

AI Enabled Identity Verification with Continuous Duty-Hour Location Tracking for Rural Healthcare Workforce

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ABSTRACT

In rural healthcare systems, ensuring the consistent presence of doctors at Primary Health Centers (PHCs) is crucial for delivering effective medical services. However, traditional attendance methods such as manual registers and biometric systems are often unreliable, lack real-time verification, and fail to ensure continuous presence during duty hours. These limitations lead to absenteeism, reduced accountability, and disruptions in healthcare delivery. The proposed AI-Enabled Identity Verification with Continuous Duty-Hour Location Tracking System is designed to address these challenges by integrating facial recognition and geolocation technologies. The system uses a Convolutional Neural Network (CNN)-based model to authenticate doctors and GPS-based geofencing to verify their presence within PHC premises. It continuously monitors attendance through random re-verification and tracks location throughout duty hours. Additionally, the system provides automated alerts for attendance violations and includes a patient activity logging module to monitor healthcare service delivery. By enabling real-time monitoring, intelligent verification, and automated reporting, the system enhances transparency, improves accountability, and ensures efficient healthcare management. This solution is particularly beneficial for strengthening rural healthcare services and ensuring reliable doctor availability.

CHAPTER 1 INTRODUCTION

1.1 OVERVIEW

Primary Health Centers (PHCs) serve as the backbone of rural and semi-urban healthcare systems, providing essential medical services such as general treatment, maternal care, disease monitoring, and emergency support. The effectiveness of these centers largely depends on the consistent availability and active participation of doctors during duty hours. However, in many PHCs, attendance monitoring still relies on traditional methods such as manual registers or basic biometric systems, which are often unreliable and lack real-time verification.

These conventional systems are prone to issues such as proxy attendance, lack of location validation, and inability to track continuous presence. As a result, unauthorized absenteeism, delayed arrivals, and early departures frequently occur, negatively impacting healthcare service delivery and reducing public trust in the system. Moreover, the absence of automated monitoring and reporting mechanisms makes it difficult for higher authorities to ensure accountability and take timely action.

To overcome these challenges, this project proposes an AI-Enabled Identity Verification with Continuous Duty-Hour Location Tracking System for PHC doctors. The system integrates facial recognition technology with real-time GPS-based location tracking to ensure both identity authentication and physical presence within the PHC premises. By incorporating geofencing and continuous monitoring through periodic re-verification, the system ensures that doctors remain available throughout their duty hours.

Additionally, the system provides automated alerts for attendance violations and maintains structured records of patient consultations, enabling better monitoring of healthcare service delivery. By leveraging artificial intelligence and location-based technologies, the proposed system enhances transparency, improves accountability, and supports efficient healthcare management in rural areas.

Overall, this solution aims to transform traditional attendance mechanisms into a smart, reliable, and data-driven system, ensuring consistent doctor availability and improved quality of healthcare services in Primary Health Centers.

1.2 OBJECTIVE

The main objective of this project is to develop an intelligent and reliable doctor attendance monitoring system for Primary Health Centers (PHCs) using artificial intelligence and location-based technologies. The system aims to ensure accurate verification of doctor identity and continuous presence during duty hours, thereby improving accountability and healthcare service delivery.

The specific objectives of the proposed system are:

- To implement secure doctor authentication using facial recognition technology.
- To capture real-time GPS location data during attendance marking.
- To enforce geofencing to ensure doctors are present within PHC premises.
- To perform continuous duty-hour monitoring through periodic re-verification.
- To prevent proxy attendance and unauthorized absence.
- To detect attendance violations such as missed check-ins or early departures.
- To generate automated alerts and notifications for authorities.
- To maintain digital attendance records for transparency and reporting.
- To integrate patient activity logging for monitoring healthcare services.

CHAPTER 2 LITERATURE SURVEY

A. Patil and R. Bartakke (2025) presented high-performance GPU strategies for real-time monitoring systems. Their work highlights the importance of low-latency processing for applications such as facial recognition and continuous monitoring. This study provides a strong foundation for implementing real-time identity verification in attendance systems.

M. Alrawahneh et al. (2025) proposed a decision-aid framework for improving face authentication detection. The model enhances the accuracy and reliability of facial recognition systems. This concept supports the development of secure identity verification mechanisms in AI-based attendance systems.

P. Troncoso-Espinosa et al. (2024) focused on intelligent healthcare monitoring systems to reduce service disruptions. Their research emphasizes the importance of structured digital monitoring in healthcare environments. This study highlights the need for real-time monitoring solutions in Primary Health Centers.

N. T. Thai et al. (2024) discussed automated attendance monitoring systems and their impact on reducing absenteeism. Their work demonstrates how digital solutions improve accountability and efficiency in organizational environments, which is relevant to healthcare attendance management.

A. Erdélyi et al. (2024) explored smartphone-based sensing techniques for detecting attendance irregularities. Their study shows the effectiveness of mobile platforms in real-time monitoring and data collection, supporting the feasibility of mobile-based attendance systems.

E. S. García-Treviño et al. (2024) introduced a multifactor authentication system combining geolocation with identity verification. Their work enhances security and transparency in access control systems, which is applicable to GPS-based attendance validation.

A. Joseph and K. Elleithy (2023) analyzed challenges in facial recognition systems, including variations in lighting and pose. Their research provides insights into building robust face recognition models suitable for real-world environments.

A. Kocacinar et al. (2022) developed a lightweight CNN-based face recognition system for mobile devices. Their work demonstrates the feasibility of real-time facial authentication on smartphones, which is essential for mobile attendance applications.

A. Mitra et al. (2021) proposed a facial authentication-based digital identity system for smart city applications. This study highlights the scalability and integration of facial recognition systems in public infrastructure.

J. Park and S. Kim (2021) introduced a location-based access control system integrating GPS and mobile authentication. This study supports the use of location-aware security mechanisms in attendance monitoring.

H. Wang and C. Song (2020) studied real-time face recognition on mobile devices, focusing on lightweight models and efficient processing. Their work supports the implementation of mobile-based authentication systems.

