

# Night Vision Security Patrolling Robot Using Raspberry Pi

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**Abstract:** The project deals with the use of Raspberry pi to survey Smart monitoring system. These days' video surveillance is important in terms of security. High end cameras are needed in commercial spaces, schools and hospitals, warehouses and other demanding indoor and outdoor environments. Current technologies require expensive RFIDs and hence the security domain becomes expensive in all, so work on this was needed. The project explains the use of Raspberry Pi, a low cost single onboard computer. This new technology is less expensive, and is used as a standalone image processing platform in this project. It makes more use of mobile technology. Security systems currently need tons of costly components and a complicated installation process. There are currently two main types of systems available. The first is that of a wired machine. One drawback is that installing a wired system can take a considerable amount of time and money. Another drawback is that the establishments a permanent part of that. When the owner moves the machine must stay in place.

**Keywords:** Raspberry Pi.

## 1. Introduction

Security is a vital asset for lot of companies and homeowners. It also avoids damage done to individuals and avoids stolen or destroyed personal belongings. Each year, companies and homeowners set aside a large budget only for security measures. On average a security guard's annual salary is around \$25,000. It expense increases with the number of alarm systems, surveillance cameras and hired security guards. In 2011 homeowners spent about \$20.64 billion on united state home security systems. These statistics show how imperative safety is for companies and homeowners alike.

Alongside security guards, there are a variety of technologies that help to ensure security. Security Camera is one of the most common types of surveillance. This security method does not prevent the crime, but helps to identify criminals to law enforcement when a crime occurs. There are also security systems, where a security may sound once triggered to prevent offenders from further breaking in. These systems typically send a warning to law enforcement or a security station, and can be triggered within a certain range by sound, movement. Remote controlled robot of rover form is

also available. It is not remote controlled and just serves as another collection of ground-level cameras and an alarm. The Security patrolling autonomous robot presented in this report will combine several technologies to feature a robot with capabilities for detection and authentication. It will also act as a preliminary alarm device, a surveillance camera, and function in an indoor / outdoor environment. It can be found in office buildings, shopping centers or even larger homes. Raspberry Pi is a computer sized to a card.

It works almost identical to a computer. Various types of surveillance systems are available, such as monitor, CCTV, etc. In these types of surveillance systems, the person who is stationary and situated in that area can only see what is happening in that location. And here, even though the user travels from one location to another, he / she can keep track at the exact moment of what is going on in that particular place. Also, it provides anonymity on both sides, is another plus. Raspbian OS is the operating system which is used here.

There are a range of techniques in a wide variety of images that can effectively detect upright frontal faces. Such systems can tackle non-upright face detection directly. This program explains progress towards a device that can detect and recognize faces accurately and in real time, regardless of position, based on hair-like characteristics. Viola et aland introduces hair Raspbian OS must be mounted in order to send the picture to the mobile Closed circuit television monitoring system has now become an essential technology in today's society. Robots in our lives have found a significantly growing market for a variety of jobs. Their use in the military and other security sectors is increasing day after day, like features, improved by Lienhart et al. The detection technique is based on the wavelet template idea which defines an object's shape in terms of a subset of image wavelet coefficients. Given its computational efficiency and simplicity, this approach is chosen.

## 2. Fundamentals of the Project

The proposed system, Raspberry pi is installed with the night vision camera that helps the system find the intruders and go for

the automation. The robot covers a specific area and checks for any intruders when an intruder is detected, the owner is alerted by the buzzer sound.

