A Novel Approach for Automated Person Verification System for Military and Educational Institutions

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***Abstract* —** Automated person verification systems play a pivotal role in ensuring security and preven-ing potential criminal activities in various domains. However, the military lacks such a system within their camps, which poses a significant risk. Additionally, educational institutions also face challenges in ensuring attendance accuracy and preventing proxy usage. To address these concerns, this project propose an innovative initiative aimed at assisting the military and educational institutions in enhancing security measuresand maintaining reliable attendance records. This project uses a bar code scanner for identifying military personnel. Each person will have their own bar code with specific information. Automatic

barcode scanning displayed on secure accessible screen for security. A double verification system can be implemented using bar code and face recognition technology. The system will scan both the bar code ID and the face of the person and compare them with the information in the database. If either of the two

does not match, an alarm will be triggered in the control room to alert the authorities. This way, a more secure and reliable system for verification can be ensured. This type of system can also be used in educational institutes to avoid the use of proxies. In this paper, the same problem is discussed.

Keywords *—Automated, Bar code, Database, Face recognition, Login id, Security*

I.INTRODUCTION

The need for a robust tool capable of verifying the identity of individuals and tracking their presence within specific areas has become increasingly vital, particularly within military camps. Our initiative seeks to fill this void by implementing an advanced person verification system utilizing bar code scanning technology. Each military personnel will be assigned a unique bar code containing specific information. The system will automatically scan the bar code and display the details on a secure screen accessible only to authorized security personnel and the head of the institution. To further strengthen the verification process, we will incorporate a double verification system employing both bar code and face recognition technology. This innovative approach will enable simultaneous scanning of the bar code ID and the individual's face, which will then be compared against the stored information in the database. Any discrepancy detected between the two identifiers will trigger an immediate alarm in the control room, promptly alerting the authorities and ensuring a more secure and reliable verification system.

II.LITERATURE REVIEW

Manori et.al [1] discuss a smartphone-based attendance recording system using QR codes, that includes two applications for generating codes and taking attendance. Students' attendance status is recorded as either 0 or 1 in
the student database. Attendance reports can be generated in CSV or XLS format. This technology seeks to increase productivity, streamline the attendance management procedure, and stop bogus registrations.

Smitha et.al [2] discuss the use of face recognition systems for the purpose of marking attendance in schools, institutes, and work spaces. The system is composed of four phases : creating a database, face detection and recognition, and updating attendance records. The system uses live streaming video with a Haar-Cascade classifier and local binary pattern histogram algorithm. The attendance record is sent via email to the respective faculty. By providing a contactless means of marking attendance, the device makes manual attendance methods unnecessary.

Dhanush Gowda H.L et.al [3] propose an auto and intelligent attendance management system that uses live video stream with OpenCV and dlib for face detection and recognition. The system compares the recognized faces with the database of student faces to mark attendance. By eliminating proxies and false attendance, this approach helps teachers control student attendance less laboriously

Subramaniam et.al [4] describe the development of a Student Attendance System (SAS) to automate the manual attendance record-keeping process in secondary schools in Selangor, Malaysia. The student card with the student identification number is scanned using a bar code scanner. User acceptance testing showed positive results. It could be effective for systematically keeping student attendance records.

Elaskari et.al [5] proposed the use of bar code technology to automate the manual process of tracking student attendance and college assets in a university setting and to improve efficiency. The required applications and software packages installed on a smartphone and laptop were used to scan the embedded barcode in each student ID, and the attendance was recorded. The study concluded that

the system is cost-effective, efficient, and easy to use. It is capable of conducting regular inventory checks of college facilities, equipment, office furniture, and classrooms.

Lakshmi Sudha et.al [6] aim to create an automated attendance record-keeping system for a college using a bar code scanner. Each student will have a unique barcode on their ID card, which contains their information. The system will display the status of the student's attendance when they have scanned their barcode and only authorized personnel with login credentials can access the system. The goal of the project is to improve attendance record-keeping at the college.

Ninad Mehendale presents a paper [7] that uses the ESP32 Camera Module and OpenCV to detect and identify objects. The project utilizes the cvlib library for object detection, which is a pre-trained AI model on the COCO dataset that detects objects using YOLOv3. For hardware, the ESP32 Camera Module was used and programmed through an FTDI module. The setup required the configuration of Arduino IDE, firmware uploading, and the installation of Python and its libraries. The project showcases the accuracy of object detection using OpenCV and the ESP32 Camera Module as the hardware.

