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IRIS RECOGNITION: BIOMETRIC AUTHENTICATION FOR COCKPIT DOOR SAFETY

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Abstract- *A face recognition system is one of the biometric types of information process. Its applicability is easier, and the working range is larger than other fingerprint, passcode, and signature. The face recognition system also enhances and improves security and privacy to a great extent, leading towards a better and modernized future. The system uses a combination of two techniques: face detection and recognition. The face detection is performed on live acquired images without any application field in mind* ***[1,2]****. The processes utilized in the system are white balance correction, skin-like region segmentation, facial feature extraction, and face image extraction on a candidate. The system is also capable of detecting and recognizing multiple faces in live acquired images. A face recognition system makes the process easier and minimizes the issues related to security* ***[3]****.*

Keywords: Cockpit, Iris Recognition, Smart Door, Biometric Identification, Security

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1. Objective

Iris recognition technology relies on the unique patterns found in an individual's iris to verify identity. The iris is a complex and sensitive part of the human eye, with distinct characteristics that distinguish one person from another. Its unique structure and positioning between the pupil and sclera make it an ideal biometric identifier. Unlike other forms of biometric identification, iris recognition is highly reliable, non-invasive, and accurate. Additionally, iris patterns remain stable over time, making them a consistent and trustworthy means of identification **[3]**. The classical human identification system was based on physical keys, passwords or ID cards, etc., which can be lost or be forgotten easily, while the modern identification system is based on distinct unique traits, i.e., physical or behavioural characteristics. One of the modern identification system called the iris recognition system is used in our project to improve the security and safety of the cockpit door and prevent the entry of unauthorised person inside the cockpit minimizing the rates accidents and incidents occurring in our day to day life **[8]**.

2. Introduction

The growing desire for increased security in everyday life because of digitalisation has prompted the development of a reliable and intelligent biometric based person identification system **[7]**. Individual's authentication has dependently been an appealing objective in computer vision. Authentication frameworks predicted on human attributes, say, face, voice, Iris, and finger are known Biometrics applications. With rapid economic growth and the rapid change of science and technology, living in such a highly information based modern society, identity identification has penetrated into every aspect of people's life. In today's date Iris recognition has gained increased attention and is highly preferred to enhance the security of cockpit doors. Iris Recognition accomplished an incredible consideration in recent times owing to its unique features, for instance, ridges, freckles, rings, furrows together with the complicated pattern. Iris recognition system is one of the most advanced system that has a several benefits such as improved safety, increased efficiency and enhance passenger experiences. Iris recognition Technology is one aspect of multilayered security approach that can be used to identify individuals involved in cockpit door incidents such as unauthorised access attempts, intrusion into the cockpit and suspicious behaviour near the cockpit door **[6]**.

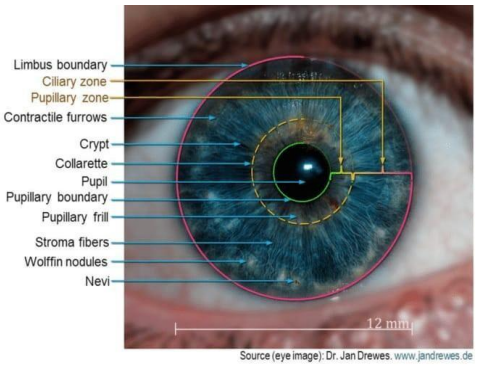

Figure 1. Eye Image

3. Problem Statement

- During the 9/11 attacks, the cockpit doors of several planes were breached by hijackers **[4]**.
- On 23 November 1985, EgyptAir Flight 648 was hijacked by Palestinian terrorist organisation Abu Nidhal who entered the cockpit to change the aircraft's course **[4]**.
- Indian Airlines Flight IC 814 that took off from Kathmandu to Delhi on 24 December 1999 was hijacked and forced to fly west towards the Pakistani air space. ˙ As per the CVR and FDR Records, Aeroflot Flight 593 on 23 March 1994 was crashed into the mountain range as Pilot's 15 year old son had unknowingly disengaged A310's autopilot control of the aircraft's ailerons by entering into the cockpit **[4]**.
- On 2015, Biometric recognition cameras helped identify a passenger who attempted to breach the cockpit door on an EI AI Israel Airlines flight from Tel Aviv to London. ˙ 2017, in United Airlines Flight from San Francisco to Beijing, a man was arrested after trying to enter the cockpit. Biometric Recognition Technology aided in identifying the individual **[4]**.
- A passenger on a China Southern Airlines flight on 2018 tried to force their way into the cockpit, Biometric recognition cameras captured the incident, and the individual was detained upon landing **[4]**.
- Biometric Recognition Technology helped to identify a individual who attempted to breach the cockpit door on an American Airlines Flight from Los Angeles to New York **[4]**.

