Face Recognition with Surveillance Robot using Raspberry Pi

Kausalya Senthil

Assistant Professor
K.S.Rangasamy College of Technology

***Abstract*- For any nation, maintaining its international borders has become an extremely difficult undertaking. Long borders are not necessarily something that border security personnel can keep an eye on year-round. In the current geopolitical climate, it is essential to deploy technology in the form of robots to identify intruders at borders and transmit data to the control center. While it can be risky for warriors, many high-risk occupations in a hostile environment are best done by robots. The goal of the proposed study is to create an autonomous system that can identify hostile events, such as fires or gas leaks, in specific locations without causing casualties. It is made up of a robotic car.**

***Keywords*- Surveillance; Raspberry Pi; face recognition; VNC Viewer.**

I. INTRODUCTION

The main goal of security is to shield countries against smuggling, infiltration, and terrorist attacks, among other threats. Therefore, places near international borders need to be very secure at all times. Security staff are needed to monitor specified regions with video cameras while employing a surveillance system. There are several issues with the manual surveillance method.

1. It is difficult for humans to keep their attention on constant observation.
2. It can be difficult to continuously watch several screens that display video streams from security cameras.
3. There's a major security breach when a tired security guard nods off while at work.
4. Shift work is required for guards to provide round-the-clock coverage, which raises costs.

To tackle these problems, a robot-centered automated surveillance system with several sensors is suggested.

To investigate the properties of a two-wheel self-balancing robot and regulate its behavior on a level surface and an inclined plane, a mathematical model is put forth [1]. It is suggested to use a robotic surveillance system powered by a Raspberry Pi to automatically identify intruders and notify the control room. Although the method allows a robot to be controlled remotely, it is unable to differentiate between an unauthorized user and a known individual [2]. A security system that detects human presence or smoke at night and sends out an email alert is shown. It uses a Raspberry Pi and OpenCV image processing technology. However, it is unable to discriminate between an invader and a recognized individual [3]. It is suggested to use sensors in a robotic system to detect fire and hazardous substanceWhen any of the sensors activate, the system notifies the user, but it is unable to determine if nearby items are human movement [4]. To target trespassers in high security areas, an automatic pistol targeting system based on microcontrollers is created. When sensors are activated, the system is activated, but it is unable to identify the person [5]. It is suggested to use Python-OpenCV as the programming language and Raspberry Pi as the controller to create a surveillance system that can record and save black-and-white video in real-time while connected to the Internet and WiFi [6].

II. ARCHITECTURE OF SURVEILLANCE ROBOT

A surveillance robot is positioned far away to keep an eye on the surroundings. The components include a Raspberry Pi, a USB camera, sensors, a driver relay with a target system, and a motor driver with two DC motors. Fig. 1 depicts the block diagram of the surveillance robot.

