

Organized by

Eranad Knowledge City Technical Campus, Manjeri, Malappuram Dist, Kerala, India

Security System Adopting Face Recognition

Sanu P¹, Ameer Basha², Shehla Sherin V³, Safeela Nasrin K⁴, Professor Jyothi K⁵,
Professor Lakshmi Priya K⁶

U.G Student, Department of Electronics and Communication, Eranad Knowledge City Technical Campus, Manjeri,
Malappuram, kerala, India¹ Orchid Id:009-0004-7104-0760

U.G Student, Department of Electronics and Communication, Eranad Knowledge City Technical Campus, Manjeri,
Malappuram, kerala, India² Orchid Id:0009-0003-0622-5163

U.G Student, Department of Electronics and Communication, Eranad Knowledge City Technical Campus, Manjeri,
Malappuram, kerala, India³ Orchid Id:0009-0002-8569-8956

U.G Student, Department of Electronics and Communication, Eranad Knowledge City Technical Campus, Manjeri,
Malappuram, kerala, India⁴ Orchid Id:0009-0007-5741-6006

Assistant Professor, Department of Electronics and Communication Engineering, Eranad Knowledge City Technical
Campus, Manjeri, Malappuram, Kerala, India⁵

Assistant Professor, Department of Electronics and Communication Engineering, Eranad Knowledge City Technical
Campus, Manjeri, Malappuram, Kerala, India⁶

ABSTRACT: We introduce a project with the idea of creating a security system for prisons that could potentially enhance the current security strength in any prison. The security system enhances the strength of the security using a powerful face detection and recognition AI that could recognize a prisoner's face and provide details on the prisoner in the cell with respect to the face of the prisoner. This system is designed around a component namely "HuskyLens", Which is an AI-based component that comes with some inbuilt functions like face detection, distance calculation, etc. which will be used for the project. Furthermore, this project can be extended as an attendance system to provide efficient marking of duty time for employees.

KEYWORD: Huskylens

I. INTRODUCTION

A security system is essential for any long-lasting institution as it prevents attacks that could threaten its existence. There are two types of security: physical and non-physical. Physical security includes security guards, fences, gates, walls, and doors, which interact with the real world but can be time-consuming and easily manipulated. Non-physical security, such as thumb impression or ID card swipe systems and camera surveillance, is faster but can have loopholes, such as the inability to detect intruders or keep track of people entering and leaving without human assistance. Our team has developed an alternative system that integrates physical and non-physical security by connecting a door and a security camera. The camera checks faces against a database and triggers the locking mechanism to open the door for authorized individuals. The system also sends an alert message to authorities if an unauthorized person is detected, and keeps the door locked until authorized. The system's main feature is a jailbreak detection system that stores facial data for all admitted prisoners and sets up cameras around the prison. Abnormalities trigger an alert with a loud noise to notify officers. A security system is essential for any long-lasting institution as it prevents attacks that could threaten its existence[1]. There are two types of security: physical and non-physical. Physical security includes security guards, fences, gates, walls, and doors, which interact with the real world but can be time-consuming and easily manipulated. Non-physical security, such as thumb impression or ID card swipe systems and camera surveillance, is faster but can have loopholes, such as the inability to detect intruders or keep track of people entering and leaving without human assistance. Our team has developed an alternative system that integrates physical and non-physical security by connecting a door and a security camera. The camera checks faces against a database and triggers the locking mechanism to open the door for authorized individuals. The system also sends an alert

Organized by

Eranad Knowledge City Technical Campus, Manjeri, Malappuram Dist, Kerala, India

message to authorities if an unauthorized person is detected, and keeps the door locked until authorized. The system's main feature is a jailbreak detection system that stores facial data for all admitted prisoners and sets up cameras around the prison. Abnormalities trigger an alert with a loud noise to notify officers [2].

II. RELATED WORKS

This set of papers covers various topics related to computer science and engineering, specifically in security and facial recognition systems.

The first paper [1] describes an intelligent home security surveillance system based on ZigBee technology, which is a wireless communication protocol commonly used in Internet of Things (IoT) devices. The system uses sensors and cameras to monitor the home, and it can send notifications to the homeowner's smartphone if any suspicious activity is detected. The second paper [2] focuses on security and privacy issues in cloud computing, a popular technology for storing and accessing data remotely. The authors discuss various threats to cloud security and suggest ways to mitigate these risks, such as using encryption and access controls.