4. Proposed Methodology

The Iris Recognition Technology combines computer vision, pattern recognition, statistical interference, and optics. The input to the system will be an eye image, and the output will be Iris template which will provide a mathematical representation of this iris region. The

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system consists of a number of sub systems, which corresponds to each stage of Iris Recognition. These stages are as follows-

- **Image or Data Acquisition-** This is the first stage of Iris that involves capturing of eye image. The Iris image should be rich in Iris texture as the feature extraction stage depends upon the image quality **[3]**. The following attention must be taken while grabbing the image :-

I. Image must be of high resolution and good sharpness.

II. Image must be captured in good lightning condition.

Figure 2. Iris/ Eye recognition

Source. *https://images.app.goo.gl/sV8RTgezRBzUPhom6*

- **Pre-processing-** This mainly involves RGB-to-grayscale conversion, contrast adjustment, brightness adjustment and prevent blurring **[3]**.

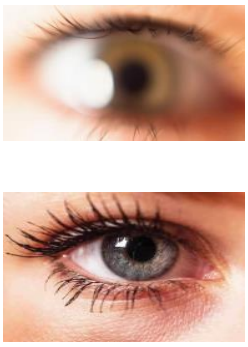

Figure 3. Pre-processing

Source. *https://images.app.goo.gl/W5FHg9JNscnAdZ5P9*

- **Segmentation-** Image segmentation is a type of image processing method that divides an image into various portions sharing similarities, based on their attributes and qualities. It deals with locating the Iris region in an eye image and separating the Iris portion from the eye. The Iris region consists of two circles, one of them is outer Iris- sclera boundary, and another one is the interior Iris- pupil boundary. The success of segmentation depends on the quality of eye images. The inner and outer boundaries are located by finding the edge image using canny edge detector **[8,3]**.

Figure 4. Iris Segmentation

Source. *https://images.app.goo.gl/ZE3pDdD6*

- **Normalisation-** It is a method of creating a dimensionally consistent representation of Iris region. Once the Iris region is segmented, the next stage is to normalise the part, to reduce the variations in the eye and generate the Iris code and their comparisons. Once the segmentation module has estimated the iris's boundary, the normalisation module uses image registration technique to transform the iris texture from cartesian to polar coordinates. The process, often called iris unwrapping, yields a rectangular entity that is used for subsequent processing **[3]**.

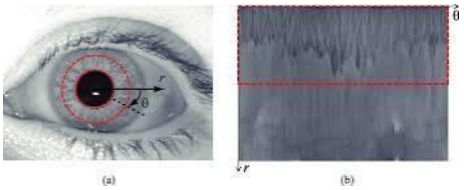

Figure 5. Normalisation

Source. *https://images.app.goo.gl/aAtyY1Rg9nSRaLc29*

Normalisation has three advantages-

1. It accounts for variations in pupil size due to changes in external illumination that might influence Iris size.
2. It ensures that irises of different individuals are mapped onto or common image domain in spite of the variations in pupil size across subjects.
3. It enables iris registration during the matching stage through a translation operation that can account for in plane eye and head rotation.

- **Feature Encoding-** It involves creating a template containing only the most discriminating features of the Iris and convert the extracted features into a compact, binary format known as as an Iris code and this code represents unique patterns of the Iris **[3]**.

5. Components/Resources Details

I. Raspberry pi model 4b (1GB RAM)
II. 8 jumper cables
III. Magnet door sensors
IV. Breadboard
V. Mantra single iris scanner
VI. USB cable harness

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VII. Data cable protection cover

Figure 6. Raspberry Pi Model 4b
Source.
https://images.app.goo.gl/AZc6nLbNJv2raYuf8