In [8], J. Wen proposes a face recognition unlocking system based on the ESP32 development board. The system offers a secure and convenient method for unlocking doors or other access points. The fundamental module of the proposed system is the ESP32, and ESP-EYE is used to gather and store pictures, which are subsequently transmitted to the computer through the data bus. The collected images are compared to control the peripheral circuit. The system is low cost, easy to operate, and highly practical. The proposed design provides a more secure and convenient alternative to traditional unlocking methods.

N. Zaini [9] proposes an Android application to take attendance at universities by scanning student cards with barcodes. The barcodes are scanned using the device's camera as a sensor, and the updated attendance list is then uploaded to an internet database. The system is efficient, eliminates cheating, and promotes a paperless environment. It can be deployed on existing Android devices without additional hardware costs. The proposed method offers a reliable way to manage attendance at universities.

Abir Alsideiri [10] proposes a mobile application for marking attendance that can be used by both the teacher and students. The student will scan a code provided by the teacher to log in and mark their attendance. The proposed system is designed for use at Buraimi University College and is expected to improve efficiency, accuracy while reducing the workload on teachers.

F. Imeri [11] proposes a smart attendance system for higher education institutions that utilizes QR codes for attendance registration. The manual process is time-consuming, and the proposed system aims to improve student participation and academic performance. This paper offers a potential solution to the current attendance management issues in higher education institutions.

Lina [12] proposes an AI-based system that uses an improved adaptive median filter algorithm and a QR code distortion correction method based on backpropagation neural networks. This system can successfully recognize distorted QR codes despite challenges such as an uneven background and inadequate illumination. This combination of algorithms can fit the distorted QR image into the geometric deformation pattern, leading to successful QR code recognition. The preprocessing stage of an image is emphasized, and the proposed algorithm can improve the reading rate of QR code images by 14%. The study offers a potential solution to the challenge of two-dimensional code distortion in existing software systems.

Al Sheikh [13] proposes a barcode-based student attendance system that uses real-time processing to monitor and record attendance in universities, eliminating the need for a registry book. It was designed using UML and implemented using Microsoft Access 2007 and the ASP.NET programming language. Reports can be generated in real-time. The system aims to reduce absenteeism, meet attendance requirements for exams, and provide accurate and efficient attendance monitoring.

G. Singh [14] explains face recognition for authentication of individual's identity. It is divided into two phases: face detection and individual

recognition. The two methods currently used in face recognition - Eigenface and Fisherface. The Eigenface method employs principal component analysis to minimize the dimensional space of the facial features, while the Fisherface method uses linear discriminant analysis to maximize the distance between classes. Digital image processing for developing a face recognition system.

M. Khan [15] suggests employing principle component analysis (PCA) for facial identification in a real-time face recognition system. Data storage is decreased by PCA to the necessary feature space. For facial identification, PCA transforms a large 1-D pixel vector into a small primary element of space function known as a projection of self-space. To choose the appropriate space, it centres on a set of fingerprint pictures using the covariance matrix's own vectors. The system uses OpenCV, Haar Cascade, Eigenface, Fisher Face, LBPH, and Python algorithms.

III.METHODOLOGY

3.1.PROPOSED RESEARCH

Research statement: To develop a bar code-based ID scanner badge that operates automatically with the aid of motion detecting sensors and a bar code scanner and uses face recognition technology from the EPS-32 for double authentication, this innovative idea hopes to improve the security system of military camps and educational institutions.

The hardware system of the attendance management project in a defense consists of several components, including the motion sensor, QR code scanner, and database system. A detailed explanation of the system's components is provided below:

3.2.Components

The main components used are FTDI and the ESP32 Cam Module. They both are connected using wires and jumper cables on a breadboard, and FTDI is connected to a laptop for programming.

MOTION DETECTING SENSOR

A motion detecting sensor detects motion in its surrounding environment. Passive infrared (PIR) technology is the most common type of motion detecting sensor. PIR sensors detect alterations in infrared radiation from objects within the sensor's range. When an object moves within its detection range, PIR sensors detect changes in infrared radiation and transmit a signal to activate linked devices or systems, such as alarms or lights. An infrared motion detecting sensor placed at the entry gate will track soldier movement and be connected to a microcontroller to process the sensor's output and transmit data to the database system.

