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ACCESS CONTROL SYSTEM USING BARCODE AND FACIAL RECOGNITION

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Abstract: Access control systems play a vital role in safeguarding physical spaces and ensuring the security of sensitive areas. Traditional methods, such as ID cards or keycards, have limitations in terms of security and user convenience. To address these limitations, an access control system utilizing barcode and facial recognition technologies has emerged as an effective solution. This abstract highlights the key features and benefits of an access control system that combines barcode scanning and facial recognition. By integrating these technologies, the system enhances security, accuracy, and user experience. The system utilizes high-quality barcode scanners capable of reading various barcode formats, enabling the quick and reliable authentication of ID cards or badges. Barcode recognition algorithms validate the authenticity of the barcode information against stored records, ensuring only authorized individuals gain access. In parallel, the system employs advanced facial recognition algorithms to capture and analyze facial features. By comparing the extracted facial features with pre-registered records, the system verifies the identity of individuals, providing an additional layer of security. The access control system offers several advantages. It enhances security by combining two-factor authentication through barcode scanning and facial recognition, reducing the risk of unauthorized access or identity fraud. The integration of these technologies strengthens access control measures and ensures the physical presence of authorized individuals. Furthermore, the system improves user experience and convenience. Users can simply present their ID cards or badges to the barcode scanner and undergo a quick facial recognition process, eliminating the need for manual input of codes or passwords. This streamlined approach enhances efficiency, reduces queues, and enhances user satisfaction. The access control system also provides auditability and accountability. Detailed access logs and reporting capabilities enable administrators to track access events, monitor user activities, and generate reports for security analysis, compliance, and incident investigations.

Keywords: Facial Recognition, Barcode Detection, Access Control System

I. INTRODUCTION

Access control systems are critical for ensuring the security and integrity of physical spaces, such as buildings, offices, or restricted areas. Traditional access control methods, such as ID cards, keycards, or PIN codes, have limitations in terms of security and user experience. To address these limitations, access control systems have evolved to incorporate advanced technologies like barcode scanning and facial recognition. An access control system using barcode and facial recognition combines the benefits of both technologies to enhance security, accuracy, and convenience. It offers a multi-factor authentication approach that strengthens access control measures and mitigates the risks of unauthorized access or identity fraud. Barcode scanning is a widely used technology that enables quick and reliable identification. By scanning barcodes on ID cards or badges, the system can validate the authenticity of the barcode information, ensuring that only authorized individuals gain access. Barcodes can contain unique identifiers linked to user profiles, access permissions, or other relevant data stored in a database.

Facial recognition, on the other hand, leverages biometric characteristics to verify an individual's identity. By capturing and analyzing facial features, such as the shape of the face, the position of facial landmarks, or unique patterns, the system can match the captured image with pre-registered records. Facial recognition adds an additional layer of security by verifying the physical presence of the authorized individual. The integration of barcode and facial recognition technologies in an access control system offers numerous advantages. It provides a robust and reliable means of identity verification, reducing the risk of unauthorized access, identity theft, or sharing of access credentials. The combination of two-factor authentication through barcode scanning and facial recognition enhances the overall security posture of the system. Moreover, an access control system using barcode and facial recognition offers improved user experience and convenience. Users can simply present their ID cards or badges to the barcode scanner and undergo a quick facial recognition process, eliminating the need for manual input of codes or passwords. This streamlines the access process, reduces queues, and enhances the overall user satisfaction. Additionally, the system provides auditability and accountability through detailed access logs and reporting. It allows administrators to track access events, monitor user activities, and generate reports for security analysis, compliance, and incident investigations.

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II. LITERATURE SURVEY

In this paper [1], the authors investigate the use of automatic face detection to improve recognition accuracy. They use the ORL dataset for their experiments. This dataset is divided into two sections, with the first section used for learning purposes and the second section used for system evaluation. The authors extract vital information from the input images using PCA. They then experiment with using linear discriminant analysis, multilayer perceptron, naive Bayes, and support vector machine. These have achieved recognition accuracy of 97% on configuration B & 100% on configuration C by using PCA and Linear Discriminant Analysis. The authors plan to review other databases, such as the GTF and YALE datasets, in future research to find more face detection difficulties such as orientation variation, lighting, poses, and facial expression variations. They also plan to apply and test other face-detection techniques to improve this research.