Figure 7. Iris Scanner

Source. https://images.app.goo.gl/ED3A1sXpquwbpNfk6

6. Boeing 737NG Flight Deck Door Access System

The cockpit doors have been improved to prevent the forged entry of intruders. Control and indicators are located both on the passenger and flight deck sides. Flight deck side consists of indicator lights and flight deck door selector on the aisle stand. The flight deck side also has a flight deck access system switch that controls the power to the system. The passenger side consists of an emergency access panel. The Emergency access panel has three indicator lights (red, amber and green). Red indicates the door is locked, Amber indicates the flight crew has entered the correct door entry code determined by the customer and green indicates the door is unlocked. The keypad is used to gain either routine or emergency access into the flight deck. The flight deck door selector lets the flight crew control access into the flight deck. The door lock selector is a three position rotary switch with unlock, auto and deny positions. In the auto position the door is locked. To unlock the door flight crew pushes and rotates the door lock selector to the unlocked position. The selector is spring-loaded to the auto position. To access the flight deck with the emergency access panel for the routine access one must utilize the keypad and select one and then 'ENT' that is the enter button. After the enter button is pressed a flight deck chime sounds if the customer has selected the doorbell option. The flight crew can then push and rotate the flight deck door selector to the unlock position to unlock the door. If there is any sort of emergency such as pilot incapacitation or if one needs an alternate method access to the flight deck then we can use the emergency access panels to enter an entry code on the keypad. The customer provides this code. Entering a code begins a timed sequence of events to unlock the door. The first aural alert sounds and then the red light indicator extinguishes and the amber light illuminates indicating that the individual has entered the correct code and the amber auto unlock light illuminates on the flight deck. After a time delay the oral alert sounds again. The third oral alert sounds a steady tone and the auto unlock light begins flashing. When the oral alert stops and the unlock light stops flashing the green indicator light illuminates and the door unlocks for 5 seconds **[9]**.

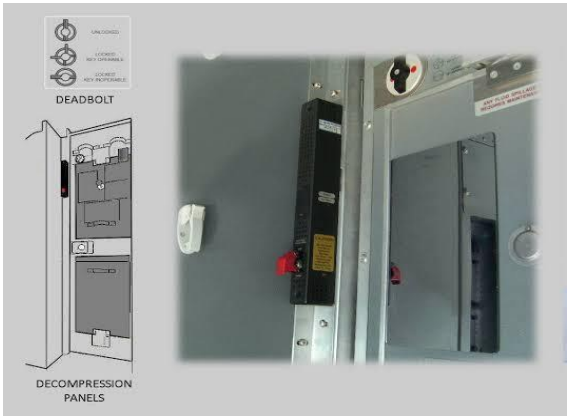

Figure 8. Boeing 737NG Cockpit Door

Source. https://images.app.goo.gl/qstrmbkSevmzgvzm9

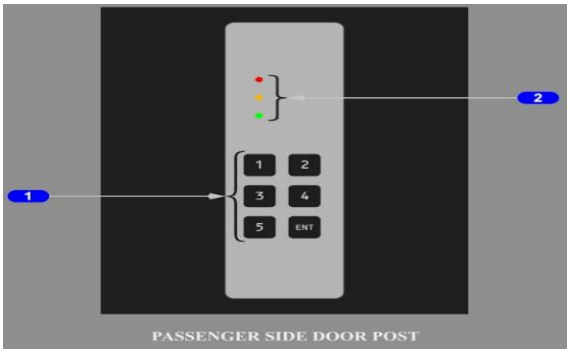

Figure 9.Passenger side door post

Source. https://images.app.goo.gl/72MRgakZQcSuEneg8

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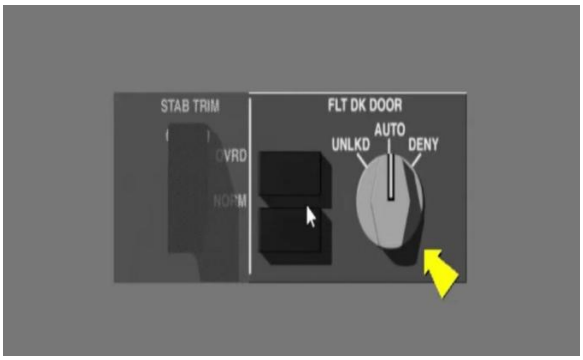
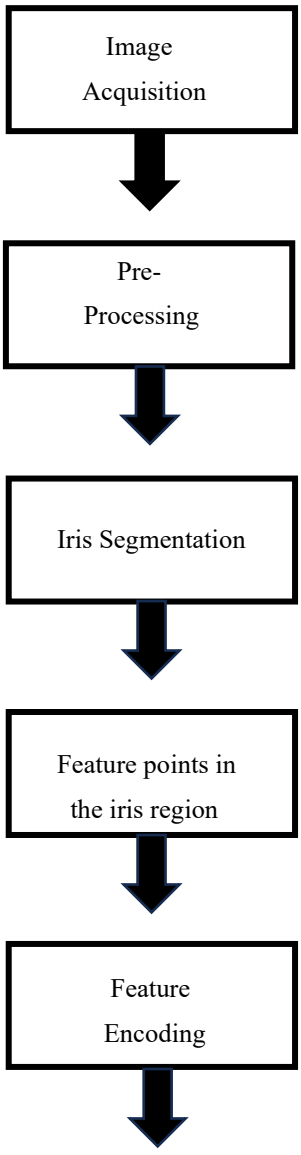


