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Quadcopter Drone with Face Recognition

Mrs. J.S. Morbale [1#], Mrs. P.R. Naregalkar [2#], Anushka Singh[3*], Priyanshu Dwivedi[4*], Raghav Mathur[5*]

[#]*Assistant Professor, Department of Electronics Engineering, Bharati Vidyapeeth (Deemed to be University), College of Engineering, Pune (India)*

[*]*Department of Electronics Engineering, Bharati Vidyapeeth (Deemed to be University), College of Engineering, Pune (India)*

***Abstract*— Drones or Unmanned Aerial Vehicles (UAVs) are often used to reach remote regions or areas inaccessible to humans. With a large field of view, remote control abilities, and compact size, drones are deemed suitable for monitoring disaster-hit areas or crowded and performing aerial surveillance. While research has focused on tracking, area monitoring and object detection, limited attention has been given to person identification, especially face recognition, using drones. In this research, we present a dataset intended to facilitate research for drone-based face recognition. For this segment, we provide videos with annotated face regions a high-resolution gallery image.**

***Keywords*— Face Recognition, IoT, Face Detection, Raspberry Pi Zero, Python, Drone**

I.INTRODUCTION

It is known fact that the face is an inherited identity of a person. A system based on facial recognition is more suitable and welcoming to people who are not willing to collaborate with other means of biometric identification systems such as fingerprint, iris, or hand scans. Most of the time, the accused get away with their loot and there is no system to track them. With the help of an image processing software such as facial recognition, it becomes possible to introduce a system that is capable of identifying ta person committing a crime and at the same time, instantly alert the concerned authorities to take precautionary measures in order to apprehend him. Some other softwares for facial recognition include audio-visual scrutiny and safety measures. It is a biometric recognition process, but it requires a face instead of a hand or fingers. Military organizations prefer facial recognition technologies instead of fingerprint or hand scan. Since the introduction of Artificial Intelligence (AI), the facial recognition system has become a worthy tool for applications such as this one. It is becoming more and more popular among researchers around the world in many fields such as medical, engineering, security, and so on.

The facial recognition algorithm introduced by Cheng et al. introduces a deep sparse representation classifier to detect the facial features and identify the face of any person. Schools have also introduced it for critical questions for specific students. Kadambari et al also proposed a system that can take automatic attendance using facial recognition.

Local Binary Patterns Histogram (LBPH) is a type of facial recognizer which is a pre-trained facial recognition classifier capable of facial recognition if enough dataset is available regarding the face that it needs to identify. Most real-time applications use facial recognition algorithm that is in use by security companies or military organization around the world. Applications such as remote monitoring which are present over long distances often require a hardware platform like Raspberry Pi zero.

II. NECESSITY OF DEVICE

In the current scenario, surveillance has become a key aspect of life. The prevailing issues of natural calamities, growing number of casualties in hilly areas have increased the need for video surveillance and face recognition. Many systems like CCTV cameras

have been developed to deal with the issue but the major challenge with such system is that it requires human interference/ presence for surveillance, also in case of an incident there is a need to go through hours of video recording which might not contain relevant information. With the use of quadcopter face recognition, we are trying to reduce the time required to respond to any threat. The system can be used to detect injured people during an accident or casualty, it can also help in carrying out rescue operation by detecting people stranded at various locations. It is designed in such a way that as soon as a person is detected a message will be send to the respective authorities stating the exact location and time of the person detected so that necessary action can be taken.

III. DESIGN AND EXPERIMENTAL SETUP

In the given figure,

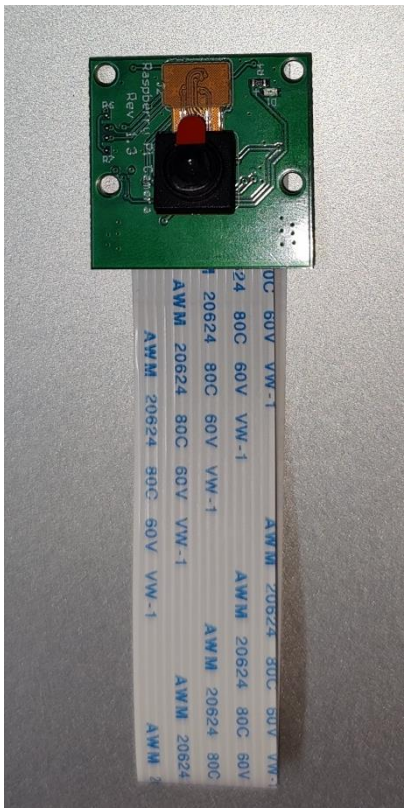


Fig.1. Raspberry Pi Camera Module

A Raspberry Pi camera module (Pi Cam) and a Raspberry Pi Zero.

