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Autonomous Drone Face Recognition and Security System

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ABSTRACT: Face recognition is used in hundreds of applications for identifying and authenticating users with high security, so our primary motivation is to implement a face recognition system in an unmanned aerial vehicle (UAV). In order to keep order in a public space and protect people's safety, surveillance is becoming an increasingly important tool. That can be accomplished with the use of an aerial surveillance system. The project is mainly based on the safety- and security-focused applications in various areas that we identified as main targets and that will help the security forces. The security threats have been increasing gradually, so there is a need for identifying them and delivering the information regarding them to the security forces quickly. So, they can take action early, we are using the drones, which conduct surveillance in the particular geographical area and live stream the images to the control room, where the captured images are interpreted, analysed, and processed, and an alert message is automatically sent to the security forces. The security forces monitor the detected abnormality and can take the necessary action immediately; even the images captured by drone's act as proof to identify the person or situation responsible for the hazards.

KEYWORDS: UAV, Face recognition, Quadcopter, surveillance

I. INTRODUCTION

Drones, also called unmanned aerial vehicles in short UAV. They can reach where it is hard for anyone to reach, as they are small and can capture images. Enabling drones to see human beings in the field through a variety of programs including surveillance, anti-theft, human search and remote surveillance is essential. Drones are able to capture a facial image, which is used for biometric recognition. Protecting citizens against crime and criminals is difficult for the authorities and the government on a day-to-day basis. Technology is required to safeguard citizens from criminals since it can detect the offender even in crowded locations, preventing crime from happening and guaranteeing their safety before it does. As a matter of fact, everyone is aware that a person's face is a feature that they get from their parents and that every individual has a particular geometrical shape, size, and colour that sets them apart from everyone else in the world, even when it comes to siblings. So, a facial recognition system is better to recognize someone if the person is not willing to cooperate with authorities or with the biometric identification system such as the fingerprint sensor or the visual sensor. As a result, it is possible to introduce a system that detects someone's face even in a very crowded area



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where there are tons of faces to detect and then recognize them with the dataset of the photographs of criminals that are recorded in the authorities' database and warn them that the criminal is there [8]. Even in the army, they use artificial intelligence to target any person's movements in the region through facial or human detection.

II. RELATED WORK

The up-to-date functions like face recognition make drones able to pleasant most of the everyday applications. [1] An easy method of solutions to reinforce the force was proposed by this project. It points out people who are missing and blacklisted. [2] It proposed especially for border safety purposes. [3] The key characteristics of this system is to recognise the face of a person. The paper says about the components and it's working. Which mainly focused on the advancement in drone using raspberry Pi. The main property of this project is it have a noise reduction feature. [4] This system used for surveillance and to find human. The main advantage of this project is the manufacturing cost is less and easy to replace. This system working based on biometric facial recognition. Which will recognise the terrorist and gives public security. The main advantage of this project is, it is a small size UAV that can take off anywhere [5] Search and rescue operations, extinguishing fires, and environment mapping are some of the different uses of drones. The risk of a collision increases as the number of moving drones increases. There is a system model, prototype, and preliminary evaluation in this paper. Ultrasonic sensors are used in the prototype of the obstacle avoidance system.

III. METHODOLOGY

Block Diagram of Drone:

The system, Fig 1 shows the block diagram, consists of a camera that will send a live video stream from video transmitter to a video receiver that is attached to a laptop so that face recognition can be done while the stream is being viewed. Face recognition is possible by Creating a dataset, Training the dataset, Face recognition. When a drone moves in air, the automation process helps us in performing certain tasks easier than doing them manually. A drone has 4 propellers at 4 corners of the frame. For balance and movement of the drone, the speed and direction of each propeller's rotation are individually controlled. To maintain the balance of the drone one pair rotates in clockwise direction and the other in anticlockwise direction. One of the primary components of the block diagram is the camera system. The camera is responsible for capturing images that allow the facial recognition software to identify individuals. The camera is connected to the flight controller, which is responsible for controlling the drone's movements and capturing the necessary images [6]. The flight controller is also responsible for analysing the images and sending data to the facial recognition software. Flight controller, which sends the signal to the electronic speed controller from the radio receiver to control the speed of the motor. At the control center, face recognition done by using 3 steps: Face capturing, extraction, comparison and matching. The drone is programmable in various languages, we chose python for this project because it has great computer vision and deep learning libraries [10]. There are different Python libraries created to provide users with a simple way to interface and send commands to the drone.