FIG.1.MOTION DETECTING SENSOR

BARCODE SCANNER

A bar code scanner reads and decodes bar codes. Bar codes are optical codes that consist of a series of lines or squares of varying widths and spacing that represent data such as product codes or inventory numbers. The scanner uses a light source and a photo sensor to read the bar code. The light source illuminates the bar code, and the photo sensor detects the reflected light to decode the bar code, which is then sent to a connected device for processing and analysis. Bar code scanners are reliable and versatile tools for data collection and management.

FIG.2.BARCODE SCANNER

DATABASE SYSTEM

The database system will track attendance and store soldier information. This system will be designed using a database management system such as MySQL. Tables will be used to store data, accessible by authorized personnel.

CONTROL ROOM

The control room will be equipped with a computer system that will receive the output from the motion detecting sensors and cameras. Authorized personnel monitor motion sensors and camera output in the control room and take strict action if anyone enters a restricted area.

FTDI MODULE

The FTDI (Future Technology Devices International) module is a USB-to-serial adapter that enables communication between a computer and external devices such as microcontrollers, sensors, and other electronic components. It is easy to use, versatile, and comes with a range of drivers and software tools, making it a popular choice in embedded systems development, robotics, and other electronics applications. The module supports a wide range of baud rates and data formats, making it flexible enough to handle various communication protocols. Overall, the FTDI module is a powerful and essential tool for modern electronics projects.

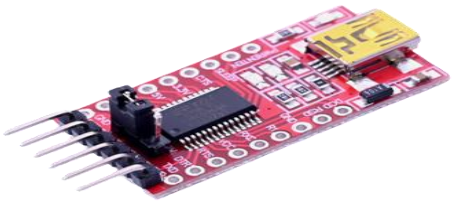

FIG.3.FTDI

ESP32 CAM

The ESP32 CAM module is a low-cost, compact camera module with an ESP32-S chip and an OV2640 camera sensor. It captures images and videos up to 2 megapixels with built-in Wi-Fi and Bluetooth. It supports JPEG and BMP image formats and the MJPEG video format. Its small size allows for easy integration into various projects with online resources for programming and troubleshooting. However, its limited processing power and memory and the fact that the camera sensor is fixed and cannot be replaced or upgraded, may be a limitation for more complex projects. In this project, the ESP32 CAM module has been utilized for implementing face recognition.

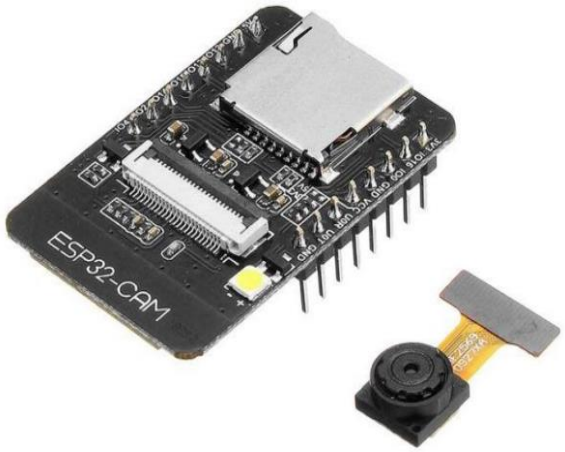

FIG.4.ESP32 CAM MODULE

Overall, the use of the FTDI and ESP32 Cam modules in the attendance management systemin the defense proved successful, and the system was able to automate attendance tracking and ensure compliance with military regulations. The system's benefits include real-time attendance tracking, reduced administrative workload, improved accountability, and better control over the movement of soldiers. This attendance management system serves as a model for other institutions looking to automate their attendance tracking and monitoring systems.

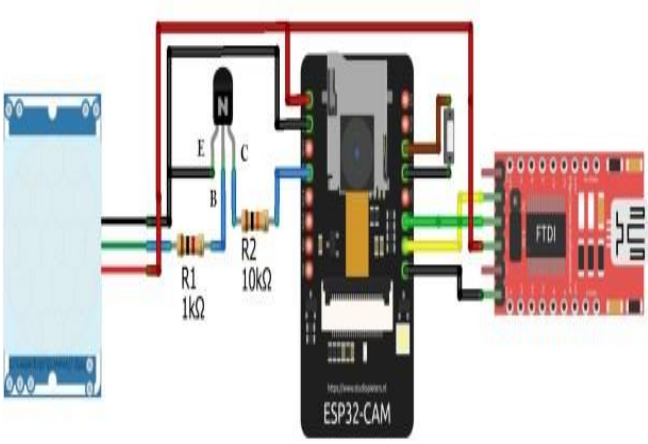

Fig. 5. Connection of motion detecting sensor, Esp32-cam and FTDI module.