S. Sultana et al. (2019) proposed a geofencing-based attendance system using mobile devices. Their research demonstrates the effectiveness of location-restricted attendance validation.

World Health Organization (WHO) (2019) emphasized the role of digital health technologies in improving healthcare delivery and accountability. Their report highlights the importance of real-time monitoring systems in strengthening healthcare services.

M. Conti et al. (2018) reviewed security and privacy issues in GPS-based systems. Their study highlights the importance of secure handling of geolocation data in location-based applications.

F. Schroff et al. (2015) developed FaceNet, an embedding-based facial recognition model that enables accurate identity verification. This approach is widely used in modern face recognition applications.

Y. Taigman et al. (2014) introduced DeepFace, a deep learning-based facial recognition system achieving near human-level accuracy. This work laid the groundwork for advanced CNN-based face verification models.

A. Jain et al. (2004) provided an introduction to biometric recognition systems, including facial biometrics. Their work offers fundamental knowledge for designing secure authentication systems.

CHAPTER 3 SYSTEM ANALYSIS

3.1 EXISTING SYSTEM

In many Primary Health Centers (PHCs), the process of doctor attendance monitoring is traditionally handled using manual methods such as attendance registers or basic biometric systems. Doctors record their attendance based on simple check-in procedures without any mechanism to verify their continuous presence during duty hours. These systems rely heavily on trust and do not ensure transparency in attendance tracking. As a result, issues such as proxy attendance, early departures, and unauthorized

absence often go unnoticed. Lack of proper communication and monitoring also makes it difficult for higher authorities to track doctor availability effectively. Another limitation of the existing system is the absence of real-time monitoring of doctor presence and healthcare service delivery. Authorities may not have accurate information about whether doctors are physically present in the PHC or actively attending patients. This leads to poor accountability and reduced efficiency in healthcare services. Therefore, the traditional attendance monitoring approach often results in unreliable records, delayed administrative action, and decreased quality of patient care.

Limitations of the Existing System:

1. It allows proxy attendance and manipulation of records.
2. Does not ensure continuous doctor presence during duty hours.
3. Limited real-time monitoring and tracking.
4. Cannot detect early departures or absenteeism effectively.
5. Requires manual supervision and periodic inspections.

Hence, there is a strong need for an intelligent AI-based system that can efficiently analyze employee skills, workload, and availability to optimize staff allocation and improve overall organizational productivity.

3.2 PROPOSED SYSTEM

The proposed system, AI-Enabled Doctor Attendance Monitoring System, is designed to overcome the limitations of traditional attendance methods in Primary Health Centers (PHCs) by introducing an automated and intelligent approach for attendance tracking and monitoring. The system integrates facial recognition technology with real-time geolocation verification to ensure accurate and reliable doctor attendance. The proposed system uses advanced algorithms such as Convolutional Neural Networks (CNN) to analyze and verify doctor identity through facial recognition. Along with this, GPS-based location tracking and geofencing are used to ensure that attendance is marked only when the doctor is physically present within the PHC premises. The system maintains a centralized database that stores doctor details, attendance records, location data, and patient activity logs. Administrators can easily monitor doctor availability, track attendance status in real time, and identify absenteeism through a user-friendly dashboard. Furthermore, the system ensures transparency and accountability by continuously monitoring doctor presence during duty hours using random interval re-verification. Automated alerts are generated in case of violations such as absence, location mismatch, or missed verification. This enables authorities to take timely actions and improves overall healthcare service delivery.

Advantages of the Proposed System:

1. Ensures accurate and real-time doctor attendance verification.
2. Prevents proxy attendance using facial recognition technology.
3. Enables continuous monitoring of doctor presence during duty hours.
4. Reduces manual effort and dependency on physical inspections.
5. Improves transparency and accountability in healthcare services.
6. Generates automated alerts for absenteeism and violations.
7. Supports better administrative monitoring and decision-making.
8. Enhances overall efficiency and quality of healthcare delivery.

3.3 PROPOSED SOLUTION

The proposed solution is a web-based AI-Enabled Doctor Attendance Monitoring System developed to improve attendance tracking and ensure continuous doctor presence in Primary Health Centers (PHCs).

The system integrates facial recognition and geolocation technologies to provide accurate and real-time monitoring.

The system accepts three main inputs from the user:

1. **Doctor Details** (such as name, ID, assigned PHC, and facial data)
2. **Geolocation Data** (GPS coordinates captured during attendance marking)
3. **Attendance Verification Inputs** (live facial image and timestamp)

Once the data is entered, the system performs multiple processes:

Step 1: Data Collection and Storage

The system stores doctor details, facial data, and attendance records in a centralized database for easy access and management.

Step 2: Face Verification

The system uses CNN-based facial recognition to verify the identity of the doctor by comparing live images with stored data.

Step 3: Location Validation

GPS data is validated using geofencing to ensure that the doctor is physically present within the PHC premises.

Step 4: Continuous Monitoring

The system performs random interval re-verification using facial recognition and location tracking to ensure continuous presence during duty hours.

Step 5: Alert Generation

If any violation such as absence, location mismatch, or missed verification is detected, the system automatically generates alerts for authorities.

IDEATION & BRAINSTORMING

The ideation and brainstorming phase of the project began with identifying the major challenges faced by Primary Health Centers in monitoring doctor attendance. The team discussed common questions such as:

- How can we ensure that doctors are physically present at the PHC?
- How can we prevent proxy attendance?
- How to monitor doctor presence continuously during duty hours?
- How can technology improve transparency and accountability?

Through these discussions, the idea of developing an AI-based attendance monitoring system was formed — a system capable of verifying doctor identity and location in real time.

The goal was to design a system that can automatically monitor attendance, detect violations, and assist authorities in making faster and accurate decisions.

During brainstorming, several features were discussed, including facial recognition, GPS tracking, geofencing, continuous monitoring, and automated alerts. The system also includes reporting and analytics to help administrators track attendance patterns and improve healthcare management.