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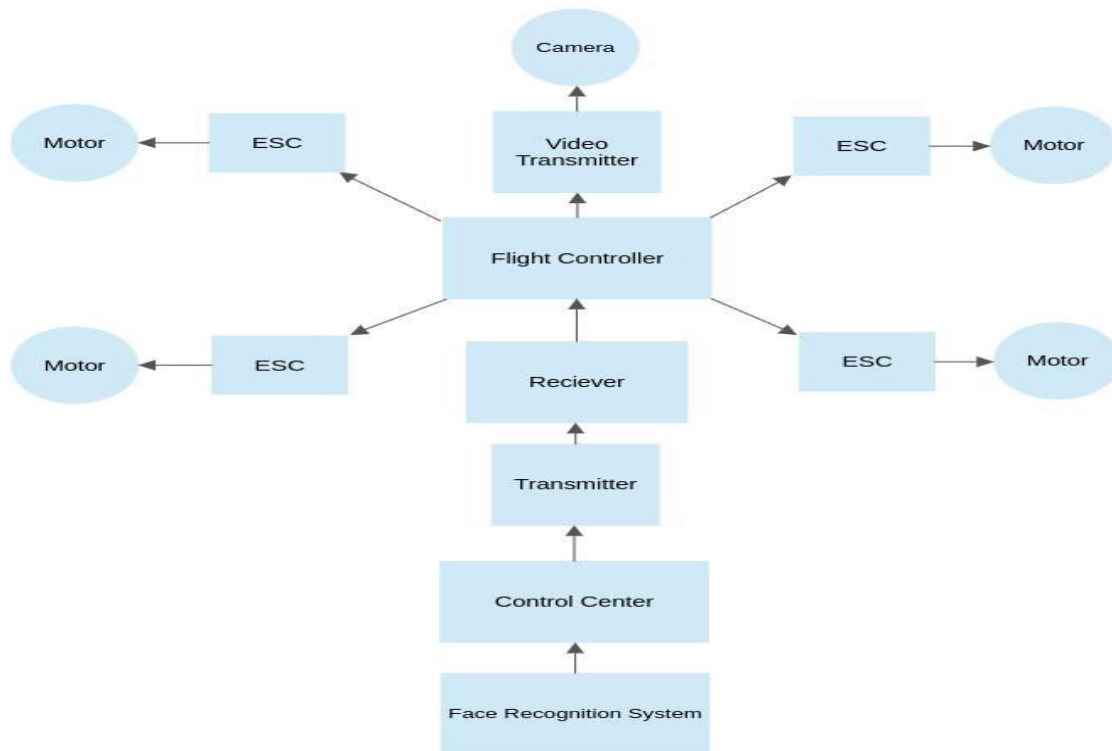


Fig 1 Block diagram of drone

Working of Drone:

Drone operation follows the same principles as flight. The differential in pressure between the rotary blades is what produces the vertical lifting force. Drag and gravity are opposing forces that prevent it from moving vertically. By changing the rotational orientation and speed of various rotors, the drone's mobility may be controlled. The flight controller receives instructions from the user or an autonomous system and transfers them to the motors to direct the movement of the drone [9]. The drone's movement is altered and its stability in the air by the flight controller, which uses the data it gets from the sensors. The flight controller receives data from the sensors and utilises it to steady the drone in the air and modify its movement. The quadcopter, which typically has four arms, is the most stable type of drone. A motor-driven propeller is attached to each arm. The Quadcopter's lifting mechanism is based on Newton's third law of motion and the Bernoulli principle. The air is forced downward by the airfoil-shaped propeller, producing thrust against gravity. Due to the torque cancellation caused by the propellers rotating in opposite clockwise and anti-clockwise directions, the quadcopter will become stable.

