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Face Recognition Door Unlocking System on the Cockpit Door for Entry of an Authorised Person

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ABSTRACT:

The aviation industry has acquired significant importance in contemporary society, which has unfortunately led to an increase in criminal and terrorist activities. These individuals aim to exploit civil aviation as a means to exert pressure on nations and advance their own interests. The unauthorized entry of an individual into the flight deck poses a serious threat to aircraft safety, as they might intentionally or unintentionally tamper the pre-set position of instruments or other equipment in the cockpit.

Keywords: Cockpit, Face Recognition, Smart Door, Security

I. Introduction

Modern aircrafts use reinforced cockpit doors that are extremely secure, they can even resist bullets and grenades. A code pad outside the door is used after an interphone communication request for entry is made to the crew; the crew can grant or deny access using a toggle switch on the pedestal panel. The overhead panel has a Control Door Locking System that monitors pressure variations in the cockpit. In case of confirmed incapacitation of both pilots, a buzzer in the cockpit overhead panel provides aural warning to alert the crew of an entry in the deck.

When it comes to recognizing people, face is the most common feature used. Facial recognition technology has come a long way in the past few years, it is being used to track human activities in various places like airports, offices, etc. Facial biometrics are non-intrusive, compared to other biometric traits like palm prints, iris colours, finger prints etc., they can be taken even without the user's knowledge and don't require as much time to capture, this data can be used for security-based applications like criminal detection, face tracking and in forensic surveillance systems. Face recognition involves capturing a face image from a video or from a surveillance camera. Then processing and comparing it with the stored database.

II. Problem Statement

An unauthorised entry in the flight deck has been a major concern for the aviation industry since forever, be it the 9/11 attacks, the EgyptAir flight 684, or the Indian airlines flight IC 814, the list goes on, with the latest unauthorised cockpit access incident being the Ryanair flight 4978 hijacking in May 2021. The entry of an unauthorised person in the flight deck could also hamper the safety of an aircraft, like the Aeroflot 593 accident, in which the pilots let two children sit in the cockpit while the aircraft was on autopilot. One of the children pushed the control column for 30 seconds, which disengaged the autopilot and started a steep turn which led to the aircraft stalling and crashing, killing everyone on board. Through our project we aim to use face recognition on cockpit doors, in order to ensure that only an authorised staff can enter the flight deck and would get access only during his or her allocated time. The system would unlock the cockpit door on identifying an authorised face while also capturing the facial biometrics of an unauthorised person trying to enter.

III. Proposed Methodology

The code used for our project is written C programming language, it is divided into four parts. One is the main code for the camera and relay module where the ESP32 locks or unlock the door according to face recognition, and the other three codes are for the web page, camera index, and camera pins. We used the if() function in our code to check if the face matches with the enrolled face.

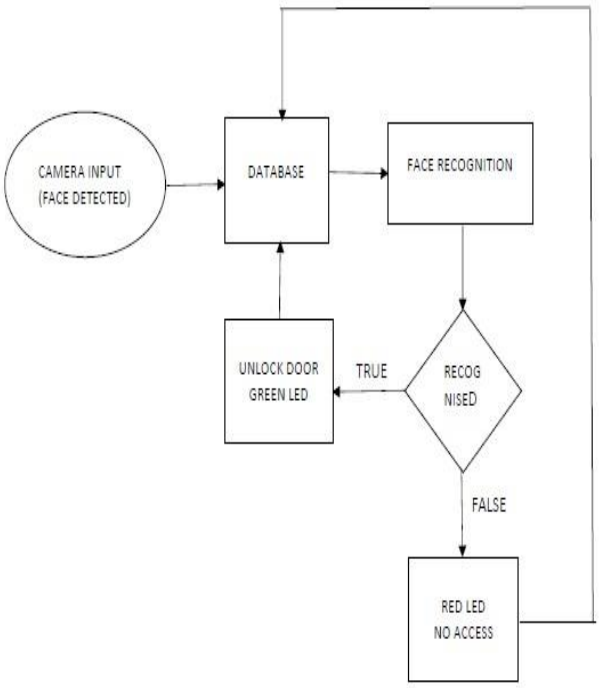

Fig1. Flow Chart For Face Recognition

Steps To Run The Face Recognition Door Unlocking System:

1. Connect the plug of the 12V DC jack to a socket for supply.
2. Turn on the Wi-Fi of the device mentioned in code, in our case it is Yash's phone. The camera will connect to the device.
3. Search the IP address provided by the system, when we ran the code after transferring it to the camera, that is http://192.168.17.21
4. You will see the camera screen on the website. The website can also be used to enrol faces.
5. The camera is now activated and ready to use. All you need to do is come in the vision of the camera, if you are authorised to enter the flight deck, the green led will glow and the cockpit door will unlock for a period of 5 seconds, else if you aren't authorised to enter the deck, the red LED glows and the camera screen on the website indicates "Intruder Alert!".
6. Switch the supply off and disconnect the Wi-Fi connection to disconnect the camera.