PROBLEM-SOLUTION FIT

Problem:

Primary Health Centers face challenges in ensuring doctor availability and attendance transparency. Traditional systems allow proxy attendance, lack real-time monitoring, and fail to track continuous presence. This results in absenteeism, poor patient care, and reduced efficiency.

Solution:

The proposed AI-based system provides an automated and reliable solution for attendance monitoring. It verifies doctor identity using facial recognition and ensures physical presence through GPS-based location tracking and geofencing.

The system continuously monitors attendance and detects violations using intelligent algorithms. It also generates alerts and reports for administrators, enabling timely action and better decision-making.

This combination of technologies makes the system an ideal solution by offering:

1. **Automation:** Reduces manual monitoring through intelligent verification.
2. **Accuracy:** Ensures correct identity and location validation.
3. **Transparency:** Provides real-time and verifiable attendance records.
4. **Scalability:** Can be implemented across multiple PHCs efficiently.

Overall, the proposed solution bridges the gap between doctor availability and healthcare service delivery, improving accountability, efficiency, and patient care in Primary Health Centers.

ARCHITECTURE DESIGN

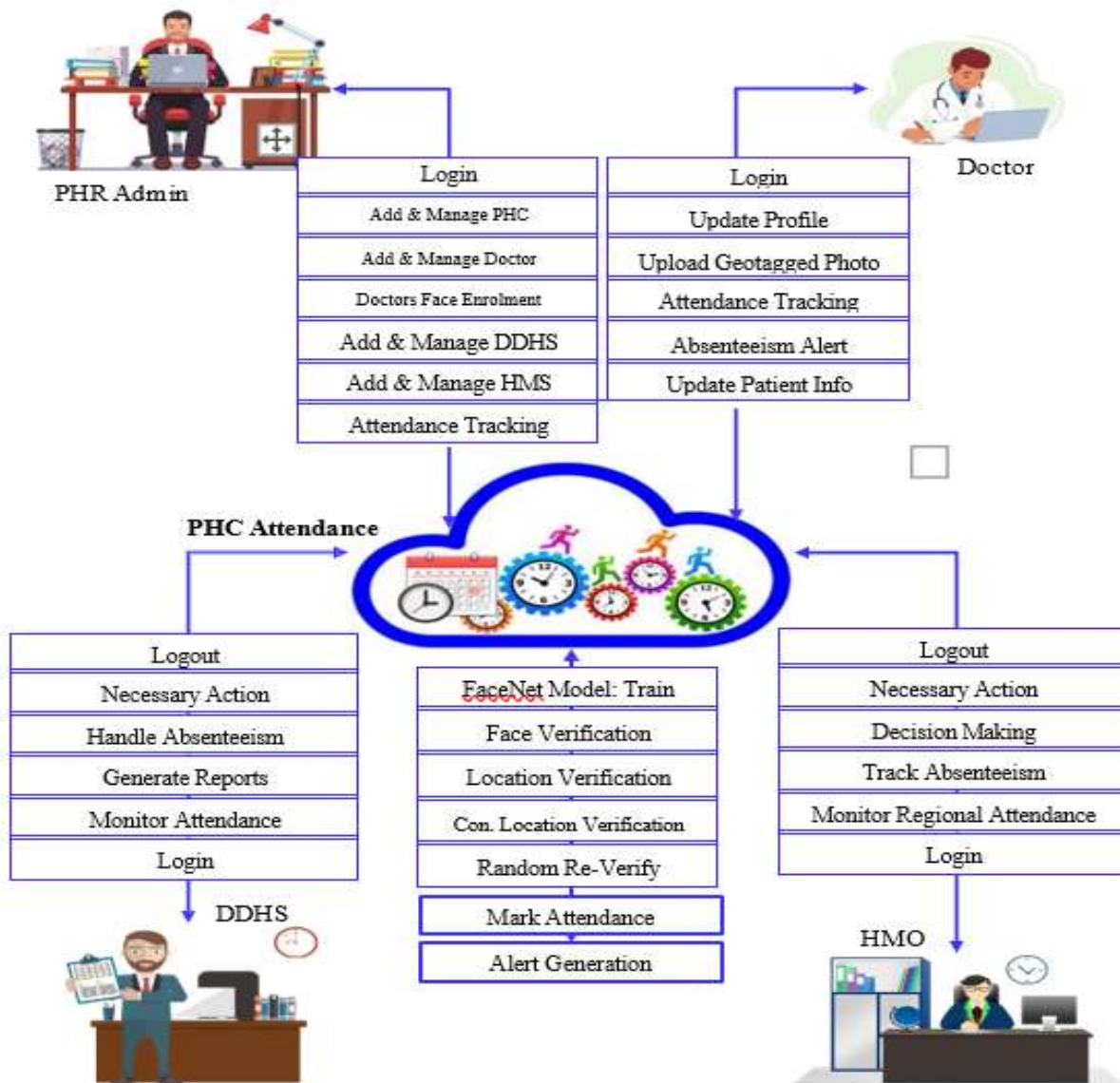


Figure 3.1 : Architecture Diagram

1. User Interface Layer (Web/Mobile Application):

- Doctors, administrators, and authorities interact with the system through a user-friendly interface.
- Doctors upload facial images for attendance and update patient details.
- Administrators can view attendance status, reports, and violation alerts in real time.

2. Data Processing Layer:

- The system collects and processes doctor data such as facial images, attendance logs, and GPS location.
- It performs preprocessing of facial images and extracts geolocation data for verification.
- Attendance data is analyzed to detect patterns like absenteeism or irregular behavior.

3. Verification Layer (AI Model & Geolocation):

- Uses CNN-based facial recognition to verify doctor identity.
- Validates GPS location using geofencing to ensure presence within PHC premises.
- Performs random interval re-verification to ensure continuous monitoring during duty hours.

4. Monitoring and Alert Layer:

- Continuously monitors doctor attendance and location data.
- Generates alerts for violations such as absence, face mismatch, or location mismatch.
- Provides analytical reports and dashboards for administrators and higher authorities.