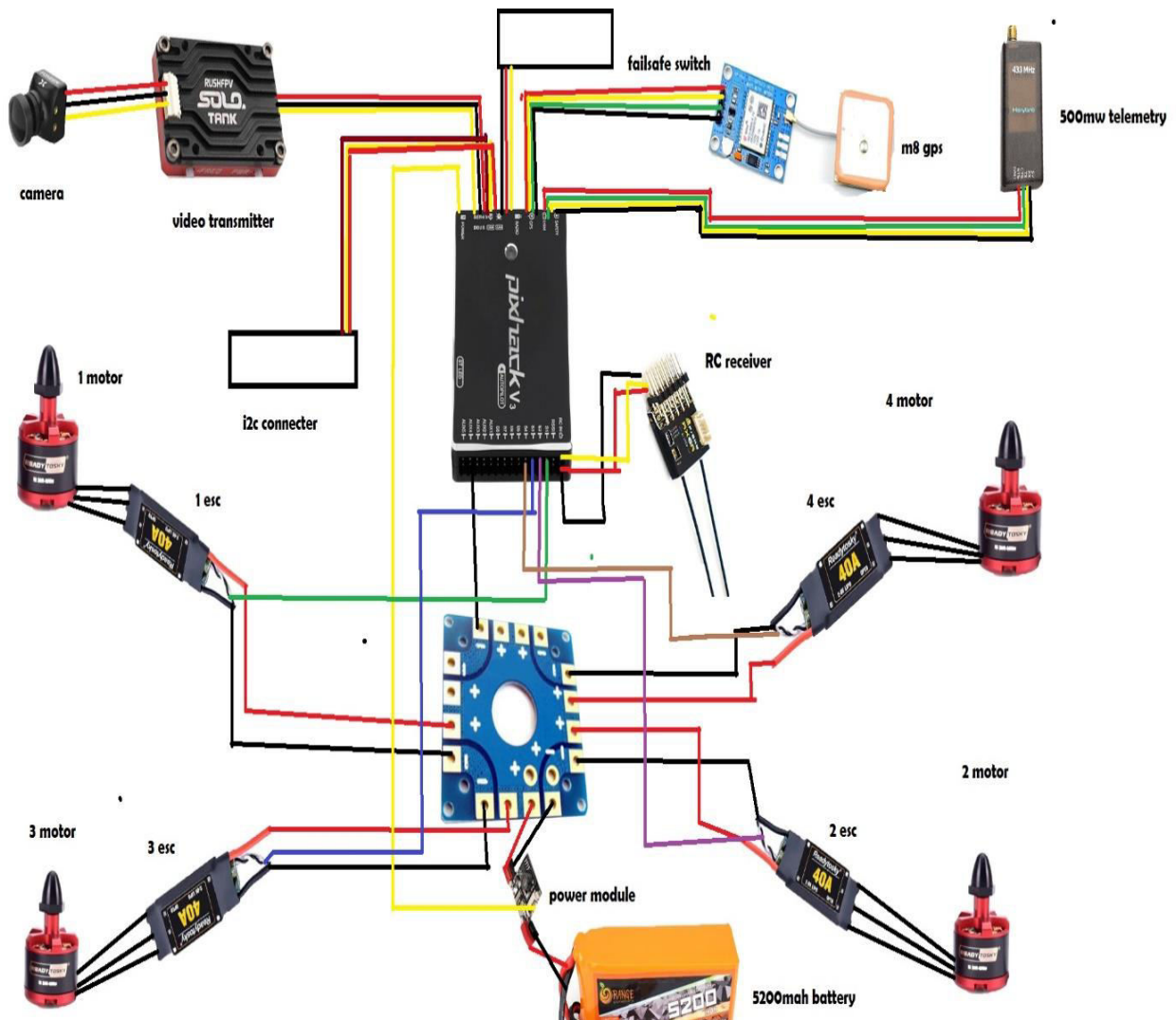


Fig 2 Layout of drone

A quadcopter may move in four different ways: throttle, yaw, pitch, and roll. The upward and downward movement of a quadcopter is referred to as the throttle. Yaw is the term for rotation about the vertical axis to the left or right. Pitch refers to tilting along the lateral axis. The Quadcopter may travel forward or backward using this motion. The quadcopter's mobility is controlled by the four motors' rotating rates.

Components Description:

For the development of drone both hardware and software tools are used. The Layout diagram shown in Fig 2. For an autonomous drone face recognition and security system includes multiple components that work together to create functional system. The main components are:

Electronic speed controller (ESC): An Electronic Speed Controller (ESC) is a critical component in modern drone systems, particularly for multirotor drones, as it controls the speed and direction of the motors that drive the propellers. It acts as an interface between the flight controller and the motors, translating the commands from the flight controller into varying voltage levels that determine the motor speed and direction. ESC is compatible with a 4s Li-Po battery and it's a 40-amp ESC with a battery eliminator circuit that outputs 5 volts and 3Amps.

