Smart Motion Detection Surveillance Rover with Night Patrolling for Women's Safety and Monitoring

B. N. Divya[1], Bhargavi Hegde[2], B. R. Chaithanya[3], M. T. Moulya Raju[4], S. Shambhavi[5*]

[1]*Asisstant Professor, Department of Electronics and Communication Engineering, East West Institute of Technology, Bangalore, India*

[2,3,4,5]*B.E. Student, Department of Electronics and Communication Engineering, East West Institute of Technology, Bangalore, India*

Abstract: Now-a-days women safety is the biggest concern in many parts of the world. so the need for a safe and secure system is desired by each and every individual in the society. Our project describes about a safety electronic system for women safety. In this project we propose to use a security camera with the night vision capabilities using raspberry pi and openCV. This is a cost effective method that uses a credit card sized chip Raspberry Pi and also we use a pi camera. The deep learning technique CNN is used for anomaly detection. So the image is captured via the pi camera and it is send to the raspberry pi for processing for face and human detection with the help of openCV. This is further sent to the authorized user with the aid of application programming interface called Twilio with the location of crime spot. Also the image of that unusual situation is also sent to the authorized user through mail. This system has accuracy of about 83 %. With the help of a smart surveillance system, we have achieved a system that can record the event, detect and recognize the unusual activities.

Keywords: Convolutional Neural Network (CNN), OpenCV, Raspberry Pi, Raspberry Pi camera, Twilio.

1. Introduction

Now-a-days, people want one sole thing that is to make them feel safe and secure. The most commonly used security system is the CCTV. The cost of implementation of CCTV varies depending upon the size and use of the system. It is usually installed in public areas like hospitals, malls, parking lots etc. However, with the help of CCTV one can monitor the area 24/7, or the footage if stored in a location can be retrieved when required. It can be used to detect crime and allows the authorities to identify and solve a crime. Security is a vital asset for lot of companies and home owners. 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. We have implemented a smart system which provides both face detection and face recognition with the help of Raspberry pi 3 and it is interfaced with a Pi camera which is made especially for the raspberry pi 3. And we have connected IR sensor for obstacle detection, sound is sensor is used to detect the unusual sounds. No sooner unusual activity or anomaly sound is created then camera opens and takes the picture of the situation. This is further sent to the authorized user with the aid of application programming interface called Twilio with the location of crime spot and also if any weapons are detected then again it will send picture of the intruder to the authorized user through mail. And further actions can be taken accordingly.
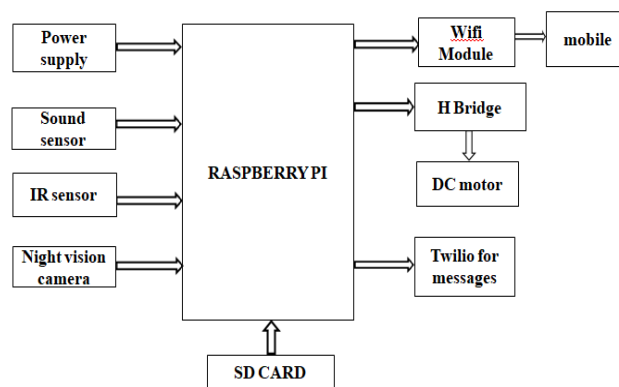
2. Proposed System

Fig. 1. Functional block diagram

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 or weapon is detected, the owner is alerted by the buzzer sound. 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.
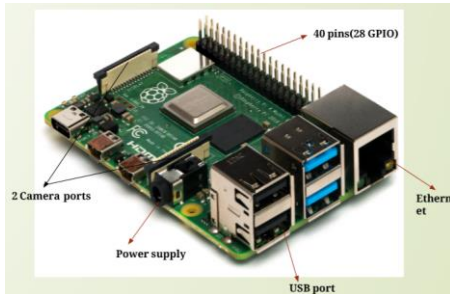
A. Raspberry Pi 3

Fig. 2. Raspberry pi diagram

Raspberry Pi is a small single-board Computer developed in UK by Raspberry Pi foundation to promote the teaching of computer science in schools and in developing countries. Original model become far more popular than anticipated sealing outside of its target market, for uses such as robots. Processor speed ranges from 700 MHz to 1.4 GHz for the Pi 3 Model B+; on-board memory ranges from 256 MB to 1 GB RAM.
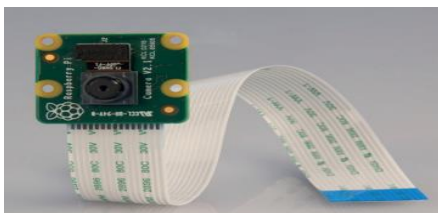
B. Night Vision Camera

Fig. 3. Raspberry pi 3 Camera module

High-Definition camera module compatible with all Raspberry Pi models. Provides high sensitivity, low crosstalk and low noise image capture in an ultra-small and lightweight design. The camera module connects to the Raspberry Pi board via the CSI connector designed specifically for interfacing to cameras. The CSI bus is capable of extremely high data rates, and it exclusively carries pixel data to the processor.