The third paper [3] discusses a face recognition system developed by researchers at Vellore Institute of Technology in India. The system uses deep learning algorithms to recognize faces, and it has potential applications in security and surveillance. The fourth paper [4] also focuses on face recognition, specifically on the problem of face detection and recognition in non-ideal conditions such as low lighting or occlusion. The authors propose a method that uses a combination of feature extraction and machine learning algorithms to improve the accuracy of face recognition.

The fifth paper [5] presents an approach to 3D face recognition that accounts for facial expressions and other deformations that may occur during the recognition process. The authors propose a method that uses a combination of feature extraction and deformation analysis to improve the accuracy of 3D face recognition. The sixth paper [6] introduces an incremental algorithm for principal component analysis (PCA) and linear discriminant analysis (LDA), two popular techniques for dimensionality reduction in machine learning. The authors propose a method that can update the PCA-LDA model in real-time as new data becomes available.

The seventh paper [7] describes a face recognition system that uses a combination of multi-scale principal component analysis (MPCA) and locality preserving projection (LPP) algorithms to improve the accuracy of face recognition. The authors evaluate their method using the ORL face database, a commonly used benchmark dataset for face recognition. The eighth paper [8] proposes a system for human identification using both face and voice recognition. The authors describe a method that uses a combination of feature extraction and machine learning algorithms to recognize individuals based on their faces and voices.

The ninth paper [9] presents a tensor-based MPCA approach to face recognition, which uses higher-order tensors to represent face images and extract features. The authors compare their method to other state-of-the-art techniques on the ORL face database and show that their method achieves high accuracy. The tenth paper [10] introduces an improved fast PCA algorithm for face recognition, which uses a combination of feature extraction and feature selection techniques to improve accuracy. The authors evaluate their method using the Yale face database, another commonly used benchmark dataset for face recognition.

The eleventh paper [11] proposes an enhanced face recognition system that uses a combination of feature extraction and dimensionality reduction techniques to improve accuracy. The authors evaluate their method using the ORL face database and show that it outperforms other state-of-the-art techniques. Finally, the twelfth paper [12] presents a modified PCA algorithm for face recognition that can handle variations in lighting and other environmental factors. The authors evaluate their method using the Olivetti Research Laboratory (ORL) face database and show that it achieves high accuracy.

III. METHODOLOGY

The Face Detection was first introduced in 2001 by Paul Viola and Michael Jones. Face Detection has come long way ever since. The Viola-Jones framework relies on a trained model to differentiate between what is and what isn't a face. Essentially, the model has been taught to recognize specific patterns that are unique to faces, allowing it to accurately detect them in images or videos. The training process is crucial to the effectiveness of the framework, as it ensures that the model is able to recognize faces under a wide range of conditions, such as different lighting or angles. After undergoing the training process, the model acquires the ability to identify certain characteristics of an image. These characteristics are then saved in a file for future reference, so that they can be compared with the features of new images at various stages. If the image being analyzed meets the feature comparison criteria at each stage, then it can be inferred that a face has been detected and further processes can take place. It still had a limitation that if the face wasn't oriented properly the framework may not be able to find the face [3].

Organized by

Eranad Knowledge City Technical Campus, Manjeri, Malappuram Dist, Kerala, India

Applications that are designed for detecting human faces utilize various techniques such as algorithms and Machine Learning to identify facial features within an image. Often, these images contain non-face objects, such as buildings, landscapes, or even other parts of the human body like hands or feet.

In order to detect human faces, the algorithms begin by searching for human eyes. This is considered to be one of the simplest features to detect. Subsequently, the algorithm would try to identify other facial features such as eyebrows, the mouth, the nose, nostrils, and the iris. By doing so, the algorithm can then determine whether the image under analysis contains a face or not. After the algorithm identifies a region of an image that it believes may contain a face, it performs additional tests to validate that the detection is accurate. These tests are designed to eliminate false positives, which can occur when the algorithm mistakes non-face objects for faces. By using a series of validation steps, the algorithm can increase the accuracy of its face detection, ensuring that it only reports true positives. In order to make sure that the algorithms are accurate, they must undergo training using large datasets that include both positive and negative images. These datasets should contain hundreds of thousands of images to help the algorithm become better at recognizing if there is a face in an image, and if so, where it is located.

