

Real Time Locomotory Surveillance Robot Using Raspberry PI and IoT

P. S. Hari Govind^{1*}, Anand K. Das², Alan Shaji³, Amrit Ashok⁴, A. Shahul Hameed⁵, T. Jaya⁶

^{1,2,3,4}Student, Department of Electronics and Communication Engineering, Universal Knowledge Foundation College of Engineering and Technology, Kollam, India

⁵Assistant Professor, Department of Electronics and Communication Engineering, Universal Knowledge Foundation College of Engineering and Technology, Kollam, India

⁶Associate Professor, Department of Electronics and Communication Engineering, Vels Institute of Science, Technology and Advanced Studies, Chennai, India

Abstract: Our homes now require more remote monitoring and surveillance than ever before. We want to present a surveillance robot that may be included into any kind of home through this article. A Raspberry Pi 4 Model B computer will serve as the bot's primary controller. The Pi's webcam keeps an eye on the region and notifies users when an incursion or potential intrusion is found. If it's an authorized employee, the voice assistant in the car will begin conversing with them. Only when an unauthorized individual is there will a notification be sent, which will include photos taken by the intruder and start a live feed from the webcam. Through the Internet, camera feeds may be analyzed from anywhere thanks to the Pi's live streaming capabilities. Each user will feel safer using such a system whether they are gone from their home or leaving their children and elderly relatives alone at home.

Keywords: Raspberry Pi 4, Webcam, Voice assistance, Live streaming.

1. Introduction

In every region where security is a concern, surveillance systems are usually installed. These systems often include many security staff to monitor the recordings, high-quality cameras, numerous computers for monitoring, servers for storing the footage, and high-quality cameras. These systems can produce significant complexity during installation and maintenance when seen as a whole. The CCTV camera feeds can only be watched in a few spots, and they also have a very small viewing area. Above all else, these systems cannot be put in every home due to the exorbitant expense of deployment.

Traditional systems necessitate ongoing supervision by a team of specialists, which is not feasible in every home. Additionally, hiring an unknown individual to do so will pose privacy concerns. The fixed modules used in today's CCTV cameras likewise have a limited field of view. An intruder cannot be followed or tracked by a CCTV camera if he walks outside of its field of view. Having a surveillance robot that can monitor the locations where it is installed and alert the owner when an incursion occurs is the answer to all of the aforementioned problems. Additionally, it enables the user to

access the webcam on the Raspberry Pi from any remote location and observe a live stream of whatever is going on inside his premises. The cost effectiveness and remote control features of the robot allow it to be used easily by every user.

2. System Overview

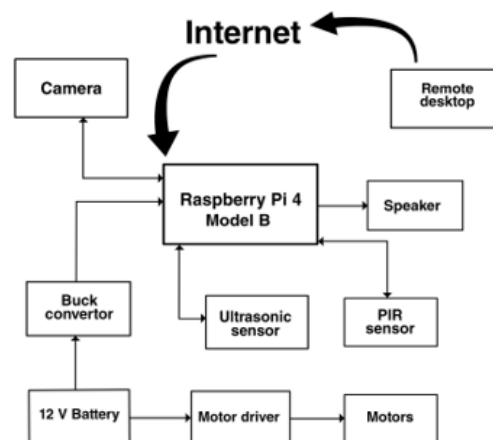


Fig. 1. Block diagram

The main components of the system are:

1) Raspberry pi 4 Model B

The microprocessor used in the project is the Raspberry Pi 4 Model B. There have been many significant upgrades made in the latest version of the Raspberry Pi board in comparison to the Raspberry Pi 3, which make it more suitable for this project. The SOC in the Raspberry Pi 4 Model B is Broad comm BCM2837, which is almost 50% faster than the Raspberry Pi 3. The CPU is also faster, at 1.2GHz, in comparison to the 900MHz Quad Cortex A7 in Pi 3. The Graphical Processing Unit is clocked at 400MHz compared to the 250 MHz Video Core IV in Pi 3. Above all, the Raspberry Pi 4 Model B features an on-board WiFi and Bluetooth 4.0, which makes it easier to use in IoT applications

2) Camera

The camera is used in this project for motion detection, capturing the image of the intruder when motion is detected, to

*Corresponding author: harigovindgokulam678@gmail.com

stream live feed of the intrusion to the user in remote location and also to authenticate the user in case the motion is caused by him or any other authorized personnel. ESP32-cam is used in this project.

