implement a real video stream.

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