Through training, the algorithm's accuracy in detecting faces in images is improved, which enhances its ability to distinguish between different facial features. This training process allows the algorithm to learn and adapt to new scenarios, which ultimately helps it to produce more accurate results. To incorporate the latest and most affordable version of Face detection AI, we use a component widely known for its efficient algorithms and affordability, namely "Huskylens", which has many inbuilt features including face detection and distance calculation. These are some of the key features that we require in order to build the system.

HuskyLens: -

HuskyLens is a user-friendly sensor that uses AI machine vision to perform six different functions. These functions include recognizing faces, tracking objects, identifying objects, following lines, detecting colors, and detecting tags. The module is well-designed and features a camera on the front and an LCD display on the back, as well as three LEDs, making it a versatile tool for various applications. onboard which can be controlled through the software. It has two buttons on it, One is a slider switch to toggle between the modes of operations and a pushbutton to capture and learn about the objects in the camera's learning capabilities improve with use, making it more intelligent over time. The implementation of a new generation AI chip has enabled HuskyLens to recognize faces at an impressive rate of 30 frames per second. HuskyLens can be easily integrated into a variety of projects through its UART/I2C port.

Kendryte K210 Architecture: -

The K210 is equipped with two 64-bit RISC-V CPU cores, each with its own independent Floating Point Unit (FPU). Its primary focus is on machine vision and hearing applications, with the KPU being responsible for computing convolutional neural networks, and an APU for processing microphone array inputs. Additionally, the K210 has a Fast Fourier Transform (FFT) Accelerator that can handle complex FFT calculations at a high-performance rate. Consequently, the K210 is capable of providing high-performance processing power for most machine learning algorithms.

Although the "Huskylens" do provide such built-in features it only has 4 pins out of which only 2 can give data output. So, the output must be differentiated from other useless signals using a microcontroller which, in this case, we use Arduino Uno that incorporates an affordable microcontroller namely ATMEGA328P

Arduino Uno (ATMEGA328P) : -

The Arduino Uno is a microcontroller board that is based on the Microchip ATmega328P microcontroller. It is an open-source platform that can be modified and customized to suit the needs of the user. The board is widely used for various projects due to its flexibility and ease of use. The Arduino Uno is a versatile microcontroller board that provides a range of input and output options. It features both digital and analog I/O pins that can be used to interface with a variety of expansion boards and other circuits. With a total of 14 digital I/O pins, six of which can be used for pulse-width modulation (PWM) output, and six analog I/O pins, the Arduino Uno offers flexibility in terms of connecting to and controlling external components.

The board can be programmed using the Arduino Integrated Development Environment (IDE), which provides a user-friendly platform for writing, compiling, and uploading code to the board. This can be done via a type B USB cable, which connects the Arduino Uno to a computer. With its ease of use and broad range of features, the Arduino Uno is an excellent choice for hobbyists, educators, and professionals alike. The Arduino Uno can be powered using either a USB cable or an external 9-volt battery, and can accept voltages ranging from 7 to 20 volts. This flexibility allows for greater versatility when using the board, as it can be powered using a variety of sources, making it easier to integrate into different types of projects. It is also similar to the



Organized by
 Eranad Knowledge City Technical Campus, Manjeri, Malappuram Dist, Kerala, India

Arduino IDE (Integrated Development Environment), via a type B USB cable. It can be powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts. The Arduino IDE is a software program that allows users to write, compile, and upload code to an Arduino board via a type B USB cable. The board can be powered either by connecting it to a computer through the USB cable or by using an external 9-volt battery. It has the ability to accept voltages within the range of 7 to 20 volts. The board is comparable in design to the Arduino Nano and Leonardo.

The word "Uno" was chosen to mark the first release of Arduino software, and it means "one" in Italian. The Uno board is the initial board in a set of USB-based Arduino boards. It, along with version 1.0 of the Arduino IDE, served as the reference versions of Arduino, which have since been updated.

The following figure 3.1 shows the block diagram of the project.