3) Motor driver

The motor driver used in this project is the L298N. The motor driver contains the H-bridge connection required for bi-directional control of the motor. This is essential for the robot to achieve all directions of locomotion, namely, forward, backward, left and right. The power source for the motors is a 12V battery which is supplied appropriately to the motors using the motor driver.

4) Battery

The battery used for powering the system is a 12v Lithium-ion battery. It is rechargeable and can provide up to 1.3 amperes in an hour. This is ideal for controlling the movement of the 4 DC motors used in the project.

5) Buck convertor

The Buck converter is a DC-DC power step down module, used to regulate higher DC voltage to lower voltages and provide constant DC voltage. In this project, we require a 12V supply for the motors, for which the lithium-ion battery is used. But the Raspberry Pi requires constant 5V DC for its operations. So, the 12V battery is connected to the buck converter, which regulates it into 5V DC which is used to power up the Raspberry Pi. We use LM2596 buck converter module, which can drive loads up to 3 amperes with high efficiency. The high precision potentiometer can be varied to obtain voltages in the range 1.25 to 30V for input voltages between 4 to 35V.

6) PIR sensor

PIR sensor HC-SR501 is used for detecting motion in this project. This sensor detects human and animal movements and can distinguished between object movement and human movement.

7) Ultrasonic sensor

HC-SR04 ultra sonic sensor is used in this project. Its work under 5v, 15mA power supply, working frequency is 40Hz, ranging distance is from 2cm to 400cm, resolution is about 0.3cm, measuring angle is 15-degree, trigger input pulse width is 10 micro sec. It is used for the proper movement of the robotic vehicle without any intervention of obstacles.

8) Motors

The robot's locomotion is achieved by connecting it to wheels. The motors used in this project are 300 rpm DC motors which have ample speed as well as torque to carry the whole weight of all the components that are mounted on the robot. We used 4 motors and wheels to build a 4 wheeled robot which provides stability and proper control of the robot's movements

9) Speakers

The speaker is used for the voice assistant. The speaker used in this project is the Sony SRSXB2 which is a portable speaker with a rechargeable battery. This makes it handy to use. It can provide up to 10 hours of battery life for one cycle of complete charge. It is also light weight which allows it to be easily mounted on the robot's base