Brushless DC Motor: A Brushless DC (BLDC) Motor is a type of electric motor that is commonly used in modern drone systems due to its efficiency, power, and low maintenance requirements. It operates using a rotating permanent magnet stator and a stationary armature with electromagnetic coils. The motor uses electronic commutation, typically via an ESC, to switch the current to the coils at the correct time and in the correct sequence to generate rotational torque.

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FPV Camera: A First Person View (FPV) camera is a type of camera that is commonly used in drones to provide a real-time video feed to the pilot or operator, allowing them to have an immersive first-person view from the perspective of the drone as if they were on board. FPV cameras are specifically designed for use in drones and typically have features that are optimized for the unique requirements of FPV flying.

Flight Controller: A flight controller is a crucial electronic device that serves as the "brain" of an autonomous drone, responsible for controlling its flight behaviour and maintaining stability and control during flight. It typically consists of a microcontroller or microprocessor, sensors, and other components that process and analyze data from the drone's various sensors and control the drone's motors, servos, and other actuators. Pixhack V3 Controller is used in this drone. The operating voltage is 4.5 to 5.5v.

Propeller: A propeller is a device that converts rotational motion from a motor or engine into thrust, which propels a vehicle or object through a fluid such as air or water. 9.5 inches in length and 4.5 inches pitch propeller is used for this drone. The material of the propeller is plastic so, it has less weight, choosing thick propellers provides durability.

Flow chart:

Flow chart for face detection shown in Fig 3. The camera mounted on the drone behaves as a sensory object through which it can detect or track the person [12]. We set up a face recognition system where the input image was captured from the camera. Not every frame was used for recognition. Frames after every 100 milliseconds are counted for recognition [7]. Before starting the camera, the face database files are loaded. The camera captures a frame and applies Haar Cascade to detect the faces in the crowd. All the detected faces and LBPH face recognizer [11] runs on each of the detected faces and compares it with the trained dataset. If the system identifies the desired person, it will tag him with his name and captures the frame. The frame was then converted into a gray image for detecting a face. The detected face is cropped and resized. It also transmits the captured frame to the concerned authority to take appropriate action. In case the system detects no person in the frame, the drone will move to the next waypoint. We can also perform this process manually. The whole process repeats at the new location where the drone just arrived.

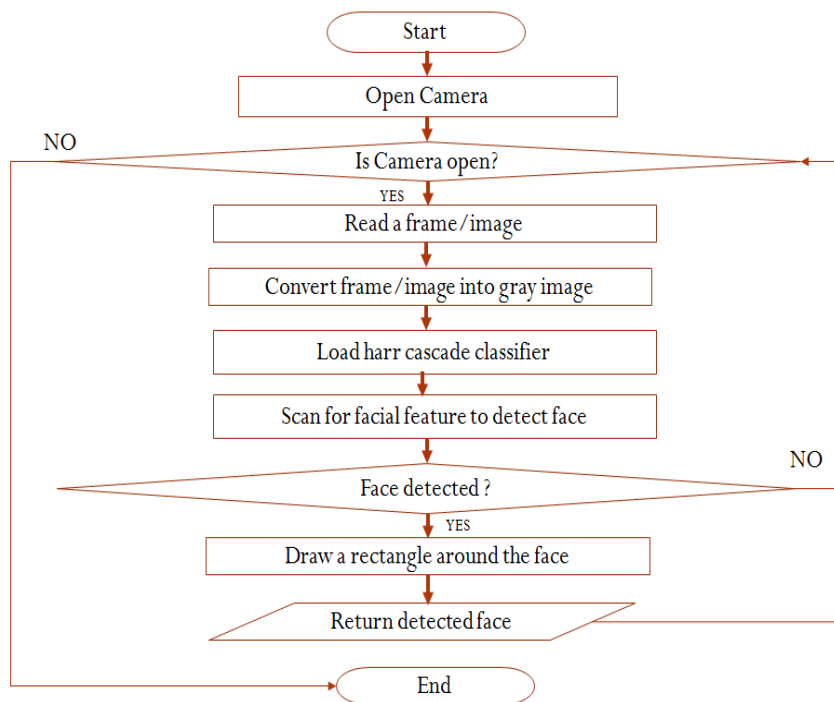


Fig 3 Flowchart for face detection.