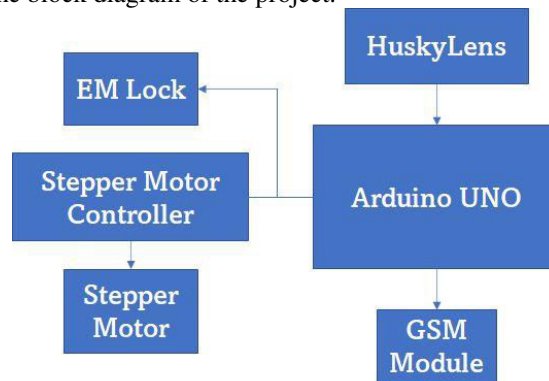


Fig 3.1 Block Diagram

The system works as follows: When an individual approaches the door, the camera module captures their face and sends the visual data to the AI module. The AI module compares the captured facial data with the stored data in the database to determine if the individual is authorized to enter. If the individual is authorized, the AI module sends a signal to the microcontroller, which activates the door lock, allowing the individual to enter. If the individual is unauthorized, the AI module sends an alert to the alarm module, triggering an alarm and preventing access[4].

Additionally, the system is capable of detecting jailbreak attempts by using specialized cameras to monitor the premises. Any abnormality in the shape of the cell or the presence of a prisoner outside the prison premises would trigger an alert, alerting the officers both inside and outside the prison. Overall, this system provides a high level of security for the prison by combining physical and non-physical security measures and using advanced image processing technology to detect and prevent unauthorized access and jailbreak attempts.

IV. EXPERIMENTAL RESULTS

We observed that the output provided by the huskylens could be distinguished using the Arduino Uno board with which we controlled the system. This system could identify the prisoners' faces fairly clearly and identify the cell details of the prisoner. In all aspects like angle distance etc., except for different lighting conditions, especially in the dark since huskylens is not equipped with infrared, the system detected the individual accurately. Once the system has detected a prisoner's face, it could provide details on the prisoner in the cell with respect to the face of the prisoner. The expected experimental result would be to test the accuracy of the recognition algorithm used in the system. This was done by testing the system with a database of known prisoners to see if it can accurately match a detected face to the correct prisoner. The security system is designed to enhance the strength of the security using a powerful detection and recognition AI. The expected experimental result is to test the efficiency of the system in terms of how quickly it can detect and recognize faces, and how quickly it can provide details on the prisoner in the cell. This was done by measuring the response time of the system in different scenarios. The project can also be extended as an attendance system to provide efficient marking of duty time for employees. The expected experimental result is to test the accuracy of the attendance system by comparing the recorded duty time with the actual duty time of the employees. This was done by testing the system with a group of employees and comparing the recorded duty time with their actual duty time.

The following images Fig 4.1, Fig4.2 shows huskylens identifying and training face data.

Organized by

Eranad Knowledge City Technical Campus, Manjeri, Malappuram Dist, Kerala, India

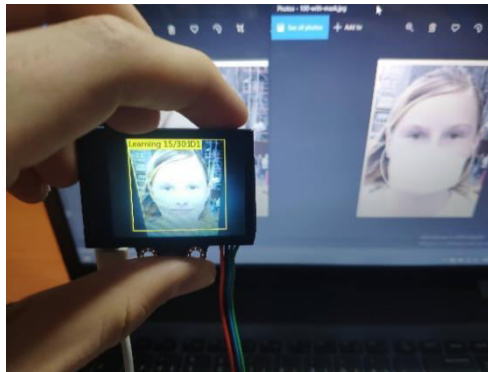


Fig 4.1 Identification and Training

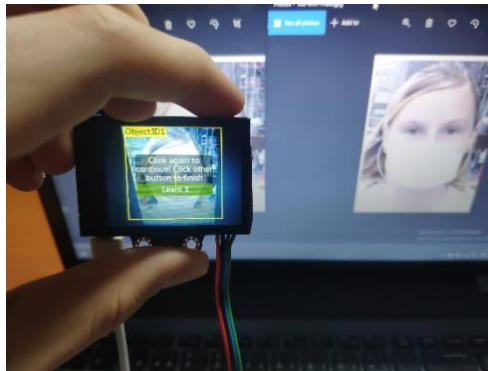


Fig 4.2 Storing

V. CONCLUSION

In conclusion, this project successfully demonstrated the potential of combining physical and non-physical security measures to create a more efficient and reliable security system for prisons. By integrating a security camera with a door, this system was able to check the faces of individuals against a database, trigger the locking mechanism of the door, and mark the individual as checked-in or signed out. This integration significantly reduces the time needed to check for authorization, which is a major disadvantage of physical security measures alone.

