Intelligent Biometric Attendance System Using IoT, ChatGPT, and AI for Automated Student Analysis and Reporting

Arvind Bagale* and Reena Singh**

*Ph.D. Scholar Apex University, Jaipur

**HOD CS IT Department Apex University, Jaipur

corresponding author

arvindbagale20@gmail.com

Abstract

Automating attendance tracking in educational institutions has become essential for efficiency, accuracy, and data-driven decision-making. This research proposes an AI-powered biometric attendance system integrated with IoT and ChatGPT to enhance attendance accuracy, generate automated student analytics, and send real-time notifications to parents. The system leverages facial recognition, fingerprint biometrics, AI analytics, and NLP-powered notifications to improve attendance monitoring. The study will also explore the use of machine learning techniques to predict student behavior based on attendance trends. This paper provides a comprehensive review of existing attendance management systems, highlights their limitations, and presents an IoT-AI hybrid framework for intelligent student attendance tracking.

1. Introduction

1.1 Background

Traditional attendance systems rely on manual roll calls, RFID cards, and fingerprint scanning, leading to inefficiencies, proxy attendance, and limited real-time analytics. Biometric solutions offer better authentication, but they lack automated AI-driven analysis and real-time reporting. Integrating IoT-based biometric devices with AI and ChatGPT-powered parental notifications can revolutionize attendance tracking.

1.2 Problem Statement

Despite advancements in biometric authentication, existing systems suffer from:

- Time-consuming manual data entry

- Lack of real-time parental notifications
- Inability to provide subject-wise attendance analytics
- Absence of AI-driven student performance predictions

This study proposes an **AI-powered biometric attendance system** that integrates IoT, ChatGPT, and **machine learning models for real-time student monitoring and predictive analysis.**

2. Extensive Literature Review

2.1 IoT-Based Attendance Systems

IoT devices such as smart cameras, fingerprint scanners, and RFID have improved attendance monitoring. Research by Gupta & Sharma (2022) found IoT-based attendance systems 30% more efficient than manual tracking.

2.2 AI in Biometric Authentication

Deep learning models like Convolutional Neural Networks (CNNs) improve accuracy in facial recognition (Patil *et al*., 2021). AI-driven authentication minimizes false positives and proxy attendance.

2.3 ChatGPT for Automated Notifications

AI-powered NLP models like ChatGPT enhance student engagement by automating parental notifications. Studies show that AI-based SMS alerts improved parental involvement by 65% (Brown *et al*., 2020).

2.4 Research Gap

Existing attendance systems lack AI-driven insights, real-time notifications, and predictive analytics. This research fills this gap by integrating AI, IoT, and ChatGPT.

3. Significance of Research Work

- Eliminates proxy attendance through biometric authentication
- Enhances parental communication with real-time AI-generated notifications
- Provides subject-wise analytics for teachers to track student performance

- Predicts student performance trends using AI-based analysis
- Reduces administrative workload through automation

4. Objectives

1. Develop an IoT-integrated biometric attendance system
2. Implement AI-powered subject-wise attendance tracking
3. Automate parental notifications using ChatGPT and NLP
4. Use machine learning models to predict student performance

5. Hypothesis / Research Questions

Hypothesis

- **H1:** AI-powered biometric authentication improves attendance accuracy
- **H2:** ChatGPT-generated notifications reduce student absenteeism
- **H3:** AI-based analytics help predict student performance trends

Research Questions

1. How does AI-driven facial recognition enhance attendance accuracy?
2. Can ChatGPT-generated SMS alerts improve parental engagement?
3. How effective is AI in predicting student academic performance?

6. Methodology

6.1 System Architecture

The proposed system consists of:

1. Biometric Authentication: Fingerprint scanner & AI-driven facial recognition
2. AI Processing Module: CNN model using TensorFlow & OpenCV
3. Database: Firebase cloud storage for real-time attendance data
4. ChatGPT Notification System: AI-generated SMS alerts
5. Teacher Dashboard: Web-based subject-wise student analytics

6.2 Implementation Workflow

1. Biometric Identity Capture
2. AI-Based Authentication & Verification
3. Attendance Logging in Cloud Database
4. Automated Parental Notification via ChatGPT
5. Teacher Dashboard for Analytics & Reporting

6.3 Data Collection & Evaluation

- **Participants:** 100 students from a university
- **Performance Metrics**
    - Accuracy of AI-driven biometric attendance
    - Parental engagement improvement
    - AI-based student performance predictions

Tools to be Used

- IoT Hardware: Raspberry Pi, Biometric Fingerprint Scanner, Camera Module
- AI Frameworks: TensorFlow, OpenCV, Scikit-Learn
- Cloud Database: Firebase / MySQL
- ChatGPT API: Automated parental notifications
- Web Dashboard: React.js / Angular.js

Statistical Techniques

- **Machine Learning Models:**
    - CNNs for facial recognition
    - Decision Trees for student behavior prediction
- **Statistical Analysis:**
    - T-tests & ANOVA to compare traditional vs. AI-driven attendance
    - Regression analysis for student performance trends

Ethical Considerations

- Data Privacy & Security: Ensuring GDPR compliance for student data

- Parental Consent: AI-based SMS notifications require approval
- Bias Mitigation: AI model fairness in biometric authentication

Conclusion & Future Scope

This research proposes an **AI-IoT biometric attendance system** that enhances accuracy, automates notifications, and provides real-time student analytics. Future work includes:

- Enhancing AI models for multi-modal biometrics (Iris + Face + Fingerprint)
- Expanding AI-based predictive analytics for student dropout risks
- Integrating blockchain for secure attendance records

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