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Original Article

Uniform Detection Using Deep Learning

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Abstract

Uniform Detection Using Deep Learning applies computer vision techniques to identify and classify uniforms like identification cards through CNNs. ID cards are important for the proper identification of persons in any organization, making it easier and fast to determine their association with the institution. This paper focuses on detecting and authenticating individuals along with their respective ID cards. By determining whether a person is wearing their assigned ID card, the system ensures that only authorized individuals gain access to the institution's premises. It also verifies the individual's affiliation, enhancing security and minimizing the risk of unauthorized entry. Besides security, the system includes an attendance tracking feature, allowing educational institutions to manage and monitor attendance records efficiently. The automation of this process reduces manual intervention, eliminates errors, and improves operational efficiency. The real-time detection and authentication capabilities make the system an invaluable tool for environments where ID cards are mandatory. This solution improves security while making everyday business processes much easier. Future expansion may include sophisticated tracking features and interfaces with other security systems, which makes it a complete tool for efficient and secure management.

Introduction

Identity cards (ID cards) are vital tools for verifying individuals' identities in workplaces, educational institutions, and other organized environments. They typically contain essential details such as name, photograph, and date of birth, making them a quick and reliable means of identification. While ID cards are crucial for security and attendance purposes, manual verification processes are often time-consuming and prone to errors. To address these challenges, advancements in computer vision have enabled the development of automated systems for ID card detection and attendance management. This paper leverages tools like OpenCV, YOLO, and DeepFace to create an intelligent system that detects ID cards, verifies their ownership, and marks attendance automatically. The system begins by detecting an individual's face using computer vision techniques and matches it against the photograph on their ID card. If a match is found, attendance is recorded in real-time. If no ID card is detected or the face does not match, the system flags the issue and notifies administrators. The solution automates ID card detection by identifying rectangular shapes typical of ID cards and analyzing their contents. It uses advanced techniques like feature matching and deep learning to ensure accuracy, even under varying conditions like different lighting or angles. By automating these processes, the system improves accuracy, saves time, and ensures compliance with institutional policies. It also enhances security by flagging violations, such as missing or mismatched ID cards, and providing evidence for further action. This innovative approach is particularly beneficial for educational institutions, workplaces, and exam centers, where identity verification and attendance tracking are critical. By streamlining operations and reducing manual intervention, the system enhances efficiency, security, and overall operational effectiveness.

Methodology

This paper brings together state-of-the-art technologies and tools to create an efficient and seamless solution for attendance management and monitoring. At the core of this is YOLOv8 (You Only Look Once), a highly advanced object detection model that ensures real-time identification of whether a user is wearing their ID card. Real-time capability enhances accuracy and responsiveness, making the system practical for everyday use. The Deep Face library is employed in this system. Deep Face is a strong facial recognition library that

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makes it possible to accurately match and compare faces with an error percentage while verifying and validating ID cards. Open CV is a critical tool in picture capture and processing. It simplifies interactions with the camera, thus allowing the system to work in real-time and carry out high-quality image processing. In such a manner, it ascertains that all visible data is captured and analysed. The attendance records are managed using Pandas, a powerful data analysis library. By using Pandas, the system can dynamically track attendance, update records daily, and store them in an Excel-based format. This ensures that attendance data is not only accurate but also easy to access and manage. To address cases of non-compliance for example, in case a person fails to wear his identification card the system uses EmailMessage module. Through this module the system automates the alerting of an administrator as it sends notification emails. These emails contained image evidence, that clearly documented a case, and ensured liability. Together, they make up a robust, automated, and user-friendly system that can simplify attendance tracking while having the ability to address violations effectively. This integration of advanced technologies ensures that there is not only enhanced operational efficiency but also reliability in theexperience of users and administrators.

Modelling and Analysis

To train the system well, we use pictures of students and their ID cards in a process that teaches the machine to identify whether the student is wearing an ID card and confirm if the ID card belongs to them. At the enrollment stage, there is a dedicated dataset that consists of:

- IMAGES OF STUDENTS: Captured during enrollment to make it clear to establish reference facial recognition.
- IMAGES OF ID CARDS: Stored along with student images to verify the identity and ensure that the system can correctly map each ID card to its owner.