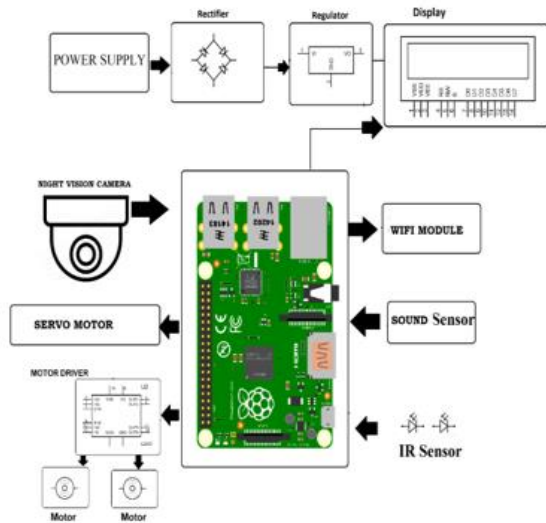


Fig. 1. Functional block diagram

We propose a robot patrolling security which uses night vision camera to secure any premises. The robotic vehicle moves at specific intervals, and is equipped with camera and sound sensors for night vision. In patrolling it uses a predefined line to follow its path. It stops at specific points and if sound is detected moves to next points. To patrol assigned area, the system uses IR-based path following system. It monitors each area using 360degree rotating HD camera to detect any intrusion. It is capable of tracking sound at the premises. Any sound after company is closed and its predefined path begins to move towards the sound. It then scans the area using its camera to detect any identified human faces It captures and begins to transmit images of the situation immediately upon detection of sound or human face. Here we use IOT Local Area Network (LAN) to get transmitted images and display them with warning sounds to the user. So we're putting forward a fully autonomous security robot that runs tirelessly and patrols large areas alone to secure the facility.

#### A. Raspberry Pi 3

The Raspberry Pi is a series of small single-board computers produced in the UK. The original model became much more popular than expected, selling for uses such as robotics outside its target market. It does not include peripherals (e.g. keyboards, mice and cases). However, some of the accessories have been included in a number of official and non-official Packages.

#### B. Night Vision Camera

Dim light from the night scene enters the front of the lens. The light is made of photons (light particles) of all colors. As the photons enter the camera, they hit a light-sensitive surface called a photocathode. It's a bit like a very precise solar panel whose job is to convert photons into electrons (small, subatomic

particles that carry electricity around the circuit).

#### C. DC Motor

A DC motor is one of a class of rotary electrical machines which converts electrical direct current into mechanical energy. The most that types of magnetic fields depend on the forces produced. Nearly all types of DC motors have some internal function, electro mechanical or electronic, to adjust the direction of current flow within part of the motor periodically. DC motors were the first type widely used, as they could be powered from existing distribution systems for direct current lighting. The speed of a DC motor can be regulated over a wide range, either by using a variable supply voltage or by adjusting the current force in its field windings. Small DC motors are used in tools, appliances and toys.

#### D. PIR Sensor

PIR infrared sensor module operates on operational infrared sight, programmed control options. It has high dependability, low power consumption, sensitivity variable, task mode low voltage. Generally used as part of various electrical gears for automated detection, especially for battery-powered and programmed control systems.

#### E. IR LED

An IR LED (infrared light emitting diode) is a solid state lighting device (SSL) that emits light within the electromagnetic radiation spectrum infra-red range. Infrared light, which is electromagnetic radiation in the range of 700 nm to 1 mm, is produced cheaply and efficiently with IR LEDs. IR LEDs are useful in different types of electronics, including many types of television and other electronic remote controls. Used with infrared cameras, IR LEDs will serve as a spot light while remaining naked-eye invisible. Infrared light, which is electromagnetic radiation in the range of 700 nm to 1 mm, is produced cheaply and efficiently with IR LEDs. IR LEDs are useful in a number of electronic types including many types of television and other electronic remote controls. IR LEDs used with infrared cameras can act as a spot light while remaining invisible to the naked eye. Since IR LEDs can be used in conjunction with a variety of different sensor types, they are becoming popular in Machine-to-Machine (M2M) and Internet of Things (IoT) environments.

#### F. TIP 120 Transistor

The TIP 120 is an NPN darlington transistor with a current gain of 1000 which is a good choice for interfacing to an Arduino or other microcontroller with many higher current or higher voltage loads. It can be used for controlling microcontroller DC motors, solenoids, or LED strings with minimum current draw

#### G. LCD Display

LCD (liquid crystal display) is the technology used in notebook displays and in other smaller computers. Like light emitting diode (LED) and gas plasma technologies, LCDs allow

displays to be much thinner than cathode ray tube (CRT) technology. LCDs consume much less power than LEDs and gas displays because they operate on the principle of blocking light rather than emitting it. An LCD is either made with a passive matrix or with an active display grid for the matrix. A thin film transistor (TFT) display is also known as the active matrix LCD. The passive LCD matrix has a grid of conductors with pixels located in the grid at each intersection. To monitor the light for any pixel, a current is sent on the grid between two conductors. An active matrix has a transistor located at each intersection of pixels which requires less current to control a pixel's luminance. For this reason, the current in an active matrix display can be turned on and off more often, increasing the refresh time on the screen (for example, the mouse may appear to be traveling faster around the screen).