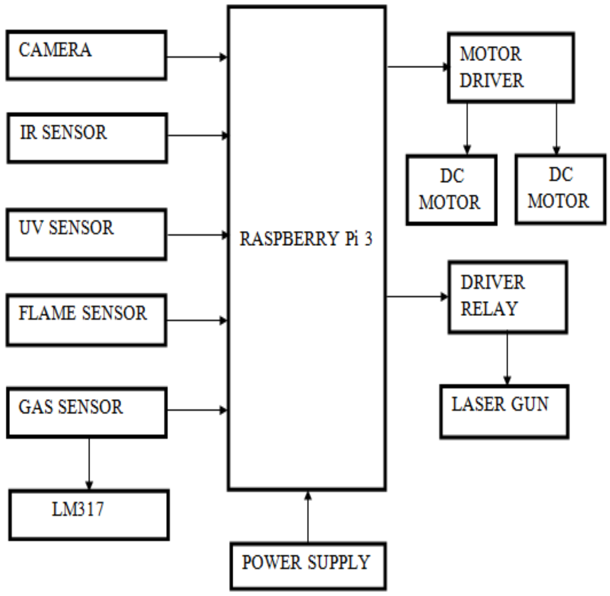

Fig.1: Block diagram of surveillance robot

Robot is developed with a Raspberry Pi as the controller, and its numerous control functions are implemented using OpenCV-Python programming language. Using an L293D motor driver module and the Raspberry Pi's General Purpose Input Output (GPIO) control signals, H-bridge DC motor driving is accomplished. All sensor modules, relay modules, and driver modules send signals to the Raspberry Pi via GPIO pins. All hardware is powered by the 12 V supply board that comes with it, with the exception of the sensors, which need 5 V and are controlled by the LM317 voltage regulator. Occasionally, the gas sensor needs more than 1.5 A of current, which could impact how well the other modules function. Thus, the LM317 is used to power the gas sensor, and its DO pin is Thus, the Raspberry Pi is connected to the DO pin of the LM317 gas sensor, which is powered by it. The methods used in fire detection include heat, flame (light), smoke, or a combination of these. Ultrasonic sensors use the time delay between the emitted and reflected waves to calculate the distance between the sensor and the obstruction, whereas infrared sensors use the surrounding environment to identify obstacles. Additionally, a USB port is used to interface a USB camera with the Raspberry Pi. As a proof of concept, an LED is attached to the relay output in place of a laser gun that shoots at the intruder. The live broadcasting of security camera footage is enabled by an Android application or a computer system controlling a robot system.

III. FLOW CHART FOR SURVEILLANCE ROBOT

A flowchart depicted in Figure 2 illustrates how a surveillance robot operates. Upon activation, the robot, sensors, and camera are turned on. It then moves around the surveillance area, moving its camera 54 degrees. Robot begins to advance while its infrared sensors scan the surrounding area for any objects. Robot advances if no obstruction is detected; if an obstacle is detected, robot stops to avoid it and the sensor output drops. If sensor output is positive, a message is sent to the Android mobile operator in the control room to alert him. Further, the surveillance robot

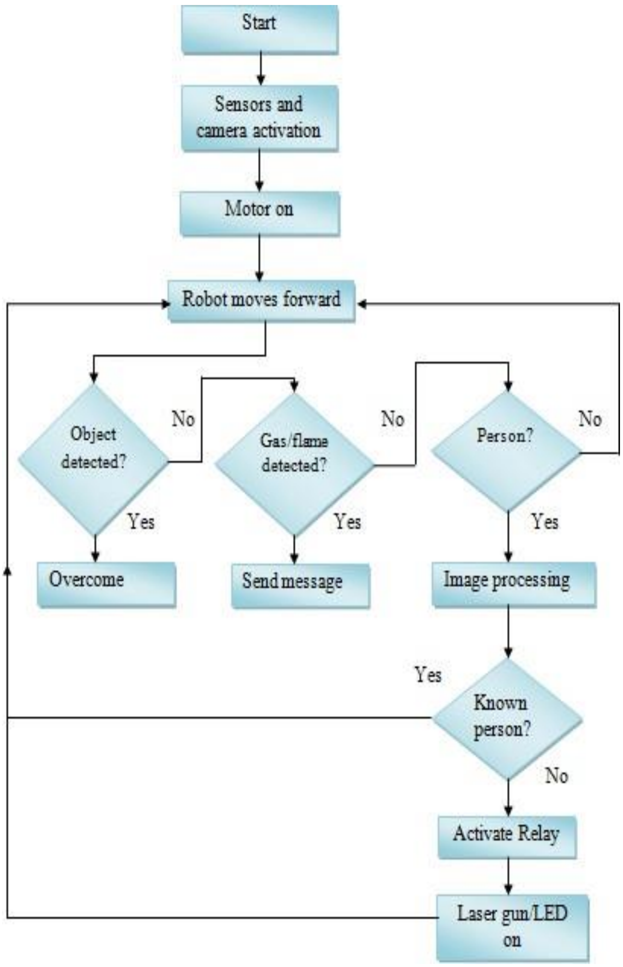

Fig.2: Flowchart Showing working of surveillance robot

When a face is identified, the system uses facial recognition data and, with the use of image processing algorithms, compares it to previously stored military personnel records in the database to ascertain whether the identified face belongs to a known or unknown individual. In order to identify and detect human presence in images, image processing techniques such as the Haar Cascade classifier and Local Binary Pattern Histogram (LBPH) algorithms are employed [7, 8]. When the detected person's face matches the database's stored facial information, the robot advances. When there is a mismatch, the surveillance robot stops and the relay triggers the laser gun, deactivating the intruder by firing at him. Nevertheless, this gun target control in this work However, in this work, this gun target control is replicated with an LED on/off control with therelay activating the LED implying triggering of the target controller. The LED turns on and the robot moves forward. This process continues in an infinite loop to provide for non- stop surveillance.

