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An Android Controlled Mini Rover for real time surveillance using Raspberry Pi 3

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Abstract: Surveillance is the process of monitoring the circumstances, an area or a person. Real-time surveillance is a vital component in any situation or environment where there is a high need of security for both personal and commercial property and assets. With the advent of cutting edge technologies the world is moving towards less manual work to more automated solutions. Sophisticated hand-held devices with enhanced processing acumen can empower the user to control and dictate remote devices with the help of internet with utmost agility. A robot can be one such remote device, which is nothing but an electro-mechanical machine that can perform task automatically. The proposed system thus aims at easing monitoring and surveillance through the Raspberry Pi3 based Mini Rover controlled by an android application for smart phone users by providing them with a cheaper alternative. This system is of great advantage to users looking for monitoring small and narrow places which are unreachable by human.

Keywords: Mini Rover, Python, Raspberry Pi3, Real Time Surveillance, WiFi.

1. INTRODUCTION

Robots have variety of applications; the main applications where the robots are being used include surveillance, military purposes and in disaster management etc. For communication purpose most of these robots use Bluetooth and infrared remote etc; but the drawback of such communication medias is that such robots are very poor in interactivity, so in order to improve the interaction between the users and the robots, the proposed system uses the android mobile phone to give remote interactive control. The robot and android phone are connected to wifi to provide wider range; the phone is having an android application which has commands for image capturing and live streaming. These captured images and streamed videos are sent on Raspberry Pi's ip from where one can view them. Only admin and registered members are able to view images and live streaming. The website can be opened on any computer using Raspberry Pi's ip. Login Page is provided to give security to the website so that only authentic users have access to images and live streaming.

2. PROPOSED SYSTEM

We proposed a model to introduce a real time live streaming for surveillance system using Raspberry Pi3 with inbuilt wifi connectivity. This will reduce the number of cases of accidents in the surveillance area as well as will provide logistics information from the images of defined area provided by the user and constantly monitor it.

This Model has the following Features.

- The model is having very low cost compared to many present day surveillance systems.
- The mini-rover is able to move forward, backward, leftward & rightward on its wheels with all the equipment on board.
- The Raspberry Pi Camera module is able to provide with clear real time view of the area at its front, the camera is also having night vision capability.
- Entire model is connected to local network, so anyone available in that particular local network can login from anywhere.
- The mini-rover is able to receive commands from the Android Application over the Internet and move around according to the given command; Android Application is having commands for Image Capturing and live streaming.
- The System is easily modifiable, so we can integrate various types of sensors with this model.

The Fig.1 shows a diagrammatic representation of our project.