IV. EXPERIMENTAL RESULTS

Our findings show that the current face recognition technologies are capable of recognizing faces on drones with some limits in distance and angle, especially when drones take pictures in high altitudes and the face image is taken from a long distance. Figures 4-7 shows the outputs of the face recognition system used in the drone. An autonomous drone face recognition and security system combines advanced facial recognition technology with autonomous drone

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capabilities for enhanced security applications. The system can detect, track, and identify individuals on the ground from a remote location, providing live and recorded video footage for the purpose of monitoring, surveillance, and security. The system records facial features and matches them with a database of known individuals for identification purposes. In case of an unknown face, the system can generate an alarm and notify the relevant authorities. The drone can also be programmed to follow and track an individual, providing real-time location updates. Overall, the autonomous drone face recognition and security system has shown promising results in enhancing security and surveillance capabilities. The system's ability to quickly identify individuals and track their movements provides an added layer of protection in various settings, such as airports, shopping centers, and public events. However, it is important to balance security needs with privacy concerns and ensure that the system is used appropriately and ethically.

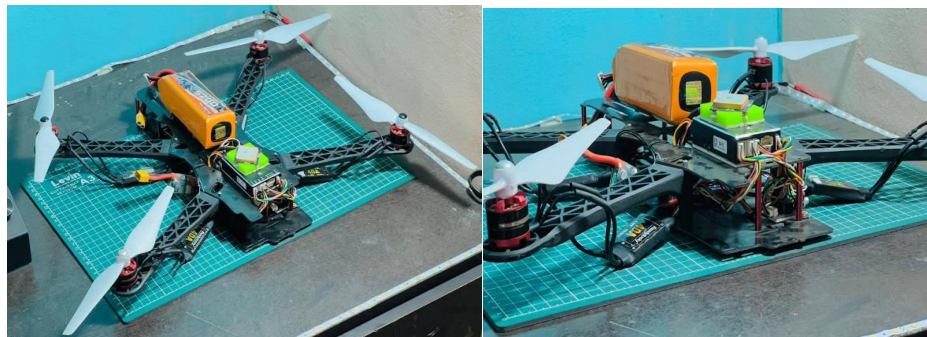


Fig 4 & 5 Assembled model of drone

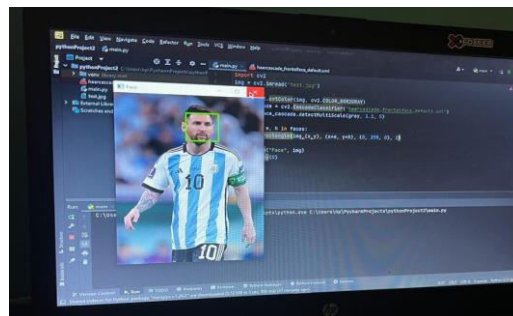


Fig 6 Face detection

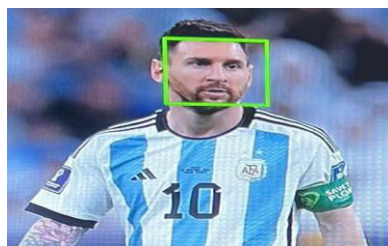


Fig 7 Face recognition

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V. CONCLUSION

Face recognition systems are a type of image processing application that are becoming increasingly important in various fields. They are commonly used in surveillance, personal verification, and other security-related activities. The system utilizes facial recognition technology through a drone, where a camera mounted on the drone captures live video streams. The system currently achieves a 90% accuracy in detecting desired individuals, and increasing the number of datasets can further improve accuracy. The proposed system has the potential to significantly enhance existing security measures. The project aims to develop a solution that utilizes a face recognition-based drone to assist the task force in chasing and providing live updates on the location of missing or wanted individuals, as well as maintaining surveillance to detect any potential threats. Other potential applications of this project include detecting humans in closed environments such as malls or exhibition halls, assisting police officials in investigations, enhancing public safety surveillance, and border security. We have implemented an autonomous drone face recognition and security system that offers accurate and fast processing of face recognition. Our future plans involve developing a drone-based system with facial recognition support that balances accuracy, computation, network transmission, and power consumption. This system has proven to be effective in various fields, including identifying and locating missing persons, terrorists, and criminals. Further improvements could be made by incorporating additional biometric features to enhance system performance.

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