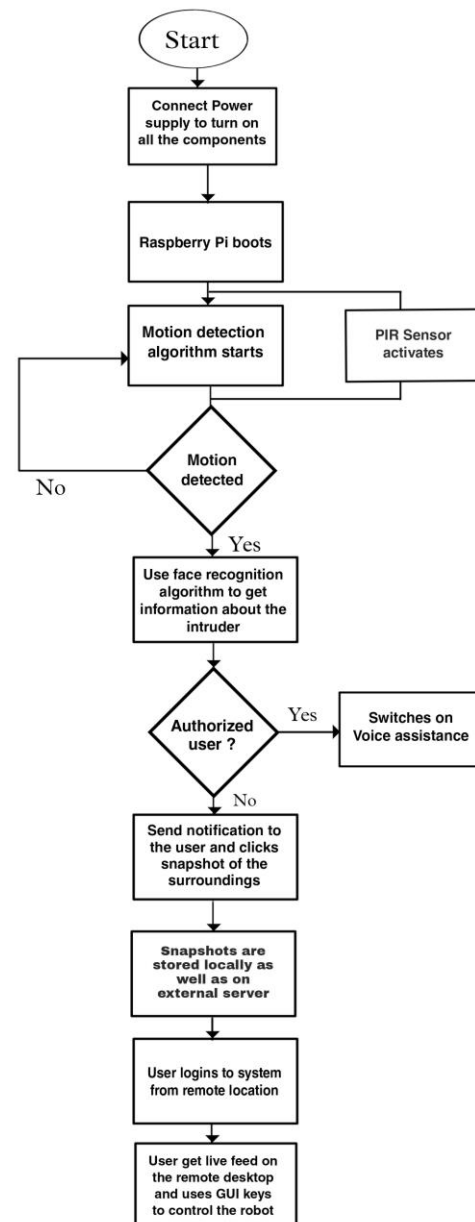


Fig. 2. Flow chart of proposed system

3. System Implementation

The main switch, which supplies the entire system with power from the 12V battery, is turned on to start the system's plot. The Raspberry Pi is powered by the buck converter, which adjusts the voltage to 5V DC after it is turned on. The Pi starts up and executes the motion detection software using the web camera stream. Figure displays the motion detection algorithm.

Background subtraction is the foundation of the method for motion detection. This process consists of the two processes of background startup and background updating. The computation of the backdrop is the first phase. This is the reference image we utilize in our study to assess whether motion has occurred or not. The second action being performed is the background update. To do this, a second image is taken, and after converting both of them to grayscale, the difference between the two photos is calculated. We draw the conclusion that motion has

been detected if this difference rises above a particular threshold.

The camera's face tracking algorithm launches once motion is detected. The onboard voice assistant on the Raspberry Pi turns on and makes it possible to control the robot using voice commands if the face recognized is that of an authorized user. If, however, the face is not that of an authorized individual, a notification is sent to the user through email. It simultaneously begins taking pictures of the intrusion while also storing them locally for later use. Additionally, it uploads them to an outside FTP server so that they can be seen from a distance, also the Raspberry Pi starts live video streaming of the camera feed so that it may be viewed from anywhere. To accomplish this, we use VNC viewer, which allows us to monitor the video feed online and remotely control the robot.

4. Result

Once motion is detected, the user's registered email address receives an email notification. The user can log onto the Raspberry Pi after receiving the warning by knowing its IP address and using VNC viewer software. The Pi's IP address should be made static for this reason, meaning that it shouldn't change whenever the device reboots and reconnects to the network.



Fig. 3. VNC login authentication

For logging in to the Raspberry Pi from remote location, we need to enter the right credentials, namely, Username and password which are defined at the time of installation. Once logged in, we can see our desktop from remote location, as shown in Figure 4.

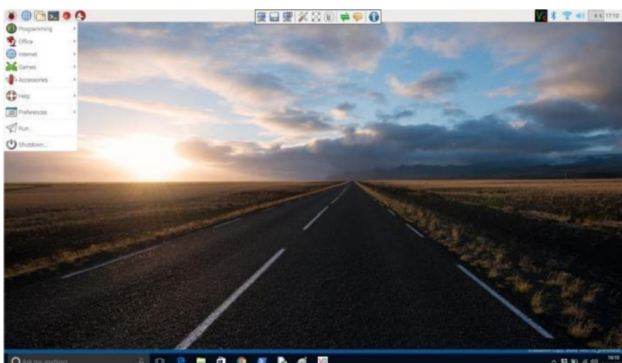


Fig. 4. Remote login using VNC viewer

Once we have remote access to our Raspberry Pi, Open CV makes it simple to examine the camera's live feed. The quality of the live feed obtained relies on the camera's resolution, the Raspberry Pi's internet speed (for uploading), and the user's end

(for video streaming). Python scripts are used to create the robot's control functions. For each movement in this script, different functions have been defined. When a key is pressed, the robot travels in the desired direction once the proper function is carried out.