C. DC Motor

Fig. 4. 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. IR Sensor

Fig. 5. Infrared sensor

IR 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.
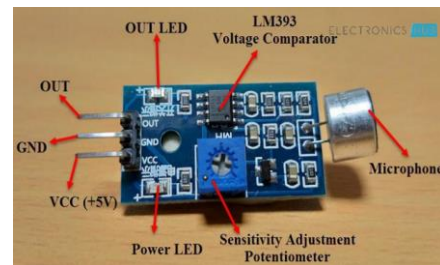
E. Sound Sensor

Fig. 6. 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.

F. H-Bridge

H-bridge is a circuit which allows the voltage to be flown in either direction Dual H-bridge Motor Driver integrated circuit (IC). The l293d can drive small and quiet big motors as well, check the Voltage Specification at the end. It works on the concept of H-bridge. As we know voltage need to change its

direction for being able to rotate the motor in clockwise or anticlockwise direction, hence H-bridge IC are ideal for driving a DC motor. In a single L293D chip there are two h-Bridge circuit inside the IC which can rotate two dc motor independently. Due its size it is very much used in robotic application for controlling DC motors. Given below is the pin diagram of a L293D motor controller.

G. 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.

H. 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.

I. Twilio

By utilizing the Twilio application a product engineers can automatically make calls or get calls, send instant messages and get instant messages, and play out some correspondence capacities utilizing its web administration APIs.

3. Literature Review

1. Published in 2017: "Implementation of spy robot for surveillance system using internet protocol of Raspberry pi" Ghanem Osman Elhaj Abdalla. 2nd IEEE International conference on recent trends in electronics, information and communication technology (RTEICT). At present the surveillance of International border areas is a difficult task. The border guarding forces are patrolling the border seriously, but it is not possible to watch the border at each and every moment. An essential requirement of this situation is a robot which automatically detects trespasser in the border and report nearby board security control unit. Many of the military departments now utilize the robots to carry out risky jobs that cannot be done by the soldiers. In this present work. The spy robot system comprises night vision pi camera and sensors. The information regarding the detection of living objects by PIR sensor is sent to the users through the web server and pi camera capture the moving object which is posted inside the webpage

simultaneously. The user in control room able to access the robot with wheel drive control buttons on the webpage. The movement of a robot is also controlled automatically through obstacle detecting sensors to avoiding the collision. This surveillance system using spy robot can be customized for various fields like industries, banks and shopping malls.

2. Published in 2018: "Review of human detection techniques in night vision" Sonu Kumar Sharma Department of CSE, MNNIT, Allahbad International Conference on Wireless Communications, Signal Processing and Networking (WiSPNET) Human detection has always been a challenge in many automations of computer vision area. This problem gains more importance when the scene involving human detection is of night time. Surveillance is one such application which has a very serious requirement of night vision mechanism. An automated system for human detection in night vision could be a helping hand to surveillance at any sensitive locations. This paper reviewed two algorithms for detecting human being in night vision videos. Proposed hot-spot algorithm uses black body radiation theory and the background subtraction algorithm uses the difference image obtained from the input image and a generated background image. The result analysis is done of the experiments performed on these approaches.

3. Published in 2017: "Robotman: A security robot for human robot interaction" Alexander Lopez, 18th International conference on advance robotics (ICAR) In this paper we present the design, development and preliminary tests of Robotman, a robot that combines qualities for interaction with humans, and security patrolling services. The robot is inspired by the information obtained from a security company in which their personnel not only perform security patrolling services, but have to interact with people, providing additional information about the area they safeguard. The robot is able to perform security patrols during the night while functioning as a guide during the day. We designed and implemented a robust, easy to assemble, anthropomorphic security robot aiming to patrol large indoor areas, interact with humans, welcome, provide information and guide clients to their destination, as well as function as a tele presence platform for the human security guards. Our results suggest that Robot man is user friendly and pleasing to the people, it can perform security tasks and interact with them

4. Published in 2019: "Depth Image-Based obstacle avoidance for an indoor patrol robot" Zhenghan Jiang, 2019 International conference on machine learning and cybernetics (ICMLC). Image-based obstacle avoidance has been studied for decades. One weak point of image-based approaches is that the performance usually depends on the lighting condition. That is, the performance can be very poor in dark environments. In this research, we investigate the possibility of the depth image-based approach for full-time indoor patrolling. As the first step, we consider a 3-class problem. Each depth image is classified as "danger" if some obstacle is too close, as "notice" if the obstacle is close, and as "normal" if there is no obstacle in the vicinity. The label of each depth image is defined based on the RGB image captured at the same time, and an AlexNet, which is a well-trained convolutional neural network, is retrained via

transfer learning, and used for classification. In our primary experiment, we collected 102,776 image data in the Research Quadrangle of the University of Aizu. Test results show that the performance of the depth image-based approach is good during both day and night, and in most cases, it is better than the RGB image-based approach. This result can provide new insights when designing more practical full-time patrol robots.

