

A
Software Requirements Specifications
on

**Advancements in Attendance Management:
Integrating Face Recognition and Location
Tracking via QR Code generation.**

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Specification Report on Advancements in Attendance Management: Integrating Face Recognition and Location Tracking via QR Code generation.

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1 Introduction

In the ever-evolving landscape of technological advancements, traditional methods of attendance management are being rapidly replaced by innovative solutions that streamline processes, enhance accuracy, and offer real-time insights. The integration of face recognition technology and location tracking through QR code automation represents a groundbreaking approach to attendance management. This project seeks to revolutionize how institutions, organizations, and businesses monitor attendance, leveraging cutting-edge technologies to overcome the limitations of manual systems. Face recognition has emerged as a groundbreaking technology in computer vision, revolutionizing various industries such as security, surveillance, and human-computer interaction. Python, with its rich ecosystem of libraries and tools, offers an ideal environment for developing robust and accurate face recognition systems. In this comprehensive guide, we will delve into the intricacies of face recognition in Python, covering the available packages, techniques to enhance accuracy, industry-standard methods, and a detailed implementation walkthrough. The advent of face

recognition technology has heralded a new era in identity verification and authentication. This technology has found widespread application in various domains, including security systems, access control, and now, attendance management. Similarly, QR codes have emerged as a versatile tool for location tracking and data collection. QR codes can store a wealth of information, including URLs, text, and geographical coordinates. By scanning QR codes using smartphones or dedicated scanners, users can quickly access information or perform actions, making QR codes an ideal solution for capturing attendance and location data. The primary objective of this project is to develop an automated attendance management system that seamlessly integrates face recognition technology and location tracking via QR code automation. To implement the automated attendance system integrating face recognition and QR code scanning in Python using object-oriented programming (OOP) principles, we'll break down the project into several classes representing different components of the system.

1.1 Face Recognition System:

The face recognition system will authenticate individuals based on unique facial features captured through cameras. Advanced algorithms like K-Nearest Neighbour (KNN) has been used to accurately identify and verify users in real-time. Facial recognition offers a non-intrusive and efficient method of attendance tracking, reducing the risk of errors and fraudulent activities. Central to our automated attendance system is the `FaceRecognitionSystem` class, a marvel of modern technology. This class harnesses the power of advanced facial recognition algorithms to authenticate users swiftly and accurately. By analyzing intricate facial features, it ensures fool-proof identification, paving the way for secure attendance tracking without the hassle of manual intervention.

1.2 QR Code:

Utilize Python libraries, such as `qrcode` and `OpenCV`, to generate unique QR codes for each location where attendance is required. Users will scan these QR codes using their smartphones or dedicated scanners upon arrival, triggering the recording of their attendance and location data. Complementing our facial recognition prowess is the `QRCodeGeneration` class, a testament to simplicity and convenience. This class empowers users with the ability to generate static QR codes tailored to each attendance location effortlessly. By encoding vital location-specific information, these QR codes serve as intuitive checkpoints, facilitating seamless attendance recording

with a mere scan. Seamlessly integrating with our QR code generation system is the QRCodeScanning class, a beacon of efficiency in attendance data capture. Employing cutting-edge scanning techniques, this class extracts and deciphers QR code data swiftly and accurately. Through its prowess in decoding, it transforms mundane scanning into a streamlined process, ensuring precise attendance recording at every turn.

1.3 Google Forms Integration:

Leverage the Google Forms to dynamically generate forms for data collection. Customize form fields to capture relevant information, such as user identification, timestamp, and location coordinates. Automate the submission of form data to the attendance tracking system for seamless integration and real-time updates. Our attendance system reaches new heights of versatility with the GoogleFormsIntegration class, a gateway to comprehensive data collection and analysis. Leveraging the robust Google Forms, this class automates the creation and submission of forms, providing a centralized hub for storing attendance records. With its seamless integration, it empowers administrators with valuable insights into attendance trends and patterns.

2 Presently Available System

2.1 Biometric Attendance Systems

2.1.1 Face Recognition

K-Nearest Neighbour (KNN) is an advanced machine learning algorithm used for classification and regression tasks. It operates on the principle of proximity, where it classifies data points based on the majority class among their nearest neighbors. The KNN algorithm serves as a robust and efficient method for user identification in the attendance management system, leveraging the similarity of facial features to classify individuals accurately. When an individual stands in front of a camera, the system captures their face and matches it against a database of enrolled faces to record attendance.