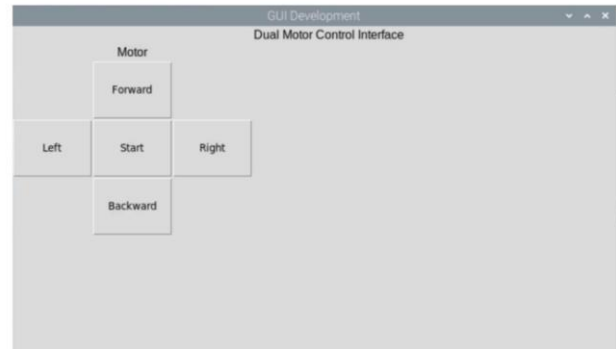


Fig. 5. Graphical User interface (GUI)

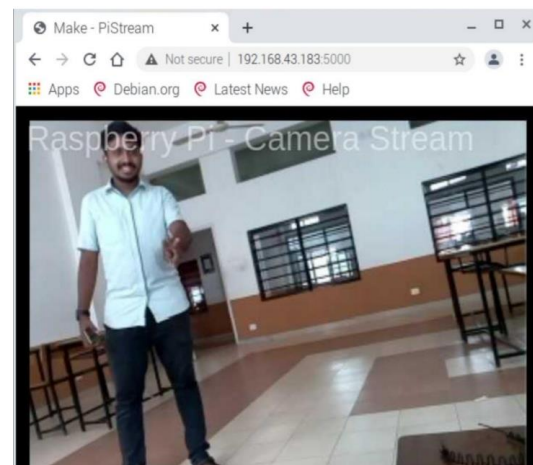


Fig. 6. Live feed from camera

5. Conclusion

The benefits of putting such a system in every home are that it gives the user peace of mind regarding his property even while he is away at home. This system may be easily implemented in any type of household because to its low power usage. It can also be used for a long period if the right battery is used. It will enable the system to function properly for several weeks at a time. This system can be added to an existing security camera system to add additional security, even if one already exists. Even while they are occupied working elsewhere, users will be able to keep tabs on their loved ones at home. If young children or elderly adults are left home alone, it offers them safety.

References

- [1] Sushant Kumar and S. S. Solanki, "Remote Home Surveillance System," 2016 International Conference on Advances in Computing, Communication, & Automation (ICACCA), 29 September 2016.
- [2] Tutun Juhana and Vivi Gusti Angraini, "Design and Implementation of Smart Home Surveillance System", 2016 10th International Conference on Telecommunication Systems Services and Applications (TSSA), 6 March 2017.
- [3] Virginia Menezes, Vamsikrishna Patchava and M. Surya Deekshith Gupta, "Surveillance and Monitoring System using Raspberry Pi and

- Simple CV”, 2016 International Conference on Green Computing and Internet of Things (ICGCIoT), 14 January 2016.
- [4] <https://hackaday.com/2016/02/28/introducing-the-raspberry-pi-3/>
- [5] <https://www.logitech.com/en-in/product/hd-webcam-c270>
- [6] <https://tronixlabs.com.au/news/tutorial-1298n-dual-motor-controller-module-2a-and-arduino>
- [7] https://robu.in/product/lm2596-dc-dc-buck-converter-step-down-module-power-supply-output-1-23v-30v/?gclid=Cj0KCQjwnqzWBRC_ARIsABSMVTNntWcvCMu9FzXc8JvR5NxH1Xur68-w1D2nTLDBTcirjNPBRoS_-z4aAmAOEALw_wcB
- [8] https://robokits.co.in/motors/300rpm-12v-dc-motor-with-gearbox?cPath=2_3&zenid=vgkkmg511t4efo596pqoulkr85
- [9] https://www.ebay.in/itm/253373210339?aff_source=Sok-Goog
- [10] https://docs.opencv.org/3.2.0/d1/dc5/tutorial_background_subtraction.html
- [11] <https://www.raspberrypi.org/documentation/remote-access/vnc/>
- [12] <https://docs.python.org/2/library/tkinter.html>