4. Design and Implementation

1) Flow chart of creating database

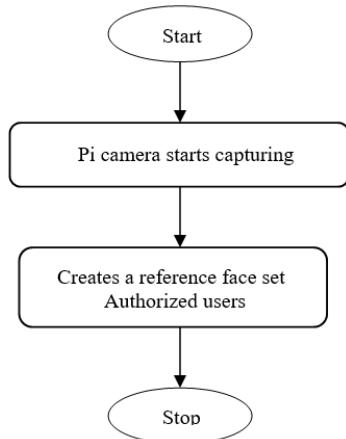The flowchart below shows the steps involved in creating an authorized user database:

Fig. 7. Flow chart of 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.

2) Flowchart for face detection and authentication

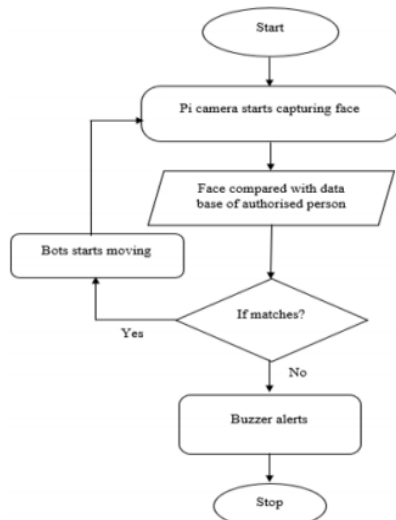The flow-chart below shows the entire Security Patrolling Robot operation:

Fig. 8. Flow chart of 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.

3) Flow diagram of unusual activity detection system using CNN

- Images are acquired using Pi Camera to capture image frames.
- Haar cascade classifier are used to identify objects and person in an image.
- Blurring: Gaussian blur.
- Edge detection: Canny Edge detector.
- This preprocessed image is now checked for unusual act.
  CNN Section:
- Images with label are extracted from COCO dataset.
- If CNN model detects weapon or suspicious activity, the same is intimated to the authorized user.
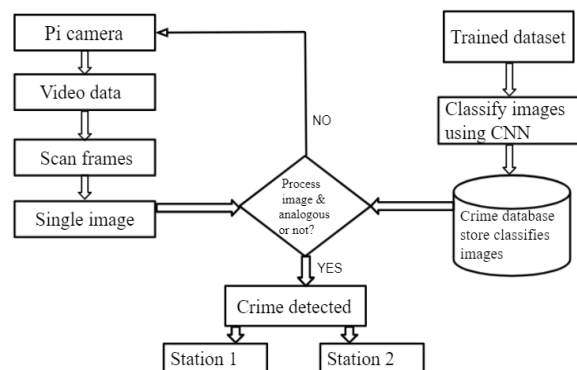

Fig. 9. Flow diagram of unusual activity detection system

5. Result

The smart surveillance camera is very effective in a way that it provides security by reducing the alarming raise of crime. The Face of the human being is detected easily with the help of the implemented algorithm a Haar classifier. like cascade. Further CNN model or algorithm will detect for the unusual activities or activities with crime intention. Also when the unusual sound such as screaming, calling for help etc. are detected then the particular image of that situation is taken and sent to the authorized user. If crime intentions are not detected, no intimation is made. If any person detected with anomalous behavior or weapon, the SMS module will activate and send it to the user with the aid of Twilio application.

A. Normal Activity

If crime intentions are not detected, no intimation is made.

Fig. 10. No crime

B. Suspicious Activity

If any person detected with anomalous behavior or weapon, the SMS module will activate and send it to the user.

Fig. 11. Crime detected

6. Conclusion and Future Scope

In this work, we have proposed Deep learning algorithm CNN to detect unusual activity and weapon. This night patrolling surveillance rover is tasked with providing constant monitoring and secure a place from adversaries. In future work, multiple robots can be implemented using swarm robots to cover larger areas.

This system has a wide range of uses in various fields, such as banking, forensic department, etc. The reason this system is quiet useful is due to the fact that it is highly compact and it provides face detection and an instant notification about the same through email. In addition to this face recognition can also

be tried in future. Recognition is the main part of any security system. Usually for a best recognition system, we require a well-trained database, which can provide the base for our recognition. So to obtain the database, first collect the images of the subject individual for the recognition. Once we obtain and train our system, we can provide face recognition. As far as the future scope of this system is concerned and as far as women's safety is an issue this robot can be an abetment and a Good Samaritan. In future work, multiple robots can be implemented using swarm robots to cover larger areas.

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