In this project, we have implemented a face recognition door unlocking system for the cockpit door. This system utilizes facial biometrics to identify authorized individuals and grants access to the flight deck. In the event of an unauthorized attempt to enter, the system detects the intruder's face and stores it in its database. This data can be transmitted to the ground station for further analysis.

Our face recognition door unlocking system can be easily installed on existing reinforced cockpit doors by following a few additional steps. These steps include adding a camera to the cockpit door and connecting it to an electrical supply and the database. For future aircraft designs, the camera can be integrated into the cockpit door during the manufacturing process, along with the necessary electrical supply connections.

Face recognition door unlocking system can be used at entry and exit points in an aerodrome, to monitor attendance and would store data related to who was given access to an area, thus reducing human dependency in case of the occurrence of an unlawful act.

With modernization and digitalization, the aviation industry has been advancing. The use of technologies like DigiYatra, helps passengers skip long queues at the airport entry gates and check-in counters, just by uploading their selfie on the application. The DigiYatra app links the traveller's boarding pass to a facial recognition system (FRS) that confirms their identification. With facial biometrics already being uploaded in the database, it can be further used at boarding gates and aircraft doors to ensure the boarding and disembarking of passengers, that is currently being done manually in the industry.

Following table I shows components used to design the Project:

Table I Components Details

Sr. No.	Name of Component
1	ESP32-CAM board
2	Electronic door lock 12v
3	7805 voltage Regulator (5v)
4	TIP122 NPN Transistor
5	10k ohm Resistor
6	220-ohm Resistors
7	Capacitor 220µF
8	Diode 1N4007
9	LEDs 5-mm (Red and Green)
10	12V DC adapter
11	FTDI232 USB to TTL converter (for programming the esp32cam)
12	Printed Circuit Board
13	Jumper Wires
14	Bread Board