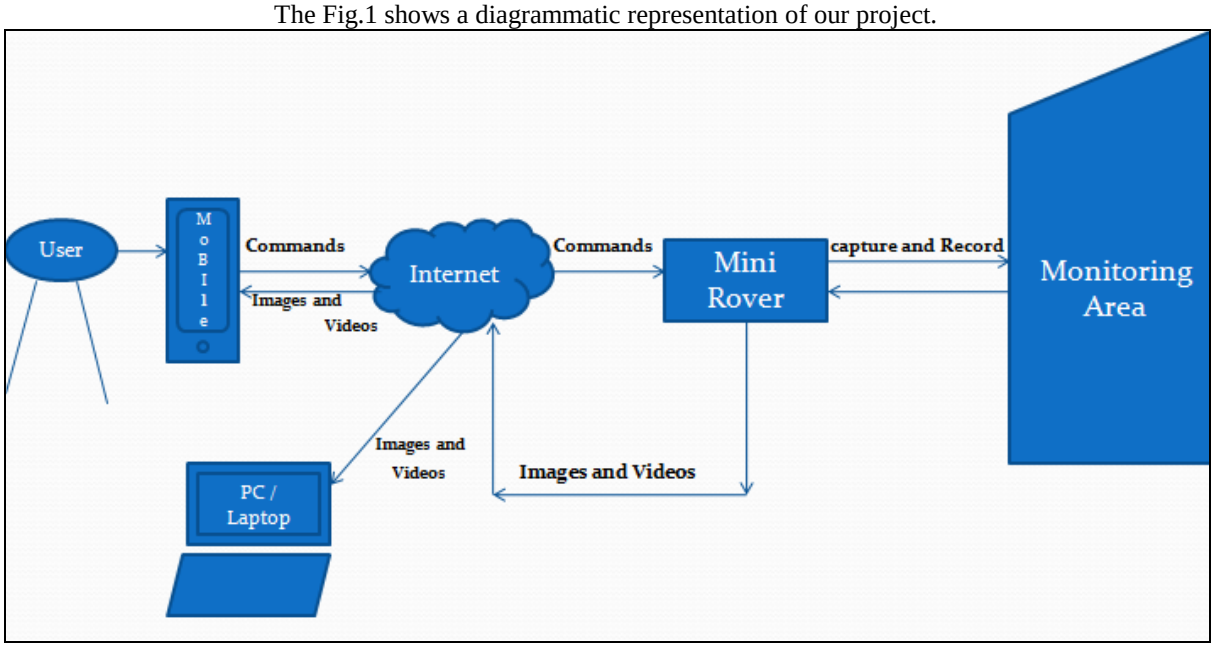

Fig.1.Diagrammatic overview of the project

3. IMPLEMENTATION

3.1 HARDWARE USED IN THE PROJECT

For implementing our project, we used various hardware which is readily available in the local market. Below here is given a list and short descriptions of various principal hardware used in our project:

3.1.1 Raspberry Pi 3 Model B:

We chose to use a Raspberry Pi3 model B to handle all computations and processes needed in our system.

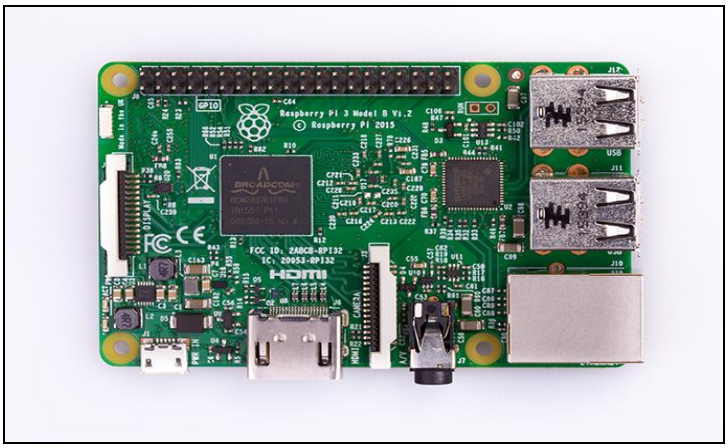

Fig.2. A Raspberry Pi 3 Model B

The Raspberry Pi3 has following features :

- Raspberry Pi 3 doesn't require much power to operate.
- It has very Low Cost.
- It has a strong processing capacity because it uses the ARM11 architecture and Linux-based operating system.
- It runs on an open source software which is Raspbian OS, an optimized version of Debian Linux.
- It's a full-fledged CPU capable of connecting to a Local Network via its Ethernet port or integrated 802.11n WiFi.
- It has in total 40 GPIO pins to interact with various sensors & modules. So, even after connecting all the hardware of our project, there are enough GPIO pins left to connect various types of sensors in future if modification becomes necessary.

3.1.2 Raspberry Pi NoIR Camera:

To obtain clear, real time video footage, we used the Raspberry pi NoIR camera.

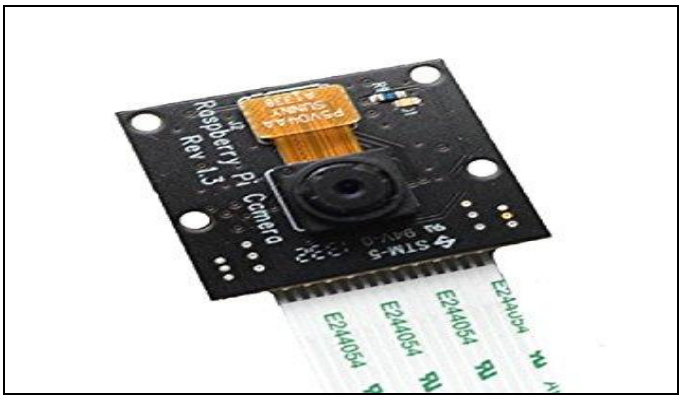

Fig.3. Raspberry-Pi NoIR Camera Module

The Raspberry Pi NoIR camera has following features,

- The Raspberry Pi NoIR Camera Module v2 is a high quality 8 megapixel Sony IMX219 sensor custom designed add-on board for Raspberry Pi.
  - It's capable of 3280 x 2464 pixel static images, and supports 1080p30, 720p60 and 640x480p90 video.