Another dataset is prepared specifically for training the YOLO model. This dataset includes:

- IMAGES OF STUDENTS WEARING ID CARDS: To help the system recognize proper ID card usage.
- IMAGES OF STUDENTS NOT WEARING ID CARDS: To train the model to detect instances of non-compliance.
- IMAGE ID CARD IMAGES : Refine model in detection independent ID card images.

Comprehensive Training: Ensures that it can actually differentiate and notify whether an individual has ID cards and verifies its owner. The Model shall be used at the entry points in the organization such that access would be granted to the only the individual carrying their own ID cards. Thus, access can be guaranteed and shall remain restricted only to those employees who should access them.

Enrollment

The system begins by gathering basic personal information like name, roll number, photograph, and ID card images during a one-time registration process.

This data is stored securely in the database to serve as a reference for future verification.

Image Capture

At the time of arrival of a person in the institution, a camera captures his live image along with a clear view of his ID card. These live images are verified real-time against the stored database.

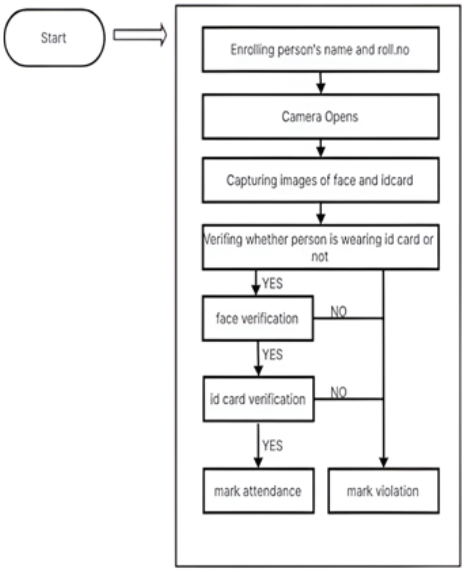


Figure 1. *Architecture*

Figure 2. *Saving the face*

Figure 3. *Saving the ID Card*

Verification

ID Card Detection:

The system analyses the live images to identify whether the individual is carrying an ID card. In case no ID card is found, the violation is raised.

Face Matching:

The system cross-checks the live image of the individual's faceagainst his or her pre-stored image in the database for identity verification.

ID Card Matching:

It verifies if the live image of the ID card matches the pre-stored ID card image in the database, so the card is of the person.

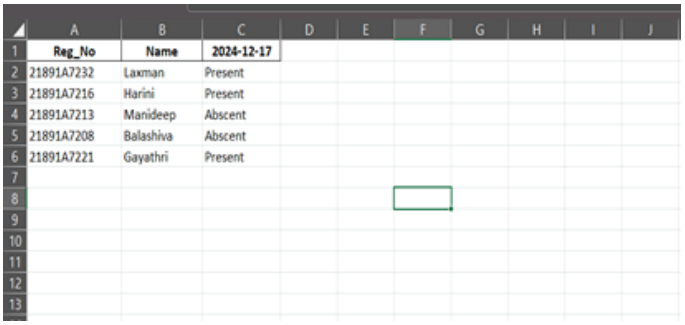
Figure 4. *Detection of the person with his own ID Card*

Attendance Recording

If all the verification checks are successful (ID card detected, face matched, and ID card matched), then the system automatically records the attendance of the person for the day. This avoids the manual tracking of attendance and ensures accuracy

Violation Handling

If any verification step does not comply (For example: missing ID card, face mismatch, or ID card mismatch), the system marks the event as a violation. The system captured and stored the image of the individual in the database to analyze later.



	A	B	C
1	Reg_No	Name	2024-12-17
2	21891A7232	Laxman	Present
3	21891A7216	Harini	Present
4	21891A7213	Manideep	Abscent
5	21891A7208	Balashiva	Abscent
6	21891A7221	Gayathri	Present

Figure 5. *Marking Attendance of person wearing the ID Card*

Figure 6. *Violation/No ID Card detected*

Admin Notification

Automatically, the Email is sent to the Administrator in case of a violation. The email contains the captured images of the individual with a request to verify the identity manually. It prevents that the situation is dealt promptly and appropriately. This sequential process ensures security, exact attendance, and efficient administration of exceptions.