The "Face Recognition using DNN with LivenessNet" [2] presents a face recognition method based on deep neural networks for liveness. This technique is considered to be efficient because it is robust and accurate. It provides accurate results with face spoofing quickly and efficiently. The main advantage of using this technique is that it can identify uniqueness in datasets by capturing real-time face data through different modes and jitter. This technique can be used for safety and security purposes because it provides an accurate face recognition model.

The process of authenticating a face [3], is divided into two phases. In the first phase, the face is quickly detected, except in cases where the object is far away. In the second phase, the face is recognized as an individual. This process is then repeated to help develop a face recognition model. There are two main techniques used in face recognition: the Eigenface method and the Fisherface method. The Eigenface method uses Principal Component Analysis (PCA) to reduce the dimensionality of the facial features. The focus of this paper is to use digital image processing to develop a face recognition system. The limitations of the face recognition system designed in the study. The system did not have an accuracy of more than 90% for both manual and automatic face recognition.

Haiqiang Shao (2020) [4] reported in 'Facial Expression Recognition Based on Local Features of Transfer Learning' that the Inception-v3 model consists of 46 layers of networks with a total of 11 Inception modules. The learning rate of model training parameters was set as 0.1, the number of iterations was 50,000, and the branch size was 100. Facial expression plays a very important role in People's Daily communication. Kotsia used Gabor filters with different scales and directions to convolve with images to extract facial expression features. This method has good recognition of the blocked facial expression, but it still fails to meet the needs of today's society. This paper proposes a human eye facial expression recognition model based on transfer learning. 123 adults were included in the research. However, "Inception-v3 network architecture after migration learning still performs well in facial expression recognition based on the eyes, with an accuracy of 98.2% in the test set," note the investigators.

Z. B. Lahaw et al. [4] introduced a method for face recognition. The suggested work uses linear discriminant analysis, independent component analysis, and principal component analysis, and supports vector machine algorithms. The experiment is carried out on AT & T Database. This database comprises 400 face pictures of 40 subjects, every one of which has 10 pictures taken at various stages and with different stances and circumstances of subjects wearing shades. These pictures are grayscale with measurement (112×92). The authors achieved recognition accuracy of 96 % by implementing a hybrid method depending on the Discrete Wavelet Transform (DWT) and principal component analysis (PCA) or linear discriminant analysis(LDA) method for reducing dimension and a support vector machine is used for the classification of faces.

N. Sabri et al. [5] present work to compare four different machine learning algorithms Multi Linear Perceptron (MLP), Naive Bayes and Support Vector Machine (SVM) classifiers to classify the human face using distance measurements of face geometry. The outcome of all the experiments reveals that The Naive Bayes eliminates the MLP and SVM classification with the utmost precision. This is attributable to a comprehensive process of SVM and MLP systems. Findings show that Naive Bayes achieved a high precision of 93.16 per cent.

Face discovery is a significant segment of any facial recognition model as a starting advance to discover faces. A. Adouani et al. [6] Present a systematic review of three widely used face detection approaches, namely Oriented Gradient Histogram, hair-like cascade Oriented Gradient Histogram with Linear Binary Pattern cascade and Support Vector Machine. The recommended methods have been developed utilizing Dlib and OpenCV libraries in Python language. The result shows that the HOG+SVM approach is more robust and efficient than LBP and haar approaches with a 92.68 per cent total recognition score.

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J. Fan et al. [7] discuss the multiple, manifold training graph-based method of face recognition. The approach suggested is known as Enhanced Adaptive Locality Preserving Projections (EALPP). Two methods have been incorporated into EALPP: Maximum Margin Criterion (MMC) and Locality Preserving Projections (LPP). The experiment is performed on four different face datasets (YALE, ORL, UMIST, and AR). Pre-processing was performed during the tests to determine the face between all four database objects. All objects are matched in size, and alignment and the two eyes are in the same place.