3.1.3 L298N H-Bridge Dual Motor Controller:

To control the DC motors, we used a L298N H-Bridge dual motor controller.

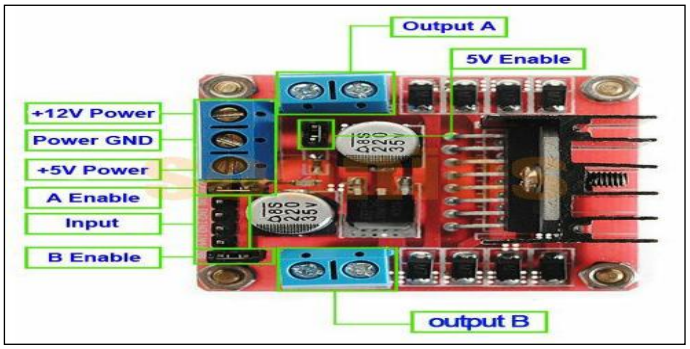

Fig.4. A L298N H-Bridge dual motor controller

The L298N H-Bridge Motor Controller has following features:

- It is a typical motor driver which allows DC motor to drive on either direction.
- It contains two inbuilt H-bridge driver Circuits which can control a set of two DC motors simultaneously in any direction.

3.1.4 11.1V 2200mAh RC Lipo Battery:

To provide external power to the two DC motors driving the mini-rover, we used RC LIPO Battery and we added a 5V/1.5A regulator bypass to supply power to the Raspberry Pi. This Lipo battery lasts for days and the battery charges in 2hrs.

Fig.5. 11.1V 2200mAh RC Lipo Battery

3.1.5 Two wheeled Double layer Chassis:

As for constructing mini rover's body, we used a double layer acrylic platform chassis as shown in fig 6.

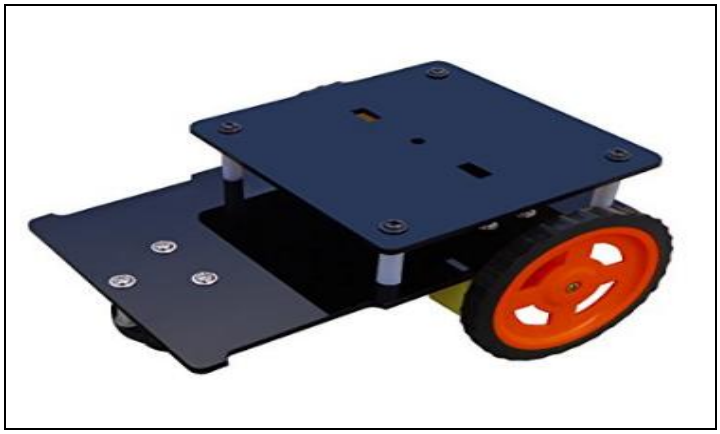

Fig.6. Two wheeled Double layerd Chassis

3.2. MAJOR SOFTWARE & LANGUAGES USED

The list of all the software used in our project is given below:

3.2.1. Raspbian OS:

We have many different operating systems for the Raspberry P3i, Among these, Raspbian is the best and most popular Debian Linux based operating system for the Raspberry Pi.

3.2.2. Python:

We found Python to be the best programming language that can be used to allow the Raspberry Pi3 to interact with the user.

3.2.3 .JAVA:

A simple navigation android app has been developed to control the bot movement using JAVA socket programming.

3.2.4. SSH and Putty:

SSH stands for "Secure Shell". SSH is used to establish cryptographic network-protocol based 'shell' sessions. Putty is third party software used to establish SSH connection for remotely accessing the command line Raspberry Pi 3.

3.3. SETUP:

Firstly we enclosed the Raspberry Pi inside the plastic casing, we established the Connection of Raspberry Pi with the motor driver, we connected the GPIO pins of the Raspberry Pi to the input pins of the motor driver. The output pins of the motor driver are connected to the motors 1 & 2 respectively. we Connected RC LIPO Battery to motor driver circuit to supply power to the motors, we added a 5V/1.5A regulator bypass to supply power to the Raspberry Pi. After doing all these connections the Raspberry Pi is ready to boot up.

We wrote a python program for controlling the motors in which the output from the Raspberry Pi will be given to the motor driver as per the option selected by user on the Android App.

A Simple Android App has been developed which is connected to the Raspberry Pi over wifi. When the button will be pressed the app will send a packet over the wifi to the raspberry pi. When accepted, the Raspberry pi will acknowledge the python program written in the Raspberry Pi for controlling the motor to send proper inputs to motor driver.