3.2 DATA FLOW DIAGRAM

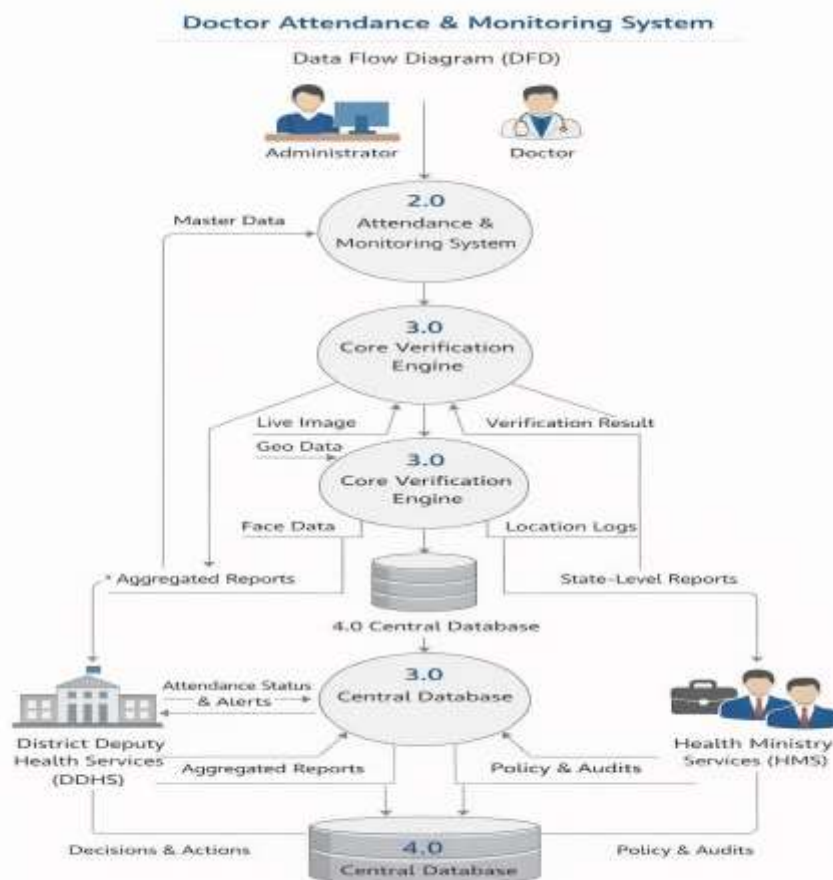


Figure 3.2: Data Flow Diagram

1. Input Phase:

- Doctor enters attendance by uploading a live facial image with GPS location.
- Administrator enters doctor details, PHC information, and system configurations.

2. Processing Phase:

- The system processes facial data and extracts location information.
- It verifies identity using facial recognition and validates location using geofencing.

3. Verification Phase:

- AI model compares facial data with stored records.
- Location data is checked against PHC boundary for authenticity.
- Continuous re-verification is performed during duty hours.

4. Output Phase:

- Attendance status (Present/Absent) is recorded.
- Alerts are generated for violations.
- Reports and analytics are displayed on the dashboard for monitoring and decision-making.

CHAPTER 4 SYSTEM REQUIREMENT**4.1 HARDWARE REQUIREMENTS****Minimum Requirements:**

- Processor: Intel Core i3 or above
- RAM: 4 GB (8 GB recommended)
- Hard Disk: 250 GB or more
- Monitor: 1024×768 resolution or higher
- Input Devices: Keyboard, Mouse, Mobile Camera
- Internet: Required for real-time monitoring and updates

Recommended Requirements:

- Processor: Intel Core i5 or higher
- RAM: 8 GB or more
- Storage: 500 GB SSD
- Camera: HD camera (for facial recognition)
- Network: Stable internet connection

4.2 SOFTWARE REQUIREMENTS**Operating System:**

- Windows 10/11 or Linux (Ubuntu)

Programming Language:

- Python 3.10 or above

Frameworks and Libraries:

- Flask (for web application interface)
- OpenCV (for image processing and face detection)
- TensorFlow / Keras (for CNN-based facial recognition)
- NumPy and Pandas (for data processing)
- Matplotlib / Seaborn (for reports and visualization)

Database:

- MySQL or SQLite (for storing doctor details, attendance records, and logs)

Development Tools:

- VS Code or PyCharm (IDE)
- Anaconda or Pip (package manager)
- Google Chrome or Mozilla Firefox (web browser)

4.3 IMPLEMENTATION

Implementation is the most crucial phase in the System Development Life Cycle (SDLC), where the designed system is transformed into a working application. It involves coding, integration of modules, testing, and deployment of the system. In the AI-Enabled Doctor Attendance Monitoring System, the implementation focuses on developing a secure and intelligent platform that verifies doctor identity and ensures continuous presence within the PHC. The system integrates multiple components such as facial recognition, geolocation tracking, and real-time monitoring. Doctors upload facial images through a web/mobile interface, which are processed using AI models for identity verification. GPS data is simultaneously captured and validated using geofencing techniques. The implementation uses technologies such as Python and Flask for backend development, while OpenCV and deep learning frameworks like TensorFlow are used for facial recognition. Data processing libraries like Pandas and NumPy handle attendance records and analytics. AI-based verification ensures accurate identity matching, while location validation confirms physical presence. Continuous monitoring and automated alerts help detect absenteeism and violations in real time. Overall, the implementation combines artificial intelligence, web technologies, and data analytics to create a reliable and efficient attendance monitoring system, improving accountability and healthcare service delivery in Primary Health Centers.

CHAPTER 5 IMPLEMENTATION**5.1 DATA COLLECTION**

Data collection is essential for the AI-Enabled Doctor Attendance Monitoring System to ensure accurate identity verification and real-time monitoring. Both structured and unstructured data sources are used.

1. Doctor Dataset Preparation

A dataset is created containing information about doctors and attendance details. Each record includes:

- Doctor Profile (Name, ID, Assigned PHC)
- Facial Data (Captured images for recognition)
- Attendance Records (Check-in time, status)
- Location Data (GPS coordinates)
- Patient Activity Data (Daily consultation details)

These attributes simulate real healthcare data and help the system verify identity, track attendance, and monitor doctor availability.