#### H. Sound Sensor

A sound sensor is defined as a module that detects and converts sound waves into electrical signals via its intensity. Before we move on to how to integrate a sound sensor with Arduino, let's first take a look at the tutorial's sound sensor module that we will be using. Based on the LM386 power amplifier, the Grove – sound sensor module is a simple, low power and highly compatible option for easy kick-starting of your next sound sensing project. With a wide voltage range and the potentiometer adjustable output, it is readily capable of detecting the ambient sound strength.

#### I. Wi-Fi Module

It uses a 32-bit RISC CPU based on the 80 MHz (or overclocked to 160 MHz) Tensilica Xtensa L106 running at. It has a boot ROM of 64 KB, RAM instruction of 64 KB, and RAM data of 96 KB. External flash memory is accessible through SPI. The ESP8266 module is a low cost standalone wireless transceiver which can be used to develop IoT endpoints. Microcontroller will need to use set of AT commands to communicate with the ESP8266 module. Using UART, the microcontroller communicates with the module ESP8266-01 having specified Baud rate. A lot of third party manufacturers produce different modules based on this chip.

#### J. Power Supply

A power supply is a component of the hardware which provides power to an electrical device. It derives input from an electrical outlet and converts the current to DC (direct current) from AC (alternating current), which is what the device needs. It also controls the voltage to a reasonable level, allowing the device to operate smoothly without overheating. The power supply is an integral part of any computer and must work properly for the rest of the components to operate. Simply find the input where the power cord is plugged in, you can locate the power supply on a system unit.

### 3. Literature Review

[1] Network video capture framework is introduced in this

paper using the nice ARM9 board support package (BSP) S3C2440. This application device captures video, shares between networked devices, and also alerts the controller with a short message service warning, as the client needs. This system operates in an environment in real time, and is supported by RT Linux embedded. This system provides low cost and high efficiency intelligent monitoring systems with low power consumption, such as elevators, home security systems, etc. Power consumption small. This real-time system provides a client video monitor with the help of friendly ARM9 BSP, unlike other embedded systems.

[2] In a wide variety of images, there are a number of techniques that can successfully detect upright frontal faces [1]. Some systems can explicitly address non-upright face detection [3]. This paper describes progress towards a system that can detect and recognize faces on the basis of haar-like features, regardless of pose reliably and in real-time. In a wide variety of images, there are a number of techniques that can successfully detect frontal upright faces [1]. Some systems can explicitly address non-upright face detection [3]. This paper describes progress towards a system based on hair-like features that can detect and recognize faces irrespective of pose reliably and in real-time. We have found that the simple attempt-all-poses system actually yields higher operating characteristics of the receiver (ROC) curve, although it is slower. Due to its computational efficiency and simplicity this approach is chosen.

[3] Multi-environment robot for surveillance and live streaming is designed to install real-time surveillance system possible within a local network. The live streaming is accomplished using mpeg streamer and the server-client model is built using java as IP-based deployment offers access from image quality and is also advantageous in terms of scalability and versatility. But IP-based systems require some networking knowledge and these systems are too expensive than the analog ones. A server-client model incorporates this robot controlled with raspberry pi. This client-server model is built on java, and can therefore work on any system like windows, Mac, or Linux. This entire model is linked to a local network and can be managed from anywhere by anyone accessible in that specific local network. MJPG streamer conducts live streaming. We proposed a framework to create a live streaming and monitoring system in real time using this whole model is linked to a local network so it can be operated from anywhere by anyone accessible in that specific local network. MJPG streamer conducts live streaming. Raspberry pi, with Wi-Fi connectivity installed. The pi will record the video of the location in real-time during monitoring process. Video capture is done via commands that are provided to the raspberry pi through the device.

[4] Raspberry pi connection with the motor driver is done using Raspberry Pi's General Purpose Input Output (GPIO) pins. The GPIO pins are connected to the motor-shield input pins. The motor shield's exit pins are connected to the motors.

The motor shield and the raspberry pi are connected by a portable charger with 2-amp current. Upon proper attachment the raspberry pi is able to boot up. For controlling the motors, a Python program is written where the GPIO pins will deliver the output from the raspberry pi to the shield. The robot movement is controlled through the directions mentioned on the web page created using Hyper Text Markup Language (HTML) code and webpage Universal Resource Locator (URL) address. The Raspberry Pi model B communicates this process through Wi-Fi. The camera module is installed in its port and is enabled in raspberry pi configurations. MJPEG streamer is installed and configured for Live streaming of videos.