The camera module is installed properly into its port. We enabled the camera interfacing in Raspberry Pi settings. Once this is done Raspberry pi will reboot itself. Now for the Live Streaming of videos we installed and configured Mjpg streamer . After the configuration steps are done the live streaming can be seen in the android app.

4. RESULTS

Here, Fig. 7,8 and 9 shows the Working of our Mini Rover. Fig. 7 shows the hardware setup while Fig.9. shows the login page of our android application, We have to enter the ip address of our Raspberry Pi and then click on Connect to get connected to our Mini Rover. We can control the movements of Mini Rover with the help of navigation keys provided in the app as shown in Fig. 9, capture and record options are also provided.

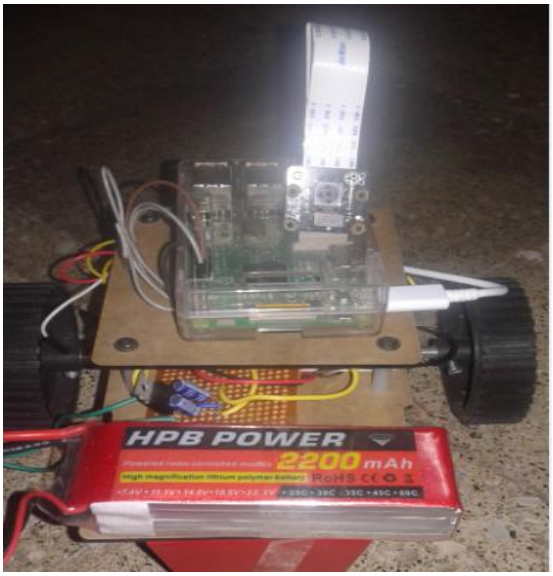

Fig.7. Hardware Product

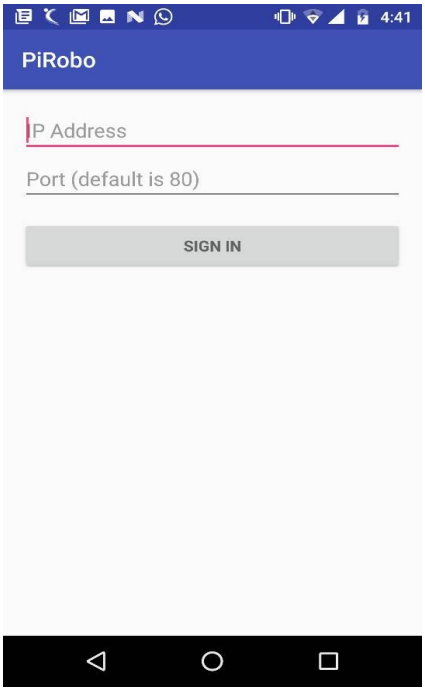

Fig.8. Login Page For the Android Application

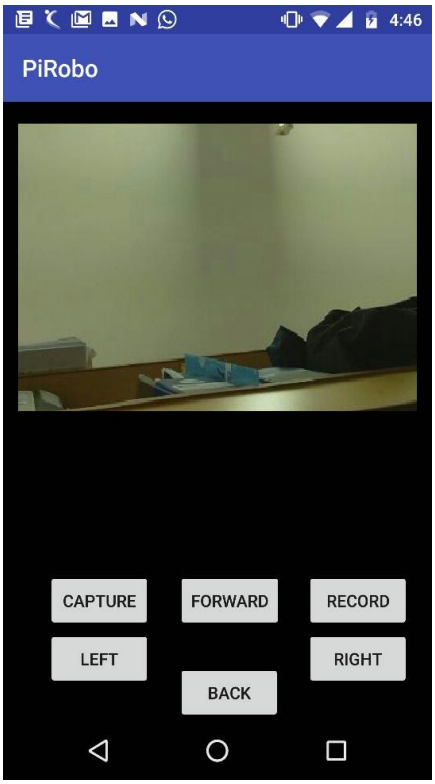

Fig.9. Live Streaming

5. CONCLUSION

Our system aims at making real time surveillance easier and cheaper through the android application. This system is of great advantage to users looking for real time surveillance of any location thus reducing the

rate of accidents. Since the cost of the system is low it will be affordable to the common man. Again with the additional features mentioned in the paper, this system becomes a complete application for any user who wishes to monitor area from any location in the network.

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