2. Data Preprocessing

Before verification, collected data is preprocessed to ensure accuracy:

- Data Cleaning: Removes duplicate or incomplete records
- Image Processing: Face detection and alignment using OpenCV
- Feature Extraction: Converts facial images into embeddings for recognition
- Data Structuring: Organizes attendance and location data into structured format

5.2 COMPONENT DESIGN

The system follows a modular architecture where each component performs a specific function.

1. User Interface (Frontend)

- Developed using Flask (HTML, CSS, Bootstrap)
- Allows doctors to mark attendance and upload images
- Provides dashboards for administrators to monitor attendance and alerts

2. Data Processing Module

- Processes facial images and GPS data
- Performs image preprocessing and location extraction
- Prepares data for verification

3. Face Verification Module

- Uses CNN/FaceNet model for facial recognition
- Matches live image with stored facial data
- Ensures identity authentication

4. Location Verification Module

- Validates GPS coordinates using geofencing
- Ensures doctor is within PHC boundary

5. Attendance Management System

- Records attendance status (Present/Absent)
- Supports continuous monitoring and re-verification

6. Database

- Stores doctor profiles, facial data, attendance logs, and location records
- Continuously updated with new data

7. Monitoring and Alert Module

- Detects violations like absence or mismatch
- Generates alerts and notifications for authorities

8. Reporting and Analytics Module

Generates attendance reports and analytics

Helps in decision-making and performance tracking

5.3 SOFTWARE DESCRIPTION

The system is developed using Python 3 due to its flexibility and strong support for AI and data processing.

Key Software Components:

1. Flask Framework

Handles web interface and user requests

Connects frontend with backend processing

2. OpenCV

Used for face detection and image processing

3. TensorFlow / Keras

Implements CNN-based facial recognition model

4. NumPy and Pandas

Used for data handling and analysis

5. SQLite / MySQL Database

Stores doctor details, attendance records, and logs

6. HTML, CSS, Bootstrap

Designs responsive user interface and dashboards

7. Matplotlib / Seaborn

Generates graphs and reports for visualization

5.5 RESULT

The AI-Enabled Doctor Attendance Monitoring System was tested using different scenarios to evaluate its accuracy and efficiency. The results show that the system effectively verifies doctor identity, tracks real-time location, and ensures continuous presence during duty hours.

The system successfully reduced proxy attendance, detected absenteeism, and improved transparency in attendance monitoring. Automated alerts helped administrators take timely actions, improving overall healthcare service delivery.

Sample Test Case

Input:

- Doctor: Dr. Arun
- PHC: Rural Health Center
- Face Image: Uploaded
- Location: Within PHC boundary

Predicted Output:

- Attendance Status: Present
- Face Match: Successful
- Location Validation: Verified
- Alert Status: No alerts generated

OUTPUT PAGES:

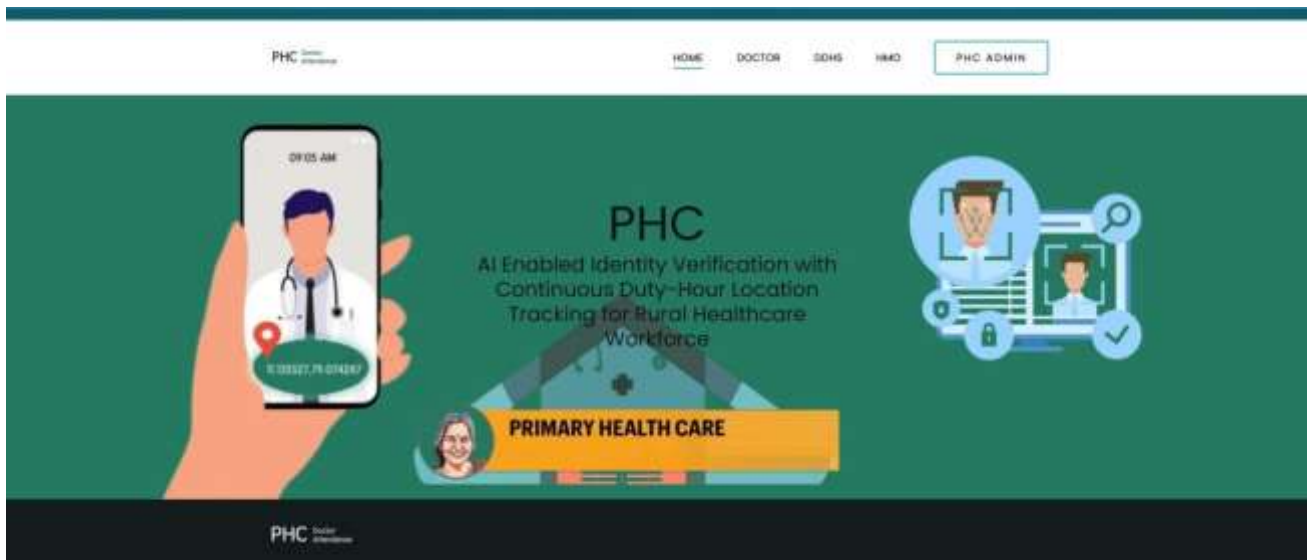


Figure 5.1: Home Page

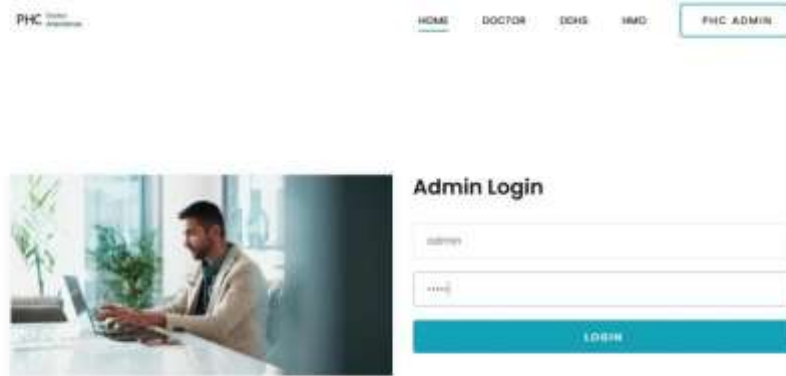


Figure 5.2: Admin module

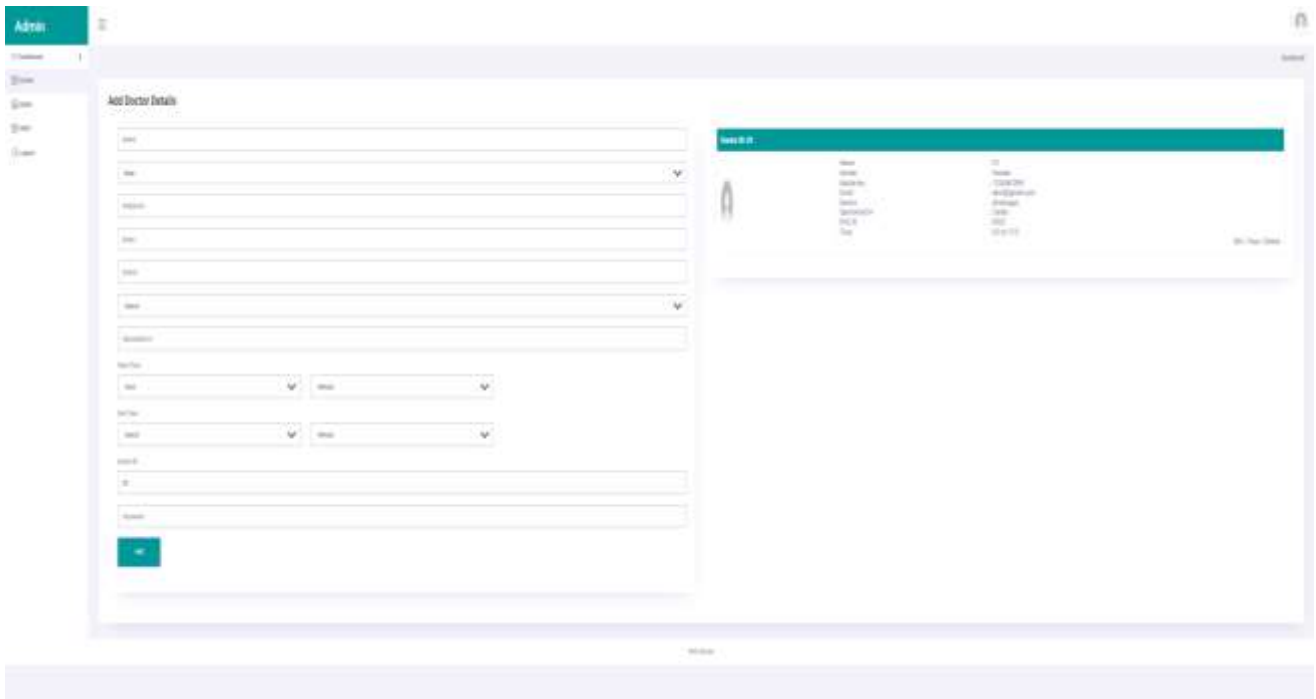


Figure 5.3: Admin Dashboard

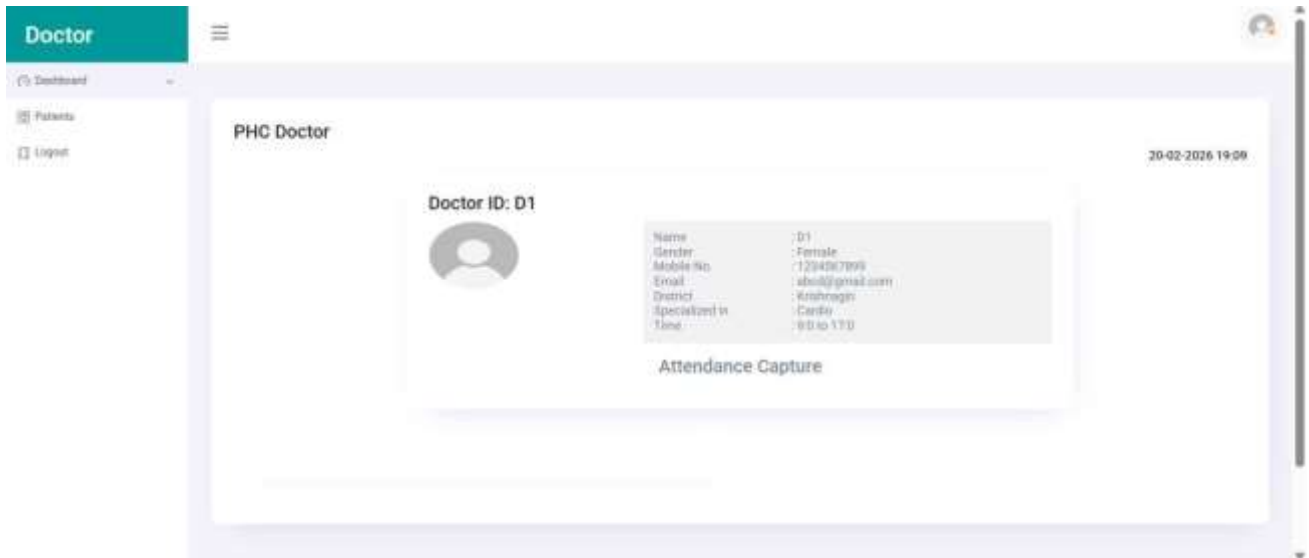


Figure 5.4: Doctor login and dashboard`

GEO Tagged Photo

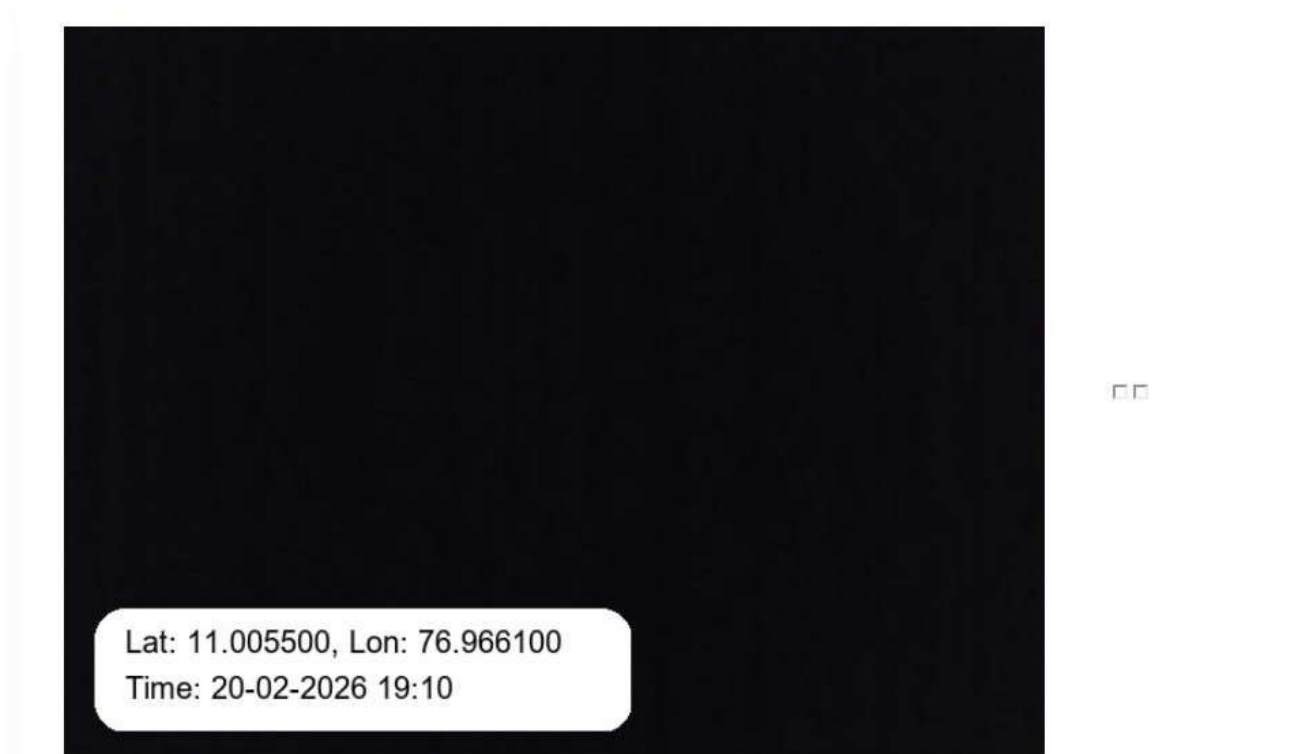


Figure 5.5: Attendance capture

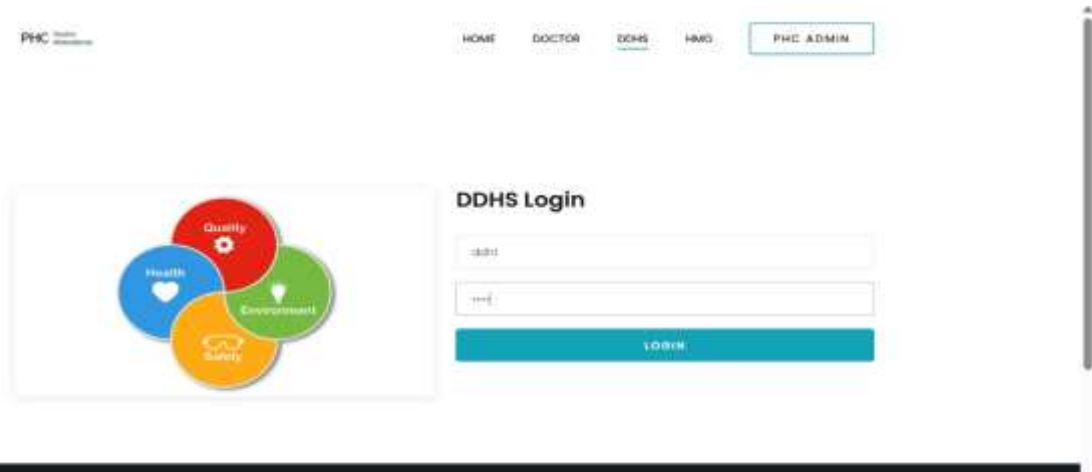


Figure 5.6: DDHS Login

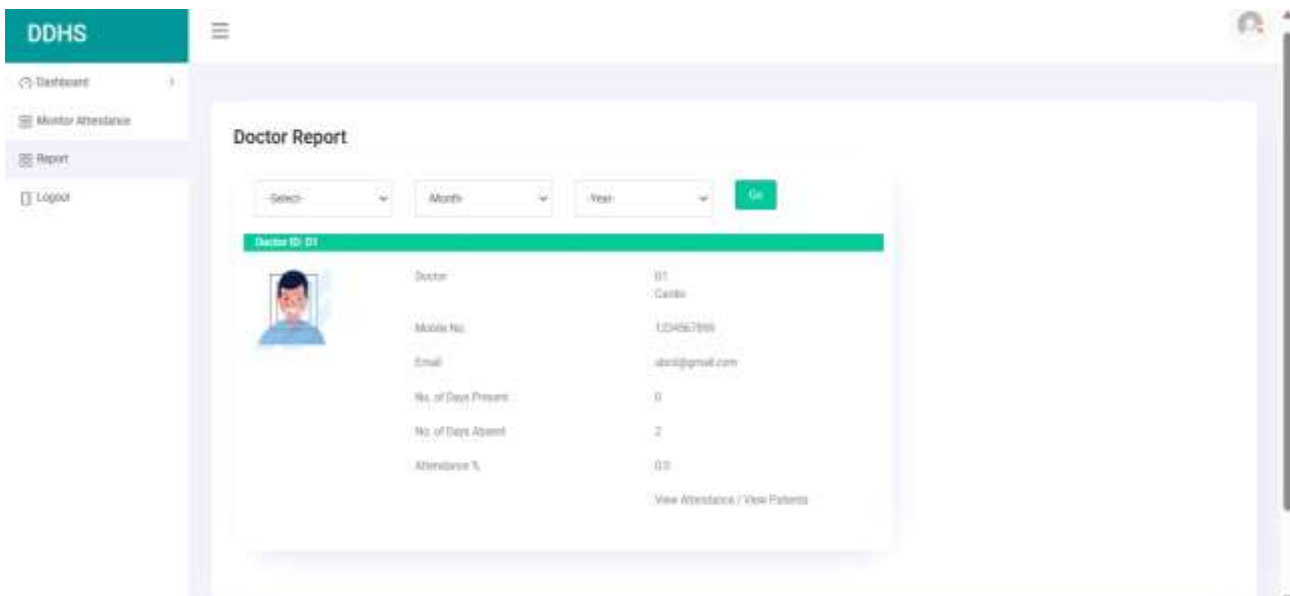


Figure 5.7: Attendance monitor and Reports

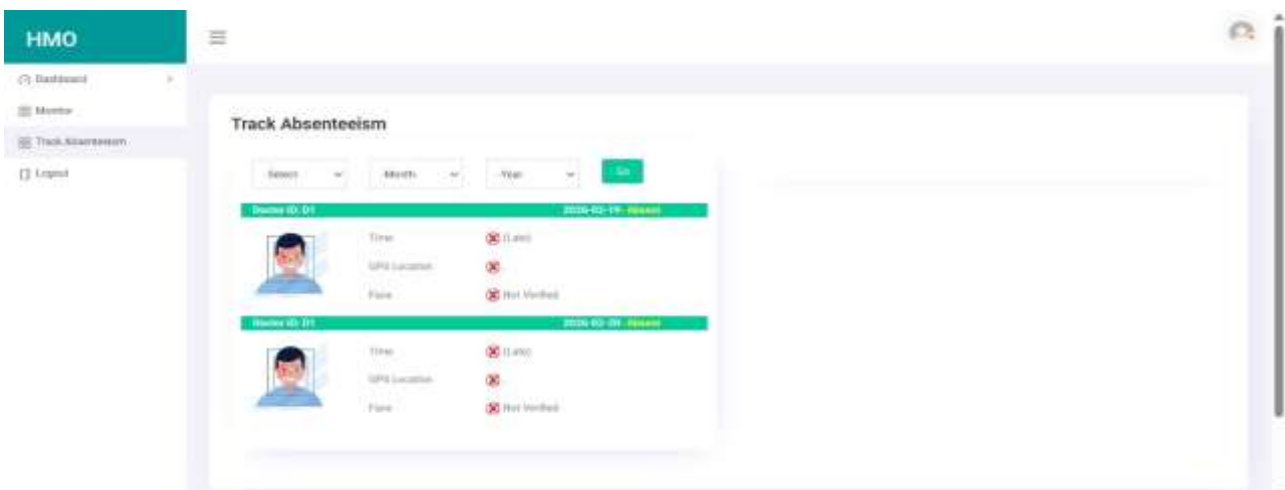


Figure 5.8: HMO dashboard

CHAPTER 6: CONCLUSION AND FUTURE ENHANCEMENT

6.1 CONCLUSION

The AI-Enabled Doctor Attendance Monitoring System provides an effective solution for improving attendance tracking and accountability in Primary Health Centers (PHCs) by utilizing artificial intelligence, geolocation technologies, and modern web-based platforms. The system is designed to verify doctor identity, monitor real-time presence, and ensure continuous availability during duty hours.

Throughout the development process, the system was implemented to capture doctor facial data, validate identity using CNN-based facial recognition, and verify location using GPS and geofencing techniques. By combining identity authentication with location validation, the system ensures that attendance is both accurate and reliable.