2.1.2 Fingerprint Recognition

Fingerprint attendance systems rely on capturing and analyzing the unique patterns found in an individual's fingerprints. A fingerprint scanner reads the ridges and

valleys of a person's fingerprint, converting it into a biometric template that is stored and used for future authentication.

2.2 Barcode/QR Code Scanners

In barcode or QR code attendance systems, each individual is provided with an ID card containing a barcode or QR code. When they need to mark their attendance, they present their card to a scanner, which reads the code and records the attendance information associated with it.

These systems are straightforward and cost-effective but may be prone to errors if the codes are damaged or if the scanning process is not properly executed.

2.3 Mobile Applications

Mobile attendance apps leverage the widespread use of smartphones to facilitate attendance tracking. Employees or students download the app onto their smartphones and use it to check in by scanning QR codes, using GPS location verification, or logging in to the app.

These apps offer flexibility and convenience, especially for remote workers or those on the move, but may require a reliable internet connection for real-time data syncing.

2.4 Cloud-based Attendance Systems

Cloud-based attendance systems store attendance data in remote servers accessible via the internet. They often offer a user-friendly interface for administrators to manage attendance records, generate reports, and monitor attendance trends.

These systems facilitate seamless integration with other HR or educational management software, enabling organizations to streamline their attendance management processes.

2.4.1 Manual system

Paper-based attendance sheets where individuals physically sign or mark their attendance. Attendance sheets or registers are physical documents where attendance data is recorded. They typically include columns for date, name or ID of individuals, and a space to mark attendance (e.g., with ticks or signatures). Each day, individuals are required to manually sign or mark their attendance to indicate their presence.

3 Need for Such a System

3.1 Drawbacks of Existing Systems

Certainly, while the mentioned attendance systems offer numerous benefits, they also come with certain drawbacks and challenges:

3.1.1 Biometric Attendance Systems

- **Privacy Concerns:** Biometric data, such as facial features, fingerprints, or iris patterns, are sensitive personal information. There may be concerns regarding the storage and potential misuse of this data, especially in light of privacy regulations like GDPR.
- **Cost:** Biometric systems often involve higher initial setup costs compared to other methods like RFID or barcode scanners. The hardware required for capturing and processing biometric data can be expensive.
- **Accuracy Issues:** While biometric systems are generally highly accurate, factors such as poor lighting conditions, facial obstructions, or changes in physical characteristics (e.g., injuries affecting fingerprints) can lead to false rejections or acceptances.
- **Cultural Sensitivity:** Certain cultural or religious beliefs may prohibit the use of biometric systems, particularly those involving facial recognition or fingerprint scanning.

3.1.2 Barcode/QR Code Scanners

- **Susceptibility to Damage:** Barcodes and QR codes can become unreadable due to damage or wear over time. If the codes on ID cards are not properly maintained, it can lead to errors in attendance tracking.
- **Dependency on Scanning Devices:** Attendance relies on the availability and proper functioning of scanning devices. If scanners malfunction or are unavailable, individuals may face difficulties in marking their attendance.

3.1.3 Mobile Applications

- **Reliance on Internet Connectivity:** Mobile attendance apps require a stable internet connection for real-time data syncing. In areas with poor con-

nectivity or during network outages, individuals may encounter difficulties in checking in.

- **Device Compatibility:** Not all employees or students may have smartphones compatible with the attendance app. This can create disparities in attendance tracking and may require alternative methods for those without compatible devices.

3.1.4 Cloud-based Attendance Systems

- **Data Security Risks:** Storing attendance data in the cloud poses security risks, including data breaches or unauthorized access. Organizations must implement robust security measures to protect sensitive attendance information.
- **Dependency on Internet Access:** Cloud-based systems rely on internet connectivity for access and data synchronization. Disruptions in internet service can hinder real-time attendance tracking and data retrieval.

3.1.5 Manual System

- **Time-consuming:** Manually recording attendance can be time-consuming, especially in large organizations or classrooms with many individuals. Teachers or administrators have to manually mark attendance for each individual, which can take up valuable time.
- **Prone to Errors:** Manual attendance systems are susceptible to human error. Teachers or administrators may accidentally mark individuals as present when they are absent or vice versa. Illegible handwriting or incorrect data entry can also lead to inaccuracies in attendance records.
- **Difficulty in Tracking Trends:** With manual systems, it can be challenging to track attendance trends over time. Analyzing attendance data for patterns or identifying trends requires manual effort and may not be as efficient or accurate as automated systems.
- **Lack of Real-time Data:** Manual attendance systems typically do not provide real-time attendance data. Teachers or administrators have to wait until attendance sheets are collected and processed before they can access attendance information, which may delay decision-making processes.