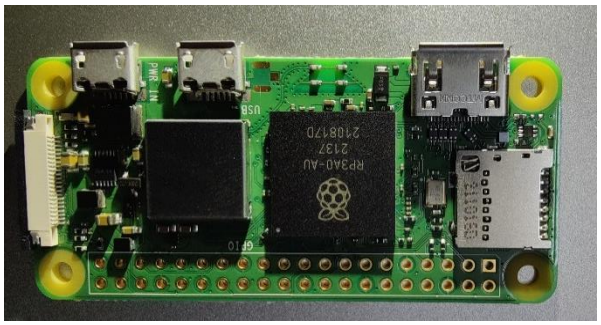


Fig. 2 Raspberry Pi Zero W

The camera is placed on the top of the drone for capturing the image of the person. The customized hardware used in the system has Bluetooth capability, which allowsplacing the proposed system within a range. And the drone will work even in the case of power failure, the proposed system can still function if it is connected to a Bluetooth. As shown in Figure, the proposed system starts detecting when an intruder comes into the monitored area. The movement of an intruder is captured and saved by a face detection module, as shown in Figure.[3]

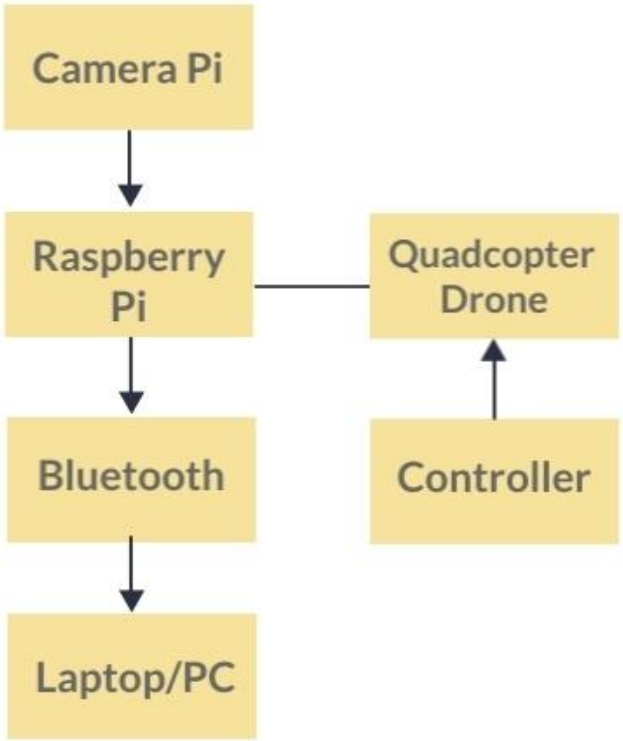


Fig. 3 Block Diagram

The Raspberry Pi Camera is used to capture the images in the real-time in UAV, then the image captured will be processed in Raspberry Pi. This will help us to detect the faces by using Face Recognition. The face recognition system is a fundamental computer application for the automatic identification of a person through a video source or digital image. It captures the images from the camera and do data processing to determine the detection. Algorithms are being written that enable AI to expand its abilities into realms of emotional intelligence, creativity and cooperation.
Face identification is essential for forensics, surveillance, and security.

Currently, the technology is used by forensic scientists, governments, the military, casinos, private companies and police.
The company uses it to gain access to restricted areas. Casinos use face recognition to eliminate cheating and dishonest money counters. The police use face recognition to identify criminals. In many countries, they are using computerized identity verification, while the Exploited Children and National Center for Missing use techniques to in missing children on the Internet.