A. Flowchart

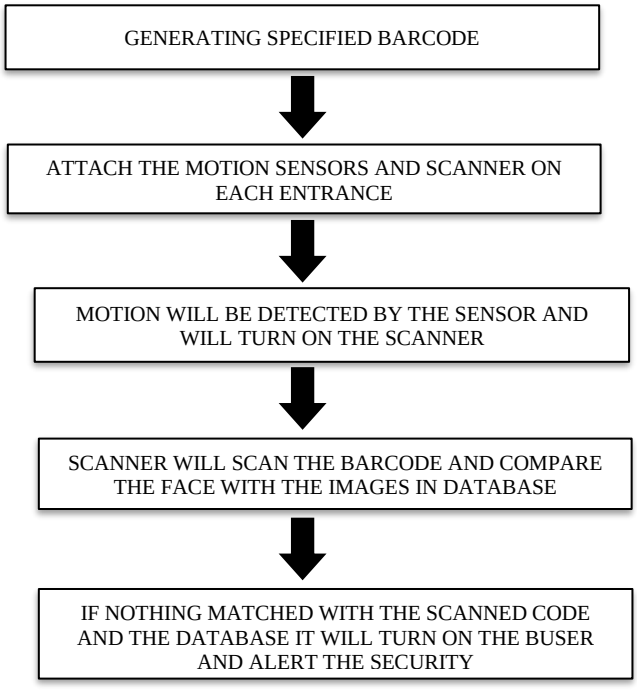

FIG.5.FLOWCHART

3.3.Algorithm

The ESP32-CAM board is programmed using the Arduino IDE. Thus, you must have both the ESP32 add-on and the Arduino IDE installed..

STEP I. In Arduino IDE, navigate to File => Examples => ESP32 => Camera and open the Camera Web server example.

The code below should load.

STEP II. The network credentials need to be entered in the following variables before uploading the code:

const char* ssid = "REPLACE_WITH_YOUR_SSID";

const char* password = "REPLACE_WITH_YOUR_PASSWORD";

STEP III. Use an FTDI programmer to connect the ESP32-CAM board to your computer.

STEP IV. A jumper on FTDI programmers lets you choosebetween 3.3V and 5V.

STEP V. Follow these steps to upload the code:

a) Choose AI-Thinker ESP32-CAM under Tools > Board.

b)Choose the COM port the ESP32 is linked to under Tools > Port.

IV. RESULTS AND DISCUSSIONS

The attendance management system for the military uses motion sensors, bar code scanning, and image recognition to track attendance, store information, verify identities, and detect if anyone enters any prohibited area.

Following images show the working of the scanner and identifier.

The system is a security system using an ESP-32 camera module for facial recognition and QR code scanning. When a registered user approaches the camera, their name is entered into the database, and a green box appears to indicate successful verification. If an unidentified person approaches the camera, an "intruder alert" is triggered, and the system can be set up to take further action to identify the person.

By registering QR codes, the system provides an extra layer of security, allowing only authorized individuals with the corresponding QR code to gain access. All data captured by the system is stored in an Excel file, which can be easily accessed and managed on the admin computer. If required, the database can be upgraded to a different application using SQL for more robust and scalable storage and retrieval.

Using MS Excel for database management makes it user-friendly and easy to understand, enabling the admin to quickly sort and filter the data based on

various criteria. However, as the system grows, using Excel may become more difficult to manage, and a more scalable solution may be required.

Overall, this system uses facial recognition and QR codes for identification and authorization, providing an efficient and secure way to manage facility access. The admin can easily manage and analyze data for security and compliance purposes.