- **Limited Accountability:** Manual systems may lack accountability mechanisms. Without a reliable way to verify attendance, there's a risk of attendance fraud, such as students signing in for absent classmates or employees clocking in for absent colleagues.
- **Difficulty in Accessibility:** Accessing and managing attendance records in manual systems may be challenging, especially if attendance sheets are misplaced or damaged. Retrieving historical attendance data for audits or analysis purposes can be time-consuming and cumbersome.
- **Dependency on Paperwork:** Manual attendance systems rely on physical paperwork, such as attendance sheets or registers. Managing and storing paper records can be cumbersome and may require additional storage space. Moreover, there's a risk of loss or damage to paper records, leading to potential data loss.

3.2 Advantages of Face Recognition System

3.2.1 Accuracy

Face recognition technology provides high accuracy in identifying individuals. It relies on unique facial features, making it difficult for individuals to manipulate or spoof the system. This accuracy helps in maintaining reliable attendance records.

3.2.2 Impact of Digitalization

Digitalization has changed the way individuals and businesses socialize, communicate, and live.

3.2.3 Efficiency

Face recognition systems automate the attendance process, eliminating the need for manual data entry. Employees or students simply need to stand in front of a camera for their attendance to be recorded, saving time for both administrators and attendees.

3.2.4 Convenience

Face recognition eliminates the need for physical contact or carrying ID cards, making attendance tracking more convenient for users. They don't need to remember to bring or wear anything specific, reducing the risk of forgetting or losing identification.

3.2.5 Security

Face recognition adds an extra layer of security compared to traditional methods. It's difficult for individuals to impersonate others or engage in attendance fraud, enhancing the overall security of the attendance system.

3.2.6 Real-time Monitoring

Face recognition systems can provide real-time attendance monitoring, allowing administrators to track attendance as it happens. This feature is particularly useful in environments where timely attendance tracking is essential, such as workplaces or educational institutions.

3.2.7 Integration

Face recognition systems can easily integrate with other software and systems, such as HR management software or access control systems. This integration streamlines attendance management processes and allows for seamless data sharing between different systems.

3.3 Advantages of Attendance by Scanning a QR code to Generate a Google Form and Retrieve User Location

3.3.1 Automation

QR code scanning automates the attendance tracking process. Employees or students can quickly scan their barcode using a smartphone or dedicated scanner, eliminating the need for manual data entry.

3.3.2 Data Accuracy

QR code scanning reduces the risk of human error associated with manual attendance systems. Each QR code contains unique information, ensuring accurate identification and recording of attendance.

3.3.3 Google Form Integration

Using QR code scanning to generate a Google Form for attendance tracking offers several advantages. Google Forms provide a user-friendly interface for collecting data,

and responses are automatically recorded in a Google Sheets spreadsheet, facilitating data management and analysis.

3.3.4 Customization

Google Forms can be customized to include additional fields or questions related to attendance, such as reasons for absence or additional comments. This flexibility allows organizations to tailor the attendance tracking process to their specific needs.

3.3.5 Location Tracking

QR code scanning is combined with location services to retrieve the user's location at the time of attendance. This feature provides valuable information for tracking attendance at different locations or events and can help ensure that attendees are where they're supposed to be.

3.3.6 Accessibility

Google Forms can be accessed from any internet-enabled device, making it easy for attendees to mark their attendance using their smartphones or tablets. This accessibility ensures that attendees can conveniently record their attendance, regardless of their location.

Above system are already available presently. But both this systems have drawbacks on using individually. Therefore, combining this both systems will lead to more advantages and least drawbacks. Overall, both face recognition systems and attendance tracking via QR code scanning and Google Forms offer significant advantages in terms of accuracy, efficiency, security, and integration.

4 Detailed Problem Statement

In many organizations, institutions, and events, efficient and accurate attendance tracking is essential for various administrative, operational, and security purposes. Traditional attendance systems often rely on manual processes or outdated methods, leading to inaccuracies, inefficiencies, and security vulnerabilities. To address these challenges, there is a need for a modern, integrated attendance tracking system that leverages advanced technologies such as face recognition and barcode scanning, while also incorporating location retrieval capabilities. The problem statement for the project involving attendance tracking using both face recognition and barcode

scanning, integrated with Google Forms to capture user location, involves several key components:

4.1 Face Recognition System

The face recognition component of the system will use advanced facial recognition algorithms like K-Nearest Neighbour(KNN) to accurately identify individuals and record their attendance. Attendees will simply need to stand in front of a camera for their attendance to be automatically recorded.