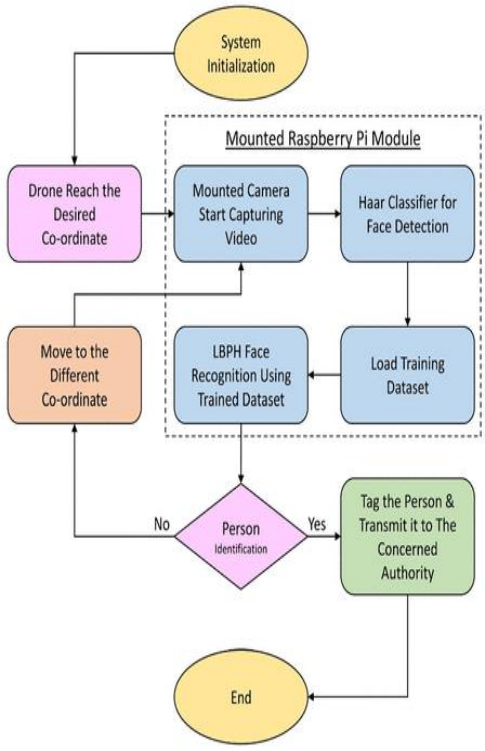


Fig. 4. Flowchart of System

IV. WORKING

The system consists of a Raspberry Pi Camera, to which a Raspberry Pi is used to capture the images in the real-time in UAV, then the image captured will be processed in Raspberry Pi. This will help us to detect the faces by using Face Recognition. It is interfaced, for the purpose of capturing video continuously, along with a battery. For face recognition, RPi and camera is mounted on the drone.

The inbuilt python script that is designed to run at boot time is entrusted with capturing continuous video and extract human face image frames. To recognize the face, the image captured is compared with the existing datasets to check if the detected image exists by matching with existing datasets. If match is found by the predetermined parameters, then the face is recognized. If match is not found, then the face is not recognized.

In, our designed system the Raspberry Pi is used as a microcontroller. The newer version of Raspberry Pi Zero W v1.3 is a 6.5cm x 3cm sized mini-computer that can have a standard monitor display unit plugged into it and uses a standard sized keyboard and mouse that is connected through a USB hub connected with it. The Raspberry Pi then turns out to become a CPU unit which is both small in size and can be easily designed to carry-out standalone applications after programming it. This Raspberry Pi system uses the Linux operating system which is required to be flashed into it. The storge unit of this system is a microSD card that is flashed with the version of Raspbian OS flashed using an image flasher from the PC.

The board is a lighter version of the advanced Raspberry Pi 4 Series which is suitable for light-weight low-power applications. This board comes with a direct port to plug in the Raspberry Pi Camera Module and comes with a integrated 2.4GHz a Bluetooth v4.1 support. Other input sensors and output devices can be connected using the GPIO pins available. It is powered by a micro-USB port. Python v3.9 is then installed in the Raspberry Pi storage as it forms the base of our software setup. After installing of Python, “dlib” library is then installed along with the “face recognition” libraryis installed.

These libraries are used for detection of the face image that is captured by the Pi Camera. Python uses the "pi camera" library for the purpose of capturing the video and extract image files from it. For the purpose of sending the message to the laptop package "paho.mqtt.client" is used which is a package used for IOT based operations. As a part of output, the GPIO pins are also required to be configured using "RPi.GPIO" library.