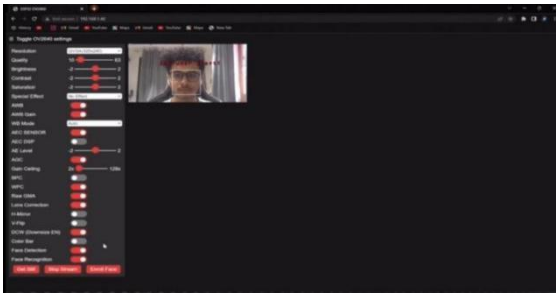

FIG.9.UNVERIFIED PERSON

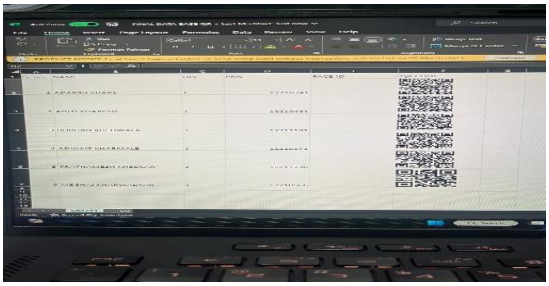

FIG.6.DATABASE

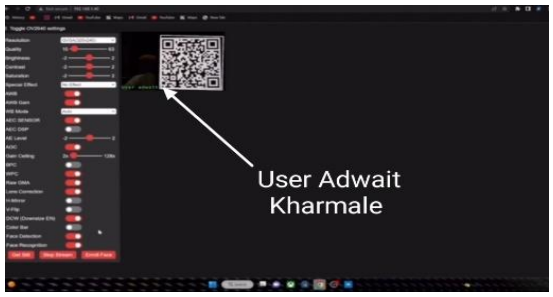

FIG.7.RESULT

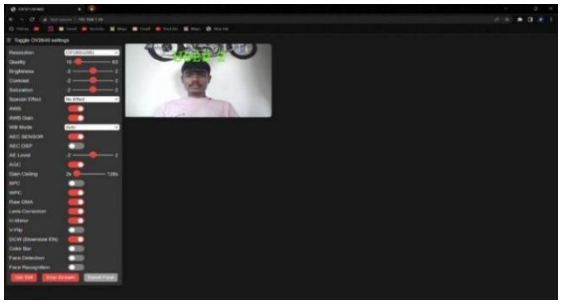

FIG.8.VERIFIED PERSON

Comparison Factors	Previous Methods	New Method
Integration of Technologies	Lack of integration between bar code scanning and face recognition technologies, leading to separate and disjointed verification processes	Integration of bar code scanning and face recognition technologies for a comprehensive and unified person verification system
Security Measures	Primarily focused on bar code scanning, neglecting the potential benefits of incorporating additional security measures like face recognition	Incorporates both bar code scanning and face recognition, strengthening security measures and reducing false identifications or breaches

Military Camp Security	Absence of a reliable person verification system in military camps, resulting in increased risks of unauthorized access and security breaches	Addresses the absence of a reliable person verification system, enhancing security measures and mitigating potential threats
Attendance Tracking	Difficulties in accurately tracking attendance in educational institutes, allowing proxy usage to persist	Enables accurate attendance tracking in educational institutes, effectively deterring proxy usage

Table. 1. The comparison between the previous methods and this new method.

V.FUTURE SCOPE

There are several potential future developments for the attendance management system in the military including:
Mobile app integration: A dedicated mobile app for soldiers could be developed to make attendance tracking and checking of schedulesmore convenient.
Smart analytics: The data collected from the system could be analysed to identify trends and patterns in soldiers' attendance and performance, which could help in identifying areas where improvements are needed.
Overall, there are many opportunities for further development and refinement in the future.

VI.CONCLUSIONS

In conclusion, this research has demonstrated the potential benefits of using barcode scanner attendance systems and face recognition technology in military applications. The implementation of these technologies can improve the accuracy and efficiency of attendance tracking,which is critical in military operations. Moreover, the use of face recognition technology can enhance security measures by identifying individuals with high accuracy, even in low light conditions.
This cost-effective and easily accessible project has the potential to revolutionize face recognition and code scanning, thereby enhancing security in any environment where it is implemented. Its versatility makes it an additional measure towards creating a secure space.

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We are privileged and honoured to have had the opportunity to undertake this project, and we remain committed to leveraging the skills and knowledge gained during this process to positively impact society.