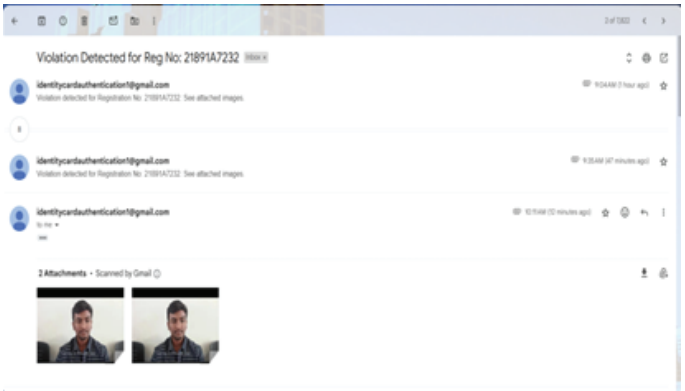


Figure 7. *Sending mail to admin to approve the person's identity*

Conclusion

Identification cards are the most important tools in corporate and institutional environments. They simplify the identification of students, staff, and visitors and enhance security and organizational integrity. This system utilizes the latest technology in determining whether a person is wearing their ID card. It makes use of the powerful object detection tool known as TensorFlow, which detects and recognizes people and their

ID cards in real time. To achieve this, the system is trained with images of people both wearing and not wearing ID cards. It also uses pre-stored images to compare live captures, ensuring accurate verification. When a match is found between the live images and the stored data, the system confirms the identity and provides the results instantly. This has the benefits of increased security and even attendance, making sure only authorized persons access the facilities.

Future scope

The future scope of the paper "Uniform Detection Using Deep Learning" includes the following enhancements and expansions:

1. Integration with Advanced Technologies

AI-Powered Insights: Integrate with AI systems to analyze attendance patterns, predict absence trends, and generate insightful reports for management. Edge Computing: Deploy the system on edge devices for faster processing and real-time decision-making without dependency on centralized servers.

2. Biometric and Multi-Factor Authentication

Add biometric verification in the shape of facial recognition and fingerprint scanning to enhance safety and accuracy of identification. Apply multi-factor authentication where ID card detection is together with other security devices.

3. Scalability Across Domains

Use the system in various domains, including health departments, government offices, airport, and retail stores by streamlining access control procedures. Customize to specialized needs, such as; detection of uniforms or badges for different organizations.

4. State-of-the-Art Safety Measures

Real-time Alerts: Alert the authorities immediately regarding unauthorized entries or absence of ID cards. Violation Recording: Record all violations safely for auditing and investigation.

5. User-Friendly Features

Mobile App Compatibility: Have companion apps for tracking attendance, alert provision, and user profile management. Multilingual Support: Supports multiple languages that can serve different user groups.

6. IoT and Smart Systems Integration

Connect with other IoT devices, for example, smart gates and cameras to integrate automatically at entry and exit points. Connect to facility management systems to have real-time dynamic control of restricted access.

7. Data Analytics and Reporting

Leverage the data gathered to predict analytics and optimize the functioning of operations like the time when most users access a service so as to use available resources accordingly. Provide dashboards with real-time view to management.

8. Privacy and Ethical Improvements

Implement privacy-preserving features such as secure data encryption along with anonymization techniques. Establish policies for usage and retention of data and individual consent.

9. Ready for Remote and Hybrid working

Provide virtual ID-based verification for remote workers/ remote meeting participants. Virtual collaboration tool integration with employee attendance tracking.

10. Extended Attendance Management

An option to mark attendance in groups in the extended version should be supported. So, the system would check IDs of multiple attendants in a classroom scenario or office scenario. Support flexible scheduling and automatic updates in case of shifts or class rosters. By doing all these future directions the paper can grow into comprehensive and widely applicable solution in the field of secure identity management and operational efficiency.

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