[5] The Raspberry pi and Open CV Smart Security Camera is a surveillance device built to be used within a warehouse facility. Using a raspberry pi, this system is conceived using a low cost safety camera with night vision capability. This system has the ability to detect and detect human smoke which can be used to prevent possible crimes and potential fire. The researchers have developed a light-footed surveillance camera that can identify the condition of the scene being monitored and also notify or alert the event. This system also offers nighttime security, as it has the potential to provide night vision. Night vision capability is accomplished by simply eliminating infrared (IR) filter from an ordinary webcam and can thus be used with the aid of the IR Light Emitting Diode illuminator for night vision sensing. The system can also use background subtraction algorithm to detect movement of an object. When a moving body is detected, it may be marked as person or smoke by the system. When smoke is detected the device may alert fire or unauthorized individual in the form of an alarm and email.

[6] Face recognition is still a very difficult task when the image of the input face is noisy, obstructed by other obstacles. Low-resolution, camera not facing and not properly lit. These problems contribute to the extraction of the feature and Face recognition system unstable as a consequence. In this paper the system proposed incorporates the novel idea of using hair-like characteristics, which were widely used in Item recognition and the probabilistic facial classification Reconnaissance. The system proposed is simple, real-time, efficient and robust against most of the problems described. Experimental findings on public databases show the proposed. The system actually outperforms state of the art facial recognition systems.

[7] The paper describes a machine learning approach for the detection of visual objects which can process images Extremely fast and attain high detection rates. That's it. Three key contributions distinguish work The former Is the implementation of a new representation of pictures, called "Integral lineage" which enables our detector to measure its features very quickly The second is a learning process AdaBoost based algorithm, which selects a small number of essential visual features and yields from a larger collection Extremely elliptical The third contribution consists of a method for combining ever more complex classier in a "cascade" that allows background regions of the classier Image to be discarded

quickly while spending more calculation on promising regions like objects Might be the cascade Seen as a special focus-of-attention mechanism for object Which, unlike previous approaches, provides statistical guarantors who are unlikely to have the object of interest in discarded regions, In the face recognition domain the machine Returns equivalent detection rates to the best previous systems. The Detector is used in real-time applications 15 frames per second without the use of differentiating pictures or detecting skin colours.

[8] Embedded remote video control device, focused on ARM and quick motion Stimulus algorithm (2011 International Conference on Instrumentation, Measurement and Control) Jian Wang Automation department, Harbin Automation Institute University of Technology 150080, Harbin Herlongjiang: Current H.264 codec-based video chaotic encryption schemes may be applied to two classes: before H.264 encoding, the original video data is encrypted with chaos; after H.264 encoding, it is encrypted with chaos. The main disadvantage of the two classes of schemes is that the contradictory problem between desirable safety and rapid frame rate is not well resolved. This paper presents a novel H.264 codec-based video-chaotic encryption scheme to cope with the problem, where the original video data is encrypted by a stream cipher and position scrambling with chaos after H.264 encoding. In particular, H.264 hardware encoding, multi-core multi-threading, H.264 data format protection and adaptive memory selection strategy are adopted for making the suggestion.

#### 4. Flowchart

##### A. Flowchart for Creating Database

The flowchart below shows the steps involved in creating an authorized user database:

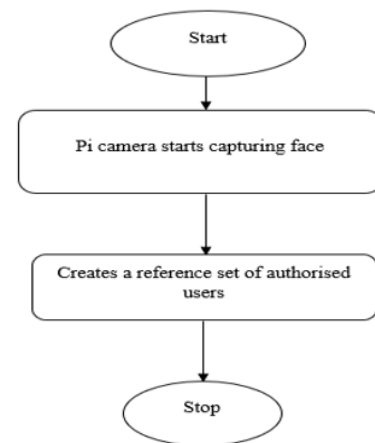


Fig. 2. Flowchart for Creating Database

When the robot receives the power supply the pi camera starts capturing the user's face in front of it. It captures the set of images and stores them during face detection as a user reference database for authentication. That authorized user

database will consist of 30-50 images in order to obtain a high precision during face detection and to avoid detection of unauthorized face as allowed. The authorized person's created image database is converted into matrix format for more rapid and accurate detection.