IV. FACE RECOGNITION ANDUNUSUAL EVENT DETECTION ALGORITHMS

Using classifiers Face recognition is carried by choose image as positive i.e. image with face, or negative i.e. image without face. Classifiers are trained from a large positive and negative images that are with and without faces. OpenCV comes with pre-trained classifiers as under:

- Haar Classifier
- Local Binary Pattern (LBP) Classifier.

a) Haar Classifier

For face detection, the Haar-feature classifier algorithm is employed. The "Integral Image" notion of the Haar classifier offers features that enable quick computation by the detector. The algorithm is based on Adaboost, which selects a select few significant features from a large set in order to produce effective classifiers.Complex classifiers are combined to form 'cascade'.This rejects if any non-face region is present in the image while focuses on face region.

b) Face recognition algorithm

Face recognition uses the local binary patterns histogram (LBPH), which generates a local binary pattern for every pixel. Comparing each pixel in an image with its neighboring pixels is the fundamental idea. It starts by using a single pixel as the center and comparing it to the nearby pixels. It writes the pixel with a 1 if the intensity value of the considered pixel is greater than or equal to that of the bordering pixel. If not, a zero is inscribed. After that, a histogram of all the decimal values is created by converting each binary pattern into a corresponding decimal number.

c) Algorithms involved in object classification

Base networks and detection networks are two categories for deep neural networks. The suggested method makes use of the MobileNet base network to produce high-level characteristics for detection and classification. Convolution layer is applied to a base network in a Single Shot Detector (SSD) algorithm type detection network in order to perform detection tasks.

IV. RESULTS AND DISCUSSION

A surveillance robot prototype with all of its functions displayed is created and is seen in Figure 3. It is made up of sensors and motor activators interfaced to a controller. The robot's ability to recognize faces is displayed, and the Open CV Python programming language is used to create the face detection system with the Haar-Classifier technique.

a) Sensor Output

When the robot is traveling forward, it continuously scans its path for obstacles in an endless cycle. The message "left side object detected" appears on the screen when the left side infrared sensor is activated. The message "right side object detected" appears on the screen when the right side IR sensor is triggered. An ultrasonic sensor locates an object by measuring the separation between it and the sensor. The measured distance is shown in the output window once the calculation is complete. Fig. 4 displays an example of the sensor output that was produced.

b) Detection of gas and fire

The system checks for the presence of fire and gas in surrounding area. If gas/fire was detected, the system displays the message to the operator as “gas detected” or “fire detected”, as shown in Fig.5.

