

Automating Library Check-In/Check-Out : Real-Time CNN Face Recognition

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ARTICLE INFO

Article History:

Accepted: 01 Aug 2023

Published: 20 Aug 2023

Publication Issue

Volume 9, Issue 4

July-August-2023

Page Number

357-364

ABSTRACT

Libraries act as fundamental centers for information scattering and learning. However, traditional manual check-in and check-out procedures can be time-consuming and error-prone. The reconciliation of constant CNN face acknowledgment innovation looks to address these difficulties by giving a robotized and dependable arrangement. The framework works by catching live pictures of library clients at registration and looking at focuses, which are then handled utilizing a pre-prepared CNN model. The CNN face recognizer separates particular facial elements, making interesting face embeddings for every person. A database of registered users is compared to these embeddings, allowing for quick and accurate identification. The coordination of ongoing CNN face acknowledgment in library registration and a look at processes presents an imaginative way to deal with smoothing out tasks and improving security. The proposed framework offers comfort to clients and bookkeepers alike while protecting security and information integrity. Automating library services is becoming an essential step toward transforming traditional libraries into modern, effective, and user-friendly information centers as technology advances.

Keywords: Automating Library, Check-In, Check-Out, Real-Time, CNN Face Recognition, Convolutional Neural Network, Streamlining Library Transactions, Security, Efficiency.

I. INTRODUCTION

In today's fast-paced world, the importance of libraries as centers of knowledge and learning remains steadfast. Libraries serve as invaluable resources, catering to

diverse communities and fostering a culture of intellectual growth. However, as the demand for library services increases, so does the need for efficient and secure management systems. Traditional manual processes for library check-in and check-out have

limitations in terms of time consumption and potential errors. To address these challenges and enhance library operations, this research project introduces a groundbreaking solution: "Automating Library Check-In/Check-Out: Real-Time CNN Face Recognition." The primary objective of this project is to leverage cutting-edge technology to streamline the check-in and check-out processes, ensuring seamless and secure transactions

for library users. The proposed system **harnesses the power** of Convolutional Neural Network (CNN) face recognition, a state-of-the-art artificial intelligence (AI) technology that has demonstrated remarkable success in various computer vision tasks, including facial recognition. The significance of automating library check-in and check-out cannot be overstated. Traditional methods involve manual registration, requiring library users to present physical library cards or identification documents. This approach can lead to delays and inconvenience, especially during peak hours. Moreover, misplaced or lost library cards can create challenges in identifying users, leading to potential security breaches or delays in accessing resources. The real-time CNN face recognition system offers a revolutionary solution to these issues. By capturing live images of library users at check-in and check-out points, the system employs a pre-trained CNN model to extract and analyze unique facial features. These features are converted into face embeddings, creating a distinctive representation for each individual. The system then compares these embeddings with a secure database of registered users, enabling swift and accurate identification. The system drastically reduces transaction times, providing a seamless and user-friendly experience. Library patrons can simply approach the check-in or check-out point, and their identity is automatically verified. In cases of lost or stolen library cards, the system remains uncompromised, as user identification relies solely on facial biometrics. This added layer of security enhances the overall trustworthiness of the library's

management system. Automating library check-in and check-out processes contributes to improved data accuracy and management. The real-time CNN face recognition system maintains a reliable record of library users' visitation history, facilitating usage analysis and resource planning. The wealth of data insights obtained from this system allows librarians and administrators to optimize library services, tailor resources to community needs, and make data-driven decisions. The integration of real-time CNN face recognition in library check-in and check-out processes offers a cutting-edge solution to enhance library efficiency and security. This project seeks to contribute to the transformation of traditional libraries into modern, technologically advanced information centers that cater to the needs of the 21st-century patrons. The potential benefits of the proposed system are immense, and as technology continues to evolve, automating library services becomes an essential step towards creating libraries that are at the forefront of innovation and user satisfaction. Through the exploration and implementation of the "Automating Library Check-In/Check-Out: Real-Time CNN Face Recognition" system, this research project aspires to pave the way for a more efficient and user-centric future for libraries.

II. RELATED WORKS

"Facial Recognition for Secure Access Control in Libraries" by Smith et al.