The system continuously monitors doctor presence through random interval re-verification and detects violations such as absenteeism, early departure, or location mismatch. Automated alerts and reporting features enable administrators and higher authorities to take timely actions, improving transparency and accountability in healthcare services.

The system was developed using Python with the Flask framework, along with technologies such as OpenCV, TensorFlow, and data processing libraries like Pandas and NumPy. The modular architecture ensures scalability, easy maintenance, and efficient integration of system components. The user-friendly interface allows administrators and doctors to interact with the system effectively without requiring advanced technical knowledge.

Testing and evaluation showed that the system can accurately verify attendance, reduce proxy entries, and provide real-time monitoring with minimal processing delay. It improves healthcare service delivery by ensuring doctor availability and supporting better administrative control.

In conclusion, the proposed system bridges the gap between traditional attendance methods and intelligent automated monitoring. By leveraging AI, facial recognition, and geolocation tracking, the system enhances accountability, improves operational efficiency, and strengthens healthcare management in Primary Health Centers.

6.2 FUTURE SCOPE

Although the system performs effectively in its current form, several enhancements can be implemented in the future to improve its performance, scalability, and usability:

- 1 **Integration of Advanced AI Models:** Future improvements can include advanced deep learning models for more accurate and faster facial recognition. Predictive analytics can also be used to analyze attendance trends and identify patterns of absenteeism.
- 2 **Real-Time Performance Monitoring:** The system can be enhanced to monitor doctor activities such as patient consultations and treatment records in real time, providing a more comprehensive view of healthcare service delivery.
- 3 **Integration with Health Information Systems:** The system can be integrated with Electronic Health Record (EHR) systems and hospital management platforms to automatically link attendance with patient data and healthcare services.
- 4 **Large-Scale Deployment:** The system can be expanded to support multiple PHCs across districts and states, enabling centralized monitoring by government health authorities.
- 5 **Cloud-Based Implementation:** Deploying the system on cloud platforms such as AWS, Microsoft Azure, or Google Cloud can improve scalability, data storage, and accessibility from different locations.

- 6 **Mobile Application Enhancement:** A dedicated mobile application can be developed for doctors and administrators to improve usability, provide notifications, and enable faster attendance marking.

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