**B. Flowchart for face detection and authentication**

The flow-chart below shows the entire Security Patrolling Robot operation:

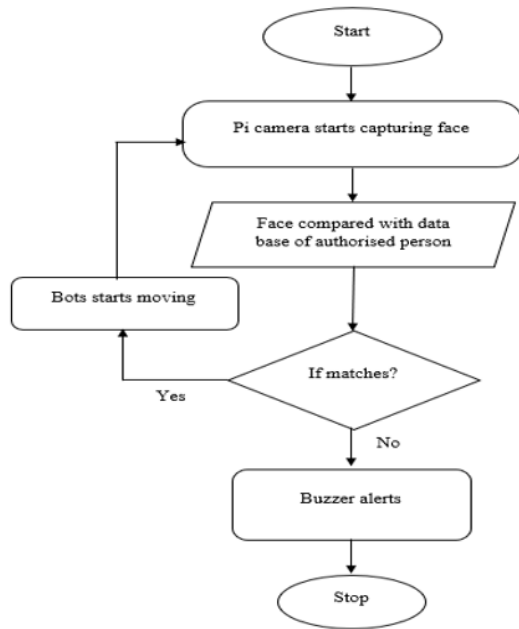


Fig. 3. Flowchart for face detection and authentication

The camera detects the face in front of it when the robot is initialized and cross-checks it with reference database. The captured face is sent to the training sequence where it is translated to matrix format and is compared to the current database of references. If the face is authenticated, then the robot starts to move forward and to check continuously. If the face is not authenticated, then the sounding of the buzzer alerts the owner.

**5. Face Detection and Recognition**

Opencv has three built-in face recognizers:

1. Eigen Faces
2. Fisher Faces
3. Local Binary Patterns Histograms (LBPH)

In the designed system we use Local Binary Patterns Histograms (LBPH).

**A. Local binary patterns histograms**

- It is the duty of the face recognition algorithm to

identify the image that marks the image pixels by thresholding each pixel's neighborhood.

- A new binary value is set for each neighbor of the central value. For values equal to or higher than threshold, we set 1.
- The result is converted as a binary number by taking the clockwise direction of the threshold values.
- The binary is converted to decimal form and then converted to histogram, which is concatenated into a larger histogram.
- The histogram obtained is compared to the Euclidean distance reference histogram.
- Distance is known as the measure of trust.
- When the value of the trust is smaller than the threshold, the other party is an intruder.

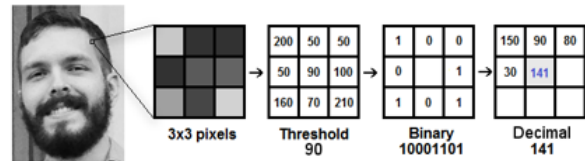


Fig. 4. Computation of LBPH (Local Binary Pattern Histogram)

**6. Conclusion**

This paper presented an overview on night vision security patrolling robot using Raspberry Pi.

**References**

- [1] M. L. V. N. B. S. Kumar, N. S. Murthi Sarma, Ch. Sridevi, A. Pravin "ARM9 Based Real Time Embedded Network Video Capture and SMS Alerting system."
- [2] Krishna Kishore, B. Chinna Rao, P. M. Francis, "ARM Based Mobile Phone- Embedded Real Time Remote Video Surveillance System with Network Camera," International Journal of Emerging Technology and Advanced Engineering, vol. 2.
- [3] Kavitha Mamindla, V. Padmaja, Ch. Naga Deepa, "Embedded Real Time Video Monitoring System using Arm," IOSR Journal of Engineering, vol. 3.
- [4] Tasleem Mandrupkar Manisha Kumari Rupali Mane, "Smart Video Security Surveillance with Mobile Remote Control."
- [5] Nava Jeevan Raju O. and Praveen P, "Video monitoring and motion detection system based on arm-linux platform and http protocol with SMS capability."
- [6] Wang Liwei Yan Shi Xu Yiqiu, "A Wireless Video Surveillance System based on 3G Network," Conference on Environmental Science and Information Application Technology.
- [7] Zhaomin Zhu, Takashi Morimoto, Hidekazu Adachi, Osamu Kiriyaama, Tetsushi Koide and Hans Juergen Mattausch, "Multi-view Face Detection and Recognition using Haar-like Features."
- [8] P. Viola and M. Jones, "Rapid object detection using a boosted cascade of simple features," in Proc. of IEEE Conference on Computer Vision and Pattern Recognition, Kauai, HI.