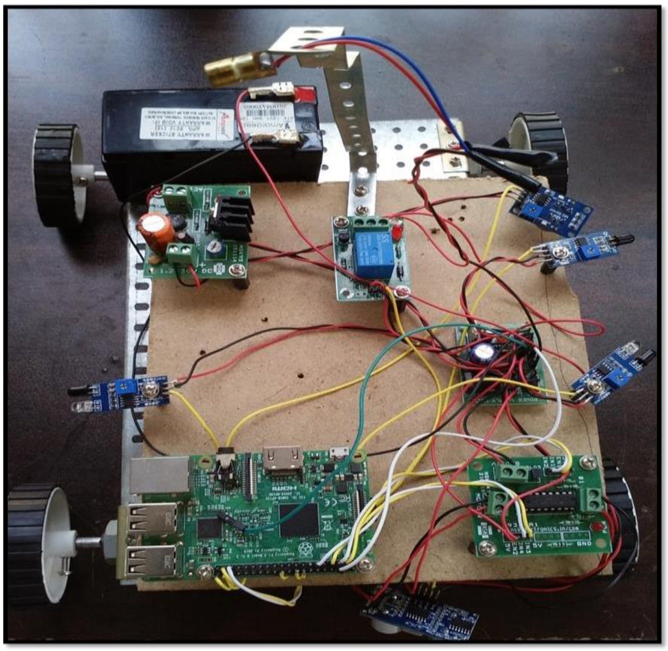

Fig.3: Prototype Surveillance robot

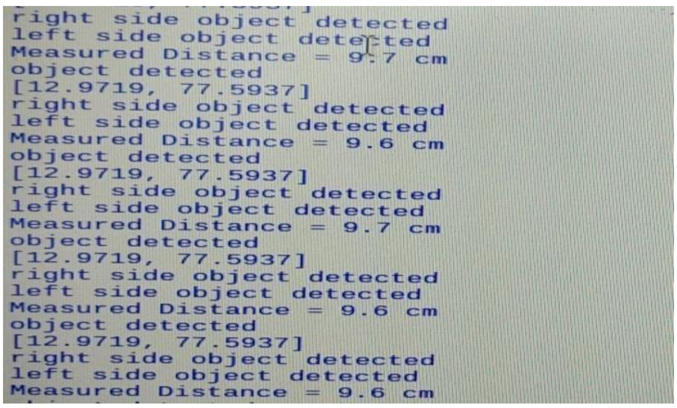

Fig.4: Output of IR, Ultrasonic Sensor for obstacle detection

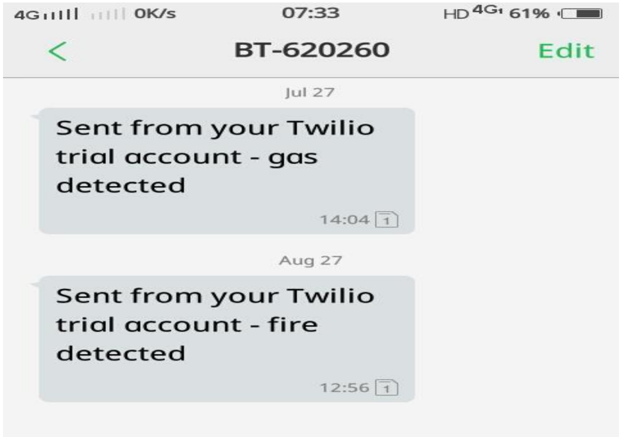

Fig.5: detection Of gas and fire

c) Detection on unusual event

An alert labeled "unusual activity detected" is sent by the system in the event of an unexpected event or dangerous circumstance, such as someone carrying a pistol or knife in a high-security area. After loading the input image, the system shows one of the top five predictions, as seen in Fig. 6. Fig. 7 shows the message that was sent to the operator. Unusual objects like a syringe and a screwdriver are used to test the system.

d) Recognition of known person

For the presence of facial data of human being the system continuously monitors the surrounding area If the detected person is known, the system displays his name asshown in Fig.8.

e) Recognition of unknown person

The Robot system stops and the relay activates the laser gun to target the detected person or turns on the LED when the face data in the image does not match the database, indicating that the individual is unknown. The outcome of the recognition of an unknown person is depicted on the system in Fig. 9.