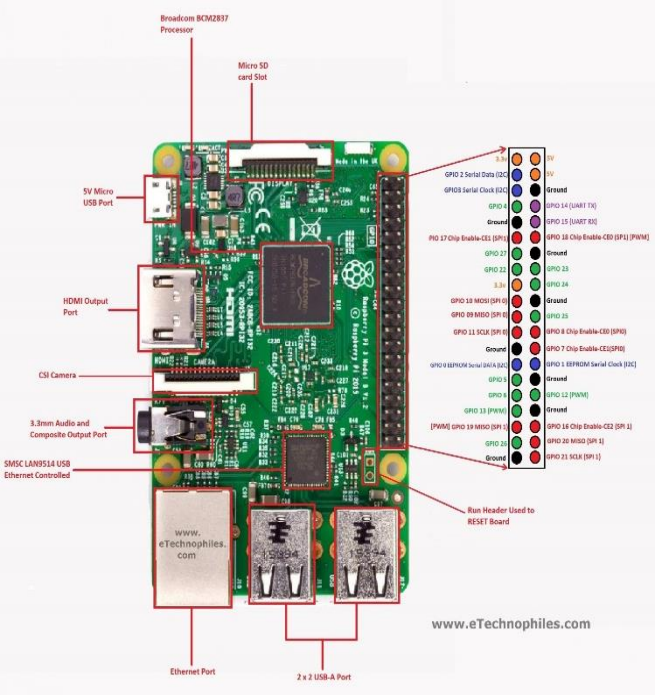


Fig. 5 Raspberry Pi Pin Diagram

The image is captured when a human face is detected in the video and is then encoded into a "NumPy array" format. Then the program compares the encoded image file with the pre-existing datasets of registered images using a method called the Euclidean distance formula. In Euclidean Distance method both the arrays are compared and the distance between each array element is found out. If the distance is closer to zero then it is assumed to be matching, otherwise if the distance isgreater than a required threshold limit then is it assumed to be not matching and then the results for all the elements of the given array is compiled to give a compiled result, that is used to estimate a match.

If the match is found, then by Pin 26 message is sent that person is recognized. Then the program connects to the MQTT client serverand publishes the result (Name if person is matching otherwise publish Unknown person) along with the timestamp. After, sleep period of 1second and the program initiates again. The python script is design to be run continually and it is initiated right during the booting process so that the application may be deployed as a standalone application without manual intervention.

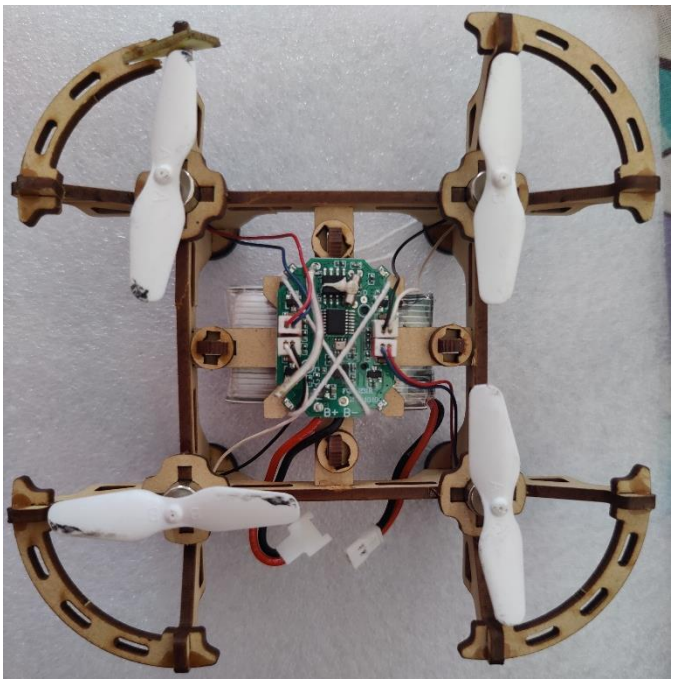
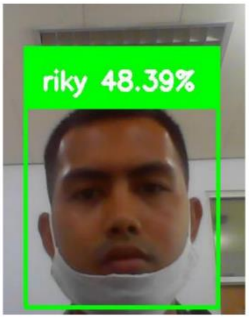


Fig.6. A Quadcopter Drone

Fig.7. Remote Controller

V. CONCLUSIONS

The importance of face recognition systems is increasing fairly regularly. They belong to a category of Image processing applications.
Mostly, these kinds of systems have applications in personal verification, surveillance, and other related security activities. The proposed system utilized the concept of facial recognition by using a pre-trained Artificial Intelligence to identify the person in the acquired frame. The drone mounted camera captured the live video stream.



An onboard Raspberry Pi module processes the acquired video information. This system can detect the desired person with an accuracy of 89%. If we further increased the number of datasets, then the chances of accuracy will also increase. We can also use the proposed system manually using an RF transceiver in order to track down the identified person if needed. This can also update the concerned authorities automatically about the culprits' location at the same time using a mounted GPS module. The proposed system can prove most beneficial for improving the existing security system.

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