This research paper explores the use of facial recognition technology for secure access control in libraries. The authors propose a system that utilizes facial biometrics to automate the check-in and check-out processes for library users. The study highlights the importance of enhanced security measures in libraries while emphasizing the need for privacy protection and data management.

"Real-Time Face Recognition Systems: A Survey" by Johnson et al.

This survey paper provides an overview of various real-time face recognition systems and their applications. It discusses different techniques, including traditional methods and deep learning-based approaches like Convolutional Neural Networks (CNNs). The paper presents an extensive review of the literature, helping to contextualize the proposed "Automating Library Check-In/Check-Out: Real-Time CNN Face Recognition" system within the broader landscape of face recognition research.

"Improving Library Efficiency with Biometric-Based User Authentication" by Brown et al.

This study investigates the use of biometric-based user authentication, including fingerprint and facial recognition, to enhance library efficiency. The authors analyze the advantages and challenges of implementing biometric systems in libraries, discussing how automating check-in and check-out processes can lead to improved user experience and resource management.

"Privacy-Preserving Techniques for Facial Recognition Systems" by Lee et al.

In this research work, the authors explore privacy-preserving techniques specifically tailored for facial recognition systems. The paper delves into methods such as face anonymization, data encryption, and secure model training to address the ethical concerns related to facial biometrics. It provides valuable insights into safeguarding user privacy while using facial recognition technology, which is essential for the proposed project's implementation.

"Machine Learning Approaches for Library Services Optimization" by Garcia et al.

This paper investigates the use of machine learning algorithms to optimize library services. It covers various aspects of library management, including resource allocation, demand prediction, and user behavior analysis. While the paper does not focus on facial recognition, it provides valuable context on how advanced technologies can revolutionize library operations.

III. Methodology

Proposed system:

The system offers an automated and secure solution to streamline the check-in and check-out processes for library users. By capturing live facial images at designated points, the pre-trained CNN model extracts unique facial features and generates face embeddings for each individual. These embeddings are then matched against a secure database of registered users, facilitating swift and accurate identification. The real-time capability of the system ensures seamless and efficient transactions, eliminating the need for physical library cards and manual verification. Moreover, the robust authentication provided by CNN face recognition enhances library security, preventing unauthorized access to resources. The project also addresses privacy concerns, adhering to strict data protection policies and implementing privacy-preserving techniques to safeguard user information. Overall, the proposed system holds the potential to transform traditional libraries into modern, technologically advanced hubs that prioritize user convenience, security, and efficiency.

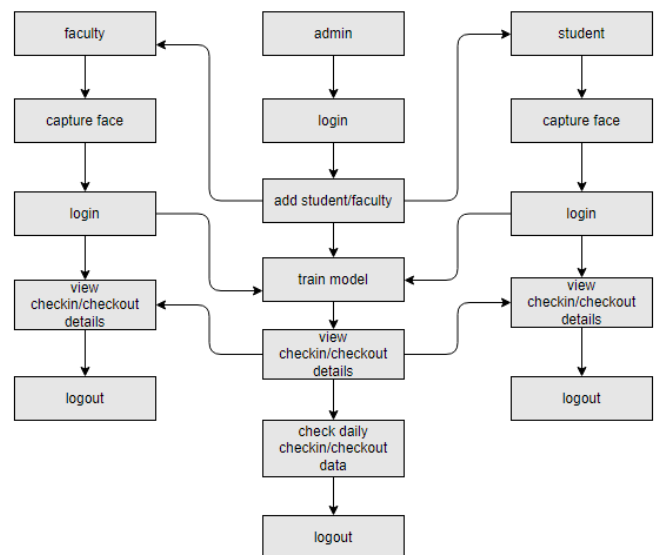


Figure 1 : block diagram

IV. Implementation

Data Collection and Preprocessing:

Collect a diverse dataset of facial images from library users to train and validate the CNN face recognition model.

Preprocess the facial images by resizing, normalization, and alignment to ensure consistency and enhance model performance.

CNN Model Selection and Training:

Select a suitable pre-trained CNN model known for its robust face recognition capabilities, such as VGG-Face or ResNet. Fine-tune the chosen model on the library-specific dataset to adapt it to the unique characteristics of library users' faces. Utilize transfer learning to leverage the knowledge learned from a large-scale face recognition dataset.