Figure 10. Flight deck side

Source.
https://youtu.be/Bd3agnm3Zb0?si=WjvgCNCj3WBa7Qik



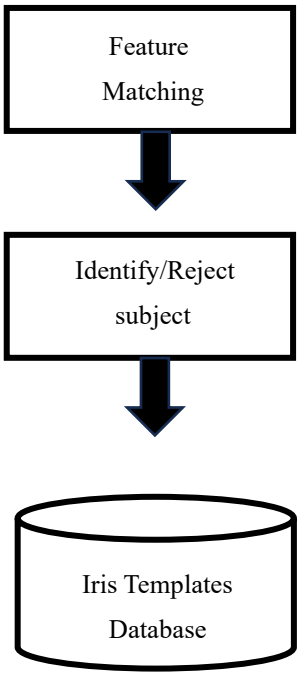


Diagram 1. Schematic diagram of Iris Recognition [3]

7. Implementation of the Plan

I. Firstly, the location of the pupil is detected, then followed by detection of Iris and eyelids.

II. Unnecessary parts, such as eyelids and eyelashes, are excluded to clip out only the Iris part, which is then divided into blocks and converted into feature values to quantify the image

III. Matching is then performed with feature data previously extracted in the same methods.

IV. Once it recognises the iris the door unlocks only if the person is authorised to enter or else it identifies the face as an 'Intruder Alert' and stores the data in the database that could be sent to the ground station in case of unauthorised attempt to enter into the cockpit.

8. Expected Results

Experimental results show that the algorithm is efficient and adaptive to the environment, e.g. it works well even for blurred Iris images, variable illumination, and interference of eyelids and eyelashes. Although the coloration and structure of the iris is genetically linked, details of the pattern are not. The iris develops during prenatal growth through a process of tight forming fold of the tissue membrane. Prior to birth, degeneration occurs, resulting in the pupil opening and the random, unique

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patterns of the Iris. Although genetically identical, an individual's irises are unique and structurally distinct, which allows for it to be used for recognition purposes. The iris recognition door unlocking system detects the iris and identifies its biometrics followed by unlocking the door. This system can be mounted on the cockpit doors of the aircraft with some additional steps like adding the system to the cockpit door and connecting it to electrical supply and database. In the upcoming new aircraft's the system can be inbuilt during manufacturing **[8]**.

9. Applications [5]

1. Implemented and substituted for passports (automated international border crossing)
2. Improved aviation security and privacy
3. Immigration Control
4. National ID
5. Database access and computer login
6. Reducing need for physical contact
7. Fast processing and reducing delays
8. Increased accuracy and efficiency
9. Intruder Detection
10. Passenger Safety
11. Crime Investigation

10. Conclusion

Iris recognition is an emerging field in biometrics as the iris has a data-rich unique structure, which makes it one of the best ways to identify an individual. Due to the unique nature of the iris, it can be used as a password for life. As the iris is the only part of human that can never be altered, there are no chances of trespassing when one is using an iris detection system, by any means. The Iris Recognition system analyses how the network behaves when an input is given and the size if the input is a direct factor influencing the performance. Since the Iris is different between the left and right eye, recognition can be performed separately by each eye **[3]**. Thus it also helps to distinguish twins. As long as the eyes are exposed, Iris Recognition can be used when subject is wearing a hat, mask, eyeglasses or gloves. Because of using infrared camera, recognition is available even at night or in the dark. Without the need to touch the device, contactless authentication is possible, making it hygienic to use. Thus the automated method of Iris Recognition for cockpit door, enhances air security and privacy and minimises the rate of incidents and accidents occurring in our day to day life leading a step towards a more safer and better future **[2,3]**.

11. Acknowledgement

We express our gratitude and special thanks to Dr. Dilip Chaudhary for his vital support, guidance and constant encouragement throughout this project. We also sincerely thank Miss. Sheetal Ghongte for guiding and providing the valuable feedback throughout the project's development.

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