III. METHODOLOGY

The system architecture for an access control system using barcode and facial recognition can be designed using a layered approach. Here's a high-level system architecture that illustrates the main components and their interactions:

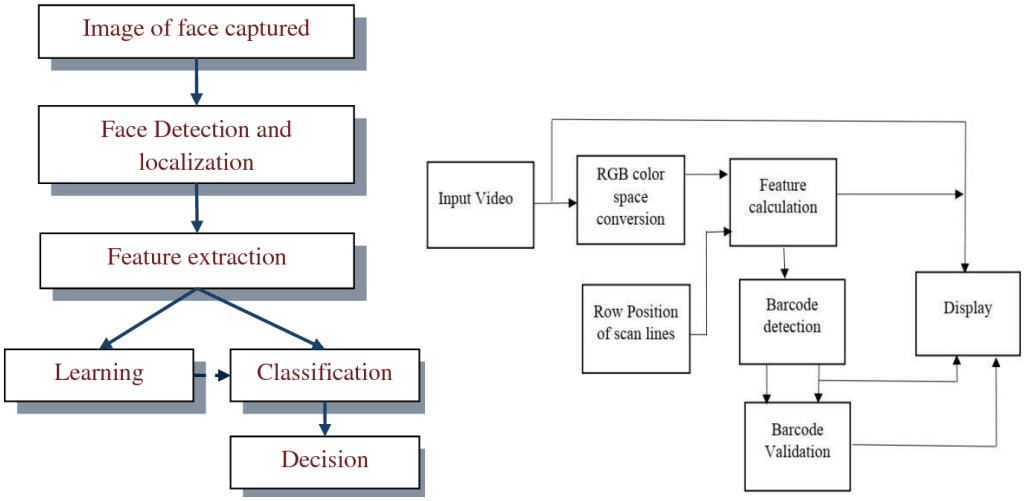

Fig. 1 Methodology

- User Interface Layer:
  - User Enrolment Interface: Allows administrators to capture user information, including facial images, and associate them with unique barcode identifiers.
  - User Authentication Interface: Provides a user-friendly interface for individuals to present their barcodes and undergo facial recognition for authentication.

- Barcode Scanning Layer:
  - Barcode Scanner: Hardware component responsible for scanning and decoding barcodes presented by users.
  - Barcode Decoder: Software component that interprets the scanned barcode data and extracts the relevant information.

- Facial Recognition Layer:
  - Facial Image Capture: Hardware component, such as cameras or sensors, for capturing facial images during the authentication process.
  - Facial Recognition Algorithm: Software component that analyzes the captured facial images, performs facial feature extraction, and matches them against enrolled user data to verify identities.

- Access Control Layer:
  - Access Control Decision Engine: Core logic that determines whether access should be granted or denied based on the results of barcode scanning and facial recognition. It takes into account user permissions, access rules, and authentication outcomes.
  - Access Control Gates/Doors: Physical devices that control access to secured areas or resources based on instructions from the access control decision engine.

- Database Layer:
  - User Database: Stores user information, including barcode data, facial templates, and access permissions.

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- Audit Log Database: Records access events, including successful and unsuccessful authentication attempts, for auditing and reporting purposes.

- Integration Layer:
- Hardware Integration: Handles integration with external hardware devices such as barcode scanners, cameras, access control gates/doors, and other relevant systems.
- System Integration: Integrates with other systems or databases, such as HR databases or visitor management systems, to synchronize user data and access permissions.

IV. CONCLUSION

In conclusion, an access control system that combines barcode and facial recognition technology offers an effective and robust solution for controlling access to secure areas or resources. By leveraging both barcode scanning and facial recognition algorithms, such a system provides an additional layer of security and enhances the accuracy of user identification. The integration of barcode scanning enables quick and efficient verification of users through their unique barcode data. It allows for easy enrollment and authentication of individuals, making it suitable for scenarios where users possess barcode-enabled credentials such as ID cards or tickets. Barcode integration provides a reliable and standardized method of identification, minimizing the chances of false positives or false negatives.

Facial recognition technology adds an extra level of security by analyzing and matching facial features captured by cameras. It enables real-time identification of individuals based on their facial characteristics, regardless of whether they possess a physical barcode. Facial recognition enhances the system's capability to detect and prevent unauthorized access attempts or identity fraud, as it is difficult to forge or duplicate someone's facial features. The combination of barcode and facial recognition technologies in an access control system offers versatility and flexibility. Users can choose to authenticate themselves either by presenting their barcode or through facial recognition, depending on their preference or the level of security required for specific access points. This flexibility accommodates various user scenarios and ensures a user-friendly experience.

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