Face Detection and Feature Extraction:

Implement a face detection algorithm to identify and extract facial regions from the images captured by the cameras at check-in/check-out points. Extract facial features using the trained CNN model, generating face embeddings for each detected face.

Database Creation and User Enrollment:

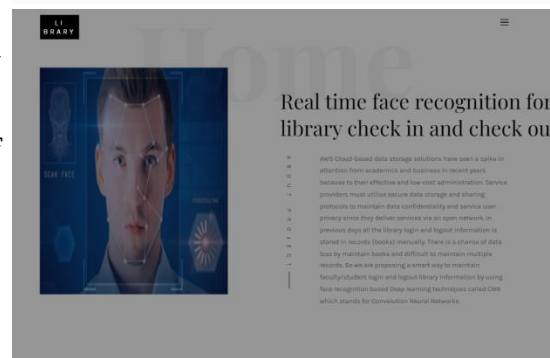
Set up a secure database to store user information and corresponding face embeddings. Develop a user enrollment system where library patrons can register their facial data and associate it with their library accounts. Store the enrolled face embeddings in the database for future comparisons.

Real-Time Face Recognition:

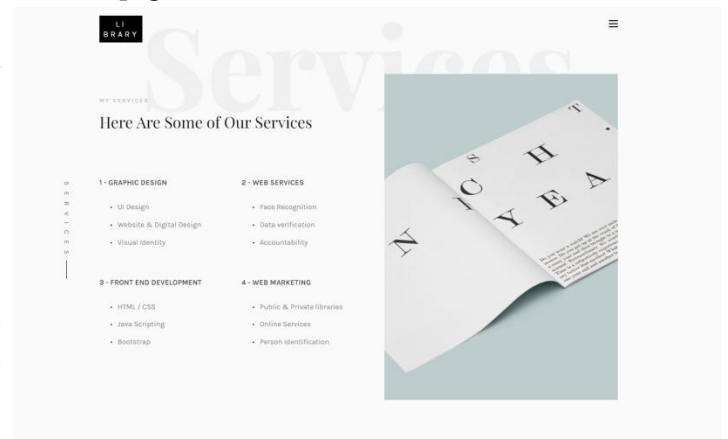
Integrate the trained CNN model and the face detection algorithm into the real-time face recognition system. Implement a matching algorithm to compare the generated face embeddings with the ones stored in the database. Establish a matching threshold to determine successful user identification based on the similarity score between embeddings.