Furthermore, our system's jailbreak detection capabilities add an extra layer of security to the prison's physical security measures. By storing the face data of all admitted prisoners and setting up cameras in all cells and around the prison premises, our system detects any abnormalities, such as changes in the shape of the inside of a cell, faces of prisoners outside the premises, or disconnected cameras, triggering an alert to the officers inside or outside the prison.

This system's reliance on advanced image processing technology, such as face detection and distance calculation, demonstrates the potential of AI-based components, such as HuskyLens, in enhancing security measures in prisons. This project's success could potentially enhance the security strength of any prison, providing a more efficient and reliable system to prevent any attacks and detect any potential jailbreaks.

Finally, this system's potential to extend as an attendance system for prison employees demonstrates the versatility and usefulness of our system beyond security measures. By providing efficient marking of duty time, our system could potentially improve the management of prison employees and reduce any potential discrepancies in attendance.

Overall, this project represents a significant step forward in the integration of physical and non-physical security measures in prisons, demonstrating the potential of advanced image processing technology and AI-based components.



Organized by

Eranad Knowledge City Technical Campus, Manjeri, Malappuram Dist, Kerala, India

REFERENCES

- [1] Research of Intelligent Home Security Surveillance System Based on ZigBee, Jun Hou, Chengdong Wu, Zhongjia Yuan, Jiyuan Tan, Qiaoqiao Wang, Yun Zhou College of Information Science & Engineering, Northeastern University, Shenyang, Liaoning, 110004, China
- [2] Security and Privacy Issues in Cloud Computing. To cite this article: Bayan A. Alenizi et al 2021 J. Phys.: Conf. Ser. 1979 012038
- [3] Face Recognition System Shivam Singh Department of SCSE, Prof.S. Graceline Jasmine Department of SCSE Vellore Institute of Technology, Chennai Tamil Nadu, India, 2278-0181
- [4] Face detection and Recognition, Assistant Professor Harjeet Singh Department of ECE, BHSBIET, Lehragaga Akanksha, Jashanpreet Kaur, 6th International Conference on Advancements in Engineering and Technology (ICAET-2018), Feb. 23-24, 2018, Sangrur, 978-81-924893-3-9.
- [5] F. Al-Osaimi · M. Bennamoun · A. Mian, | An Expression Deformation Approach to Non-rigid 3D Face Recognition |, Springer Science+Business Media, LLC 2008
ISSN: 2278 – 1323 International Journal of Advanced Research in Computer Engineering & Technology (IJARCET)
Volume 1, Issue 8, October 2012 344 All Rights Reserved © 2012 IJARCET
- [6] Issam Dagher, | Incremental PCA-LDA algorithm |, International Journal of Biometrics and Bioinformatics (IJBB), Volume (4): Issue (2)
- [7] J. Shermina, V. Vasudevan, | An Efficient Face recognition System Based on Fusion of MPCA and LPP |, American Journal of Scientific Research ISSN 1450-223X Issue 11(2010), pp.6-19
- [8] Ishwar S. Jadhav, V. T. Gaikwad, Gajanan U. Patil, | Human Identification Using Face and Voice Recognition |, International Journal of Computer Science and Information Technologies, Vol. 2 (3), 2011
- [9] Yun-Hee Han, Keun-Chang Kwak, | Face Recognition and Representation by Tensor-based MPCA Approach |, 2010 The 3rd International Conference on Machine Vision (ICMV 2010)
- [10] Neerja, Ekta Walia, | Face Recognition Using Improved Fast PCA Algorithm |, Proceedings of IEEE 2008
- [11] S. Sakthivel, Dr. R. Lakshmi pathi, | Enhancing Face Recognition using Improved Dimensionality Reduction and feature extraction Algorithms_An Evaluation with ORL database |, International Journal of Engineering Science and Technology Vol. 2(6), 2010
- [12] Lin Luo, M.N.S. Swamy, Eugene I. Plotkin, —A Modified PCA algorithm for face recognition |, Proceedings of IEEE 2003