REFERENCES

[1] Manori, Anupama&Devnath, Nandgopal & Pasi, Nitin&Kumar, Vivek (2017).QR Code Based Smart Attendance System.*International Journal of Smart Business and Technology. 5. 1-10. 10.21742/ijsbt.2017.5.1.01.*
[2] Smitha, & Hegde, Pavithra & Afshin,. (2020). Face Recognition based Attendance Management System. *International Journal of Engineering Research and. V9. 10.17577/IJERTV9IS050861.*
[3] Neha Kumari Dubey, Pooja M.R., K Vishal, Dhanush Gowda H.L, Keertiraj B.R,2020,Face Recognition based attendance system, *International*

Journal of Engineering Research & Technology(IJERT) Volume 09,Issue 06 (June 2020)

[4] Subramaniam, Hema & Hassan, Marina & Widyarto, Setyawan. (2013). Bar Code Scanner Based Student Attendance System (SAS). *TICOM (TECHNOLOGY OF INFORMATION AND COMMUNICATION). VOL. 1 NO. 3 (2013).*

[5] Salah Elaskari, Muhammad Imran, Abdurrazag Elaskri, Abdullah Almasoudi,Using Barcode to Track Student Attendance and Assets in Higher Education Institutions,*Procedia Computer Science,Volume 184,2021,Pages 226-233,ISSN 1877-0509*

[6] K.lakshmi Sudha, Shirish Shinde,Titus Thomas and Aris Abdugani. Barcode based Student Attendence System.*International Journal of Computer Applications 119(2):1-5, June 2015*

[7] Mehendale, Ninad and Mehendale, Ninad, object Detection using ESP32 CAM (July 2, 2022).*https://ssrn.com/abstract=4152378*

[8] J. Wen, J. Liu, F. Xu, X. Duan and J. Huang, "Face recognition system design based on ESP32," *2022 International Seminar on Computer Science and Engineering Technology (SCSET)*, Indianapolis, IN, USA, 2022, pp. 114-116, doi: 10.1109/SCSET55041.2022.00034.

[9] S. A. M. Noor, N. Zaini, M. F. A. Latip and N. Hamzah, "Android-based attendance management system," *2015 IEEE Conference on Systems, Process and Control (ICSPC)*, Bandar Sunway, Malaysia, 2015, pp. 118-122, doi: 10.1109/SPC.2015.7473570.

[10]A. AlSideiri *et al.*, "Users Acceptance Online Attendance Application Using Barcode Scanner: The Case Study in al Buraimi University College (BUC) Students," *2022 ASU International Conference in Emerging Technologies for Sustainability and Intelligent Systems (ICETSIS)*, Manama, Bahrain, 2022, pp. 23-28, doi: 10.1109/ICETSIS55481.2022.9888852

[11]A. Nuhi, A. Memeti, F. Imeri and B. Cico, "Smart Attendance System using QR Code," 2020 9th Mediterranean Conference on Embedded Computing (MECO), Budva, Montenegro, 2020, pp. 1-4, doi: 10.1109/MECO49872.2020.9134225.

[12]Huo, Lina, Zhu, Jianxing, Singh, Pradeep Kumar and Pavlovich, Pljonkin Anton. "Research on QR image code recognition system based on artificial intelligence algorithm" *Journal of Intelligent Systems*, vol. 30, no. 1, 2021, pp. 855-867.

[13]Al Sheikh, Rahmah and Al-Assami, Raghad and Al-Bahar, Mariam and Al Suhaibani, Muntaha and Alsmadi, Mutasem and Alshabanah, Muneerah and Alrajhi, Daniah and Almarashdeh, Ibrahim and Alsmadi, Sanaa and Abouelmagd, Hayam and Tayfour, Mohammed Fahed, Developing and Implementing a Barcode Based Student Attendance System (January 1, 2019). *International Research Journal of Engineering and Technology (IRJET)* Volume: 06 Issue: 1 | Jan 2019

[14]G. Singh and A. K. Goel, "Face Detection and Recognition System using Digital Image Processing," 2020 *2nd International Conference on Innovative Mechanisms for Industry Applications (ICIMIA), Bangalore, India,* 2020, pp. 348-352, doi: 10.1109/ICIMIA48430.2020.9074838.

[15]M. Khan, S. Chakraborty, R. Astya and S. Khepra, "Face Detection and Recognition Using OpenCV," 2019 International Conference on Computing, Communication, and Intelligent Systems (ICCCIS), Greater Noida, India, 2019, pp. 116-119, doi: 10.1109/ICCCIS48478.2019.8974493.