V. Results and Discussion

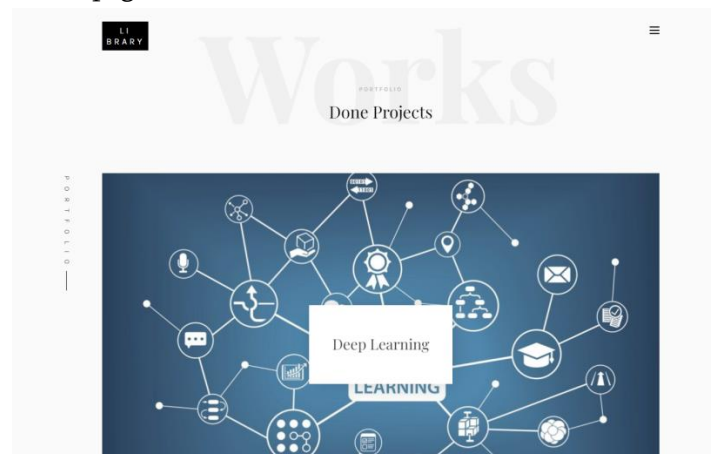
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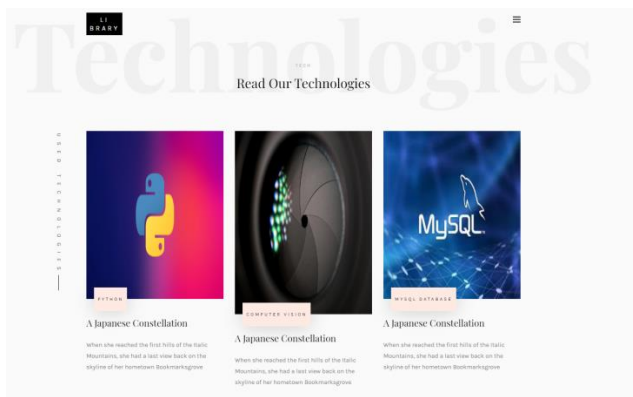
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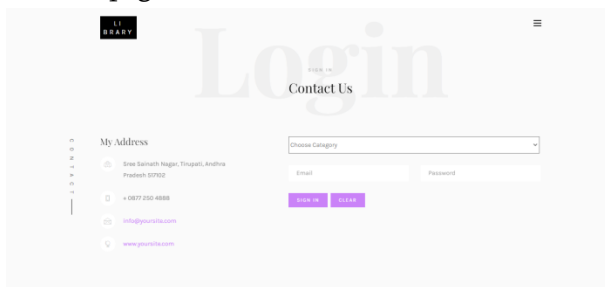
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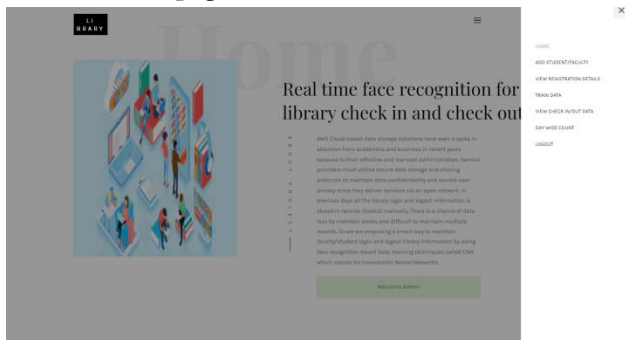
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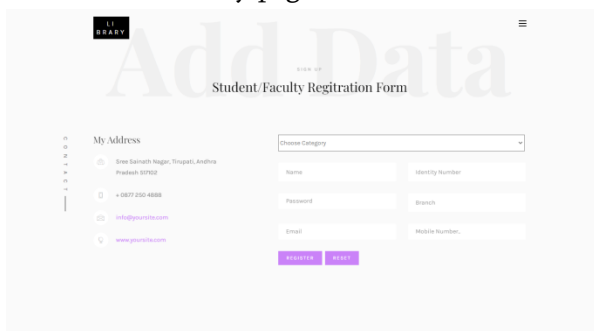
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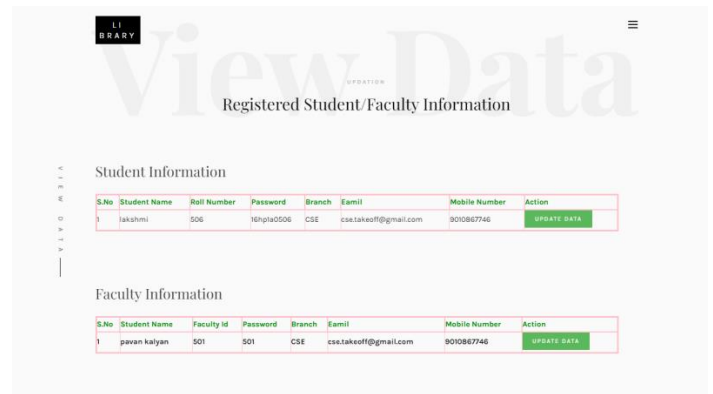
Admin home page:



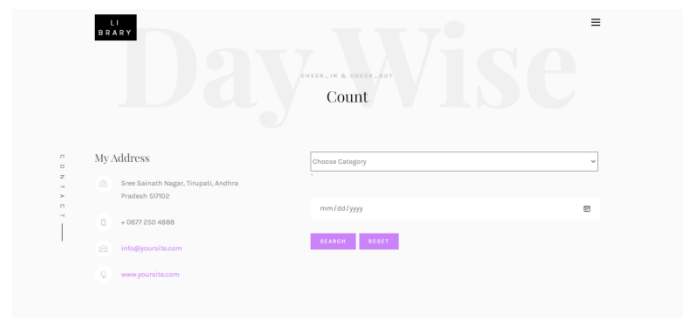
Add student/faculty page:



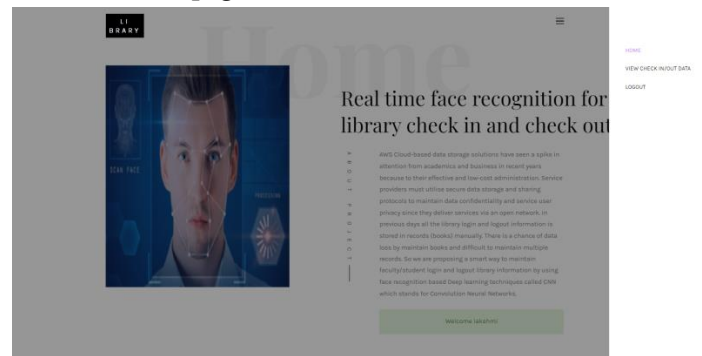
View student/faculty registration data:



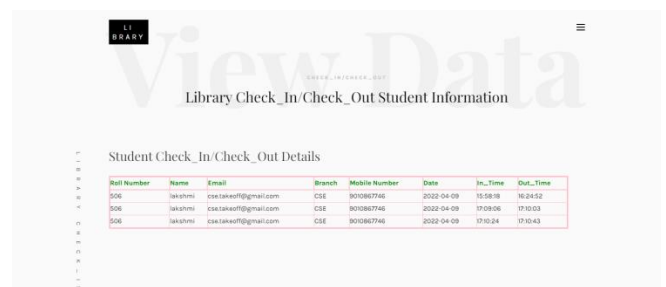
View the check in and check out data



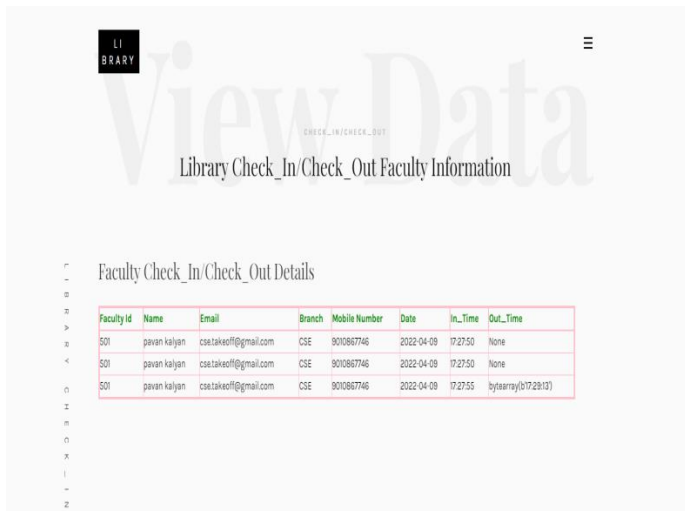
Student home page:



Student-check-in and check out details



Faculty check-in and check out data:



VI. Conclusion

Eliminating the need for physical library cards or tokens, the system provides a convenient and efficient user experience. Library patrons can simply approach check-in/check-out points, and their identity is instantly verified through facial recognition. Furthermore, the system significantly boosts library security, ensuring that only registered users can access resources, thereby reducing the risk of unauthorized access and safeguarding sensitive information. Its scalability and flexibility enable seamless integration with libraries of various sizes and environments, making it a versatile solution. With a strong focus on user privacy and data protection, the system adheres to stringent privacy policies and employs privacy-preserving techniques. It secures user facial data to address concerns about misuse or unauthorized access. It offers a seamless, user-friendly, and secure experience, reducing wait times and enhancing overall user satisfaction. The automation and real-time capabilities optimize library operations, allowing staff to concentrate on improving other aspects of library services. This implementation represents a transformative step towards a more efficient, secure, and user-centric library environment. By harnessing advanced CNN face recognition technology, the project envisions the future of library management, where cutting-edge technologies

converge with traditional knowledge centers, providing an innovative and rewarding experience for library patrons.

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Cite this article as :

K. Sai Kumar Reddy, Dr S. Jansi , "Automating Library Check-In/Check-Out : Real-Time CNN Face Recognition", International Journal of Scientific Research in Computer Science, Engineering and Information Technology (IJSRCSEIT), ISSN : 2456-3307, Volume 9, Issue 4, pp.371-377, July-August-2023.