4.2 QR code scanning and Google Form Generation

Additionally, attendees can mark their attendance by scanning a QR code using a smartphone or dedicated scanner. This action will trigger the generation of a Google Form pre-populated with attendance data, allowing attendees to quickly confirm their presence.

4.3 Location Retrieval

The system will utilize location retrieval technology, such as GPS to capture the user's location at the time of attendance. This information will be recorded alongside attendance data, providing valuable insights into attendance patterns and ensuring accountability.

4.4 Objectives

- Develop a robust face recognition system capable of accurately identifying individuals in real-time.
- Implement QR code scanning functionality to generate a Google Form for attendance tracking.
- Integrate location retrieval capabilities in google form to capture the user's location at the time of attendance.
- Ensure user accessibility and ease of use through intuitive interfaces features.
- Enhance security measures to prevent attendance fraud and unauthorized access to attendance data.

- Facilitate seamless integration with existing organizational systems and processes for data sharing and workflow integration.

Overall, the proposed integrated attendance tracking system aims to address the challenges associated with traditional attendance systems by leveraging advanced technologies to provide an accurate, efficient, and secure solution for attendance tracking in various organizational settings.

5 System Requirements

5.1 Software Requirements:

5.1.1 Programming languages framework

- Python (Version: 3.10.12) : For developing the face recognition system and integrating barcode scanning by using its rich libraries.
- OpenCV (Open Source Computer Vision Library): For image processing tasks, including face detection and recognition.
- Flask (Version: 3.0.2) : To develop a web application for user interaction and administration.

5.1.2 Database Management System

- MySQL: For storing user data, attendance records, generating % report and total report.

5.1.3 Development tools

- Integrated Development Environment (IDE) such as PyCharm, Vim, Anaconda, Visual Studio Code, Spider and Jupyter Notebook for coding and debugging.

5.1.4 Libraries and Tools

- NumPy (Version: 1.26.4) : For data manipulation.
- scikit-learn (Version: 1.4.1) : machine learning library for Python.

- joblib (Version: 1.3.2) : library for saving and loading Python objects to/from disk.
- openpyxl (Version: 3.1.2) : python library to read/write Excel 2010 xlsx/xlsm files.
- mysql.connector (Version: 8.3.0) : For python-MySQL connectivity.
- Pandas (Version: 2.2.0) : For data manipulation and analysis.
- cv2 (Version: 4.9.0) : OpenCV library for computer vision tasks for image processing and object detection.
- os (Version: 3.10.12) : Provides functions for interacting with the operating system, such as file and directory operations.

5.2 Hardware Requirements:

- Operating System: Windows 10, Linux, or macOS.
- Webcam or Camera: webcam or camera for capturing video of individuals for face recognition.
- Internet connectivity: Stable internet connection for accessing Google Forms and Google Sheets for data storage and retrieval.
- Mobile Devices: Smartphones or tablets for attendees to participate in the attendance tracking process by scanning QR code or interacting with the web interface.
- CPU: Intel® Core™2 Duo Processor E6600 2.4 GHz or AMD Phenom™ X3 8750 2.4 GHz processor
- Cores: 2
- Processor Speed: 1.10Hz
- RAM: 4 GB of memory
- HDD: Minimum of 500 MB of free space.

6 Functional Features

6.1 Educational Institutions:

Streamlines attendance tracking in schools, colleges, and universities, reducing administrative burden and improving accuracy in recording student attendance.

6.2 Corporate settings:

Facilitates attendance management in workplaces, offices, and meetings, enhancing efficiency and providing insights into employee attendance patterns.

6.3 Events and conferences:

Simplifies attendance tracking at events, conferences, and seminars, allowing organizers to monitor participant turnout and engagement in real-time.

6.4 Training Programs:

Automates attendance recording in training sessions and workshops, ensuring accurate tracking of participant attendance and compliance with training requirements.

6.5 Security and access control:

Enhances security by accurately identifying individuals through face recognition or barcode scanning, enabling access control in secure environments such as laboratories, research facilities, or restricted areas.

6.6 Remote work and Virtual Meetings:

Adapts to remote work environments by enabling virtual attendance tracking in online meetings, webinars, and virtual classrooms, ensuring accountability and participation among remote participants.

6.7 Compliance and regulatory requirements:

Helps organizations comply with regulatory requirements related to attendance tracking and reporting, providing a reliable system for maintaining accurate attendance records and audit trails.

Overall, the project's functional features and uses contribute to improving efficiency, accuracy, and security in attendance tracking across various sectors and environments.