IV. Implementation of Project

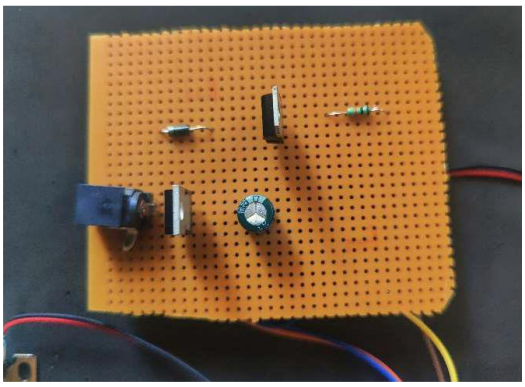

Fig.2 Components soldered to the Printed Circuit Board

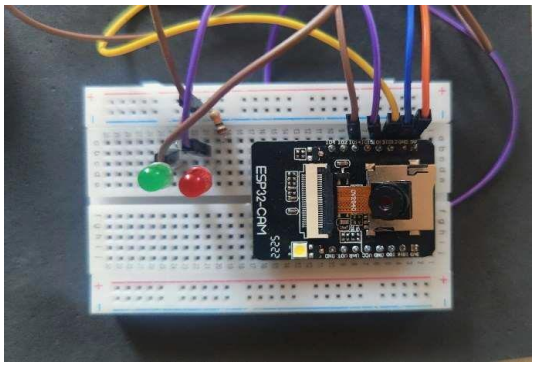

Fig.3 ESP 32 CAM and LEDs mounted on Bread Board for circuit connections

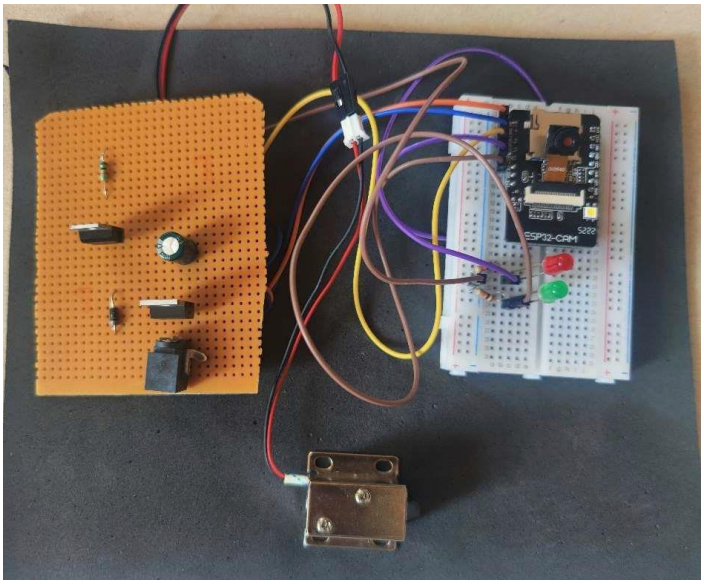

Fig.4 circuit connections for the camera installation

External Model Construction

To showcase the functionality of our project, we have developed a prototype of the Boeing 747 aircraft nose section utilizing the advanced technique of 3D printing also referred to as additive manufacturing. 3D printing uses computer-aided design to fabricate three-dimensional objects by layering various materials such as plastics, composites, or bio-materials to create objects that range in shape, size, rigidity, and color.

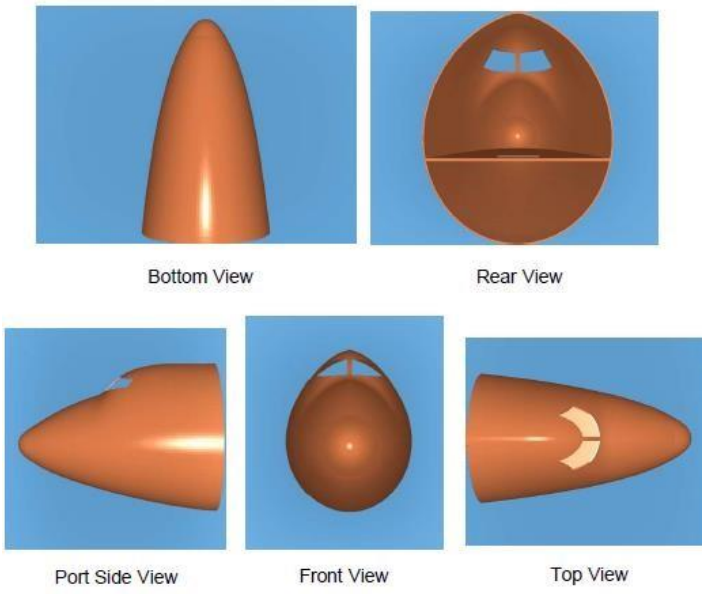

Fig.5 3D Printing Model Sketch

Fig.6 3D Printed Structure

Fig.7 Demo model of Project Working of Project

In aviation, aircraft duties are in shifts. All staff details are saved in our database along with the time allotted to them in a specified aircraft, for which duration they are authorised to enter the flight deck. When any unauthorised person tries to enter the cabin access is denied, as shown in fig 8 and 9, and the facial biometrics captured are sent to the database.

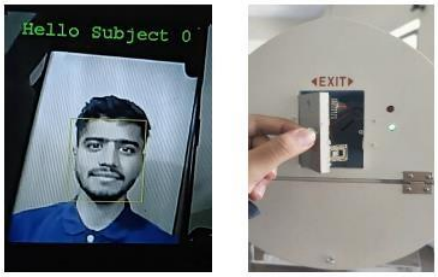

Fig.8 Authorised Person Entry

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Fig.9 Unauthorised Person Entry restricted

Conclusion

xOur project proposes the implementation of a face recognition door unlocking system on cockpit doors to enhance air security. However, it is important to note that our project has certain limitations. For instance, it may not be able to differentiate between individuals who share identical physical features, such as identical twins. Additionally, the system may unlock if an unauthorized person forcefully presents an authorized individual in front of the camera. To address these limitations, ongoing research is being conducted by Cheng Zhang and his colleagues at Cornell University in Ithaca, New York, to develop software that can comprehend facial expressions. We look forward to further advancements in this field that will help eliminate these limitations.

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