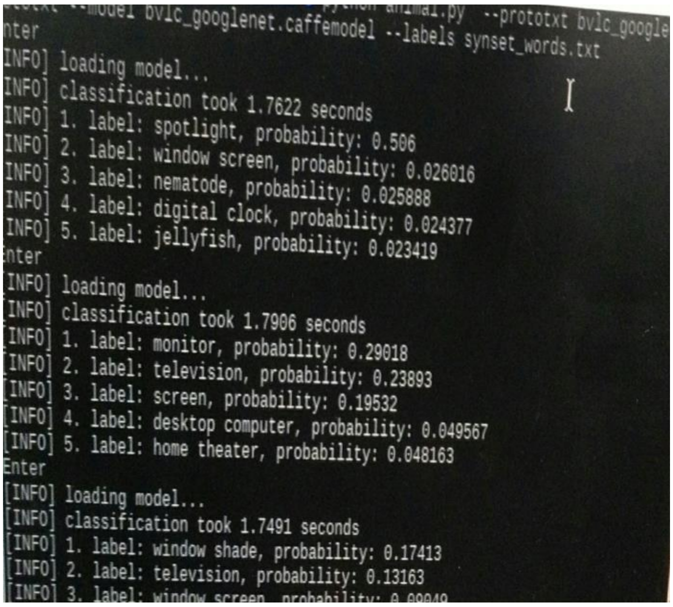

Fig.6: Object classification on unusual event detection

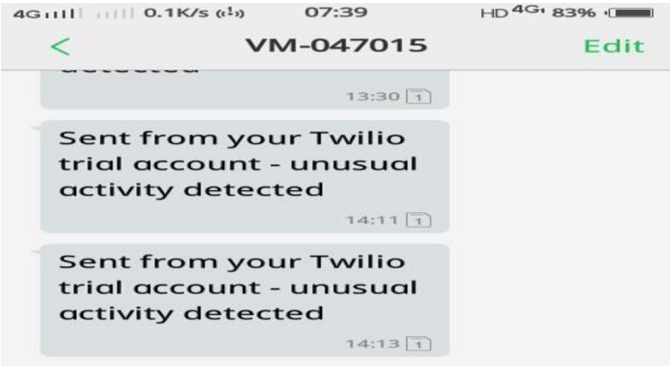

Fig.7: Alert message of unusual event detection

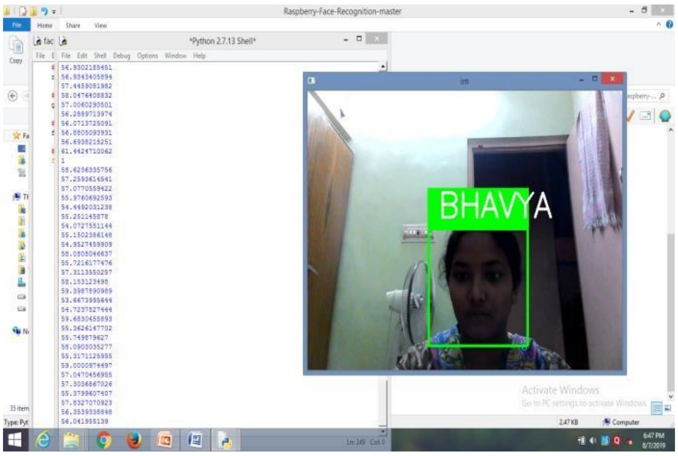

Fig.8: recognition of known person

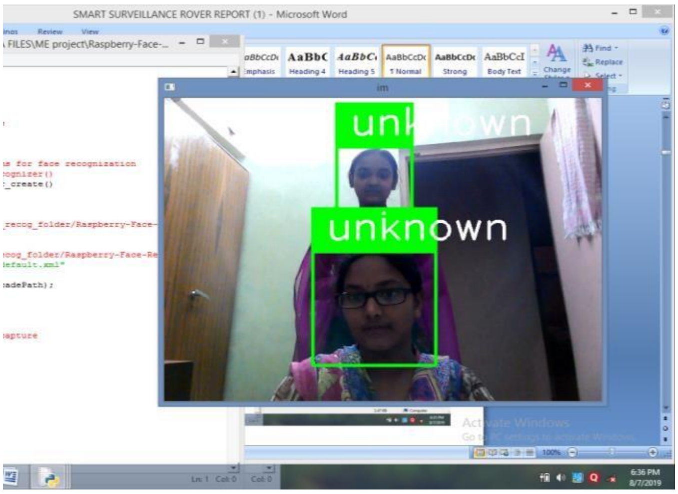

Fig.9: recognition of unknown person

V. CONCLUSIONS AND FUTURE SCOPE

a) Conclusions

The suggested face-recognition surveillance robot system is always scanning the neighborhood. The robot detects the things, goes past them, and continues forward. The robot can detect fire and carbon monoxide in its immediate surroundings. The technology can distinguish between a known and unknown individual by continuously monitoring the specified area. The device fires a laser gun at the detected individual and takes him down if he is unknown. Alert messages and image streaming can be done in real time by the system. As such, it is appropriate for use in border or combat surveillance applications. The suggested method additionally identifies peculiar items that people in high-security areas are carrying.

b) Future Scope

In order to identify the actions of an unknown or known individual, the current work might be expanded by incorporating the detection of uncommon events. Advanced methods can be utilized to protect the robot from light effects because image processing algorithms are impacted by illumination.

REFERENCES:

[1] The paper "Modelling and implementation of two-wheel self-balance robot" was published in December 2017 in the International Journal of Electrical, Electronics and Computer Science Engineering, Vol. 4, Issue 6, pp. 33-40.

[2] The paper "Implementation of Spy Robot for A Surveillance System using Internet Protocol of Raspberry Pi" was presented at the 2nd IEEE International Conference on Recent Trends in Electronics Information & Communication Technology in May 2017, held in India. It was written by Ghanem Osman Elhaj Abdalla and T. Veeramanikandasamy.

[3] "Low Cost Smart Security Camera with Night Vision Capability Using Raspberry Pi and OpenCV," by Wilson Feipeng Abaya, Jimmy Basa, Michael Sy, Alexander C. Abad, and Elmer P. Dadios, was presented at the 7th IEEE International Conference on Humanoid, Nanotechnology, Information Technology Communication and Control, Environment and Management (HNICEM), in November 2014.