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# 1. Introduction

Attendance tracking is an essential administrative task in academic and professional institutions. Traditional methods such as roll calls and manual sign-in sheets are still widely used but are often inefficient, prone to human error, and easily manipulated. These methods consume valuable time, affect productivity, and compromise the integrity of attendance records. Studies have shown that institutions lose significant instructional or operational time due to outdated attendance methods [1]. Moreover, the rise of proxy attendance where one individual marks presence on behalf of another, remains a widespread issue, particularly in classroom environments.

The global COVID-19 pandemic introduced additional challenges by making face masks mandatory in most public and institutional settings. This shift has rendered many conventional biometric systems ineffective, as facial features are partially obscured. Furthermore, advances in spoofing techniques such as printed photos or recorded videos have raised security concerns in automated systems, making liveness detection and anti-spoofing mechanisms more critical than ever [2].

In the context of Nepal, while certain institutions such as airports and telecom providers have implemented biometric or digital tracking systems, most universities and colleges still rely on manual attendance processes. These are not only outdated but also fail to scale with growing class sizes and health-conscious environments. There is a clear need for a smarter, contactless, and secure solution tailored for local academic institutions [3].

To address these challenges, our project introduces a Face Recognition Attendance System enhanced with mask detection and resistance to spoofing. The system leverages real-time camera feeds and advanced computer vision techniques to identify students accurately, even when wearing face masks. Anti-spoofing mechanisms such as blink detection and head movement tracking ensure that only live individuals are marked present, thereby reducing the risk of fraudulent entries. Attendance data is logged securely into both CSV files and an optional MySQL database for scalability and integration with broader academic management systems.

This project aims to provide a reliable, efficient, and secure attendance management solution that adapts to modern requirements while minimizing administrative overhead and improving accuracy.

# 2. Problem Statement

In educational institutes and workplaces, manual or traditional methods are still being used to track attendance. These traditional methods such as roll calls, sign-in sheets and ID card swipes are time consuming, prone to human error and vulnerable to fraudulent activities such as proxy attendance. A face recognition system can address these issues in attendance tracking. However the COVID-19 pandemic has introduced a new problem in traditional face recognition system with the wide use of face masks. It reduces accuracy as well as increase the risk of spoofing attacks which tries to fool the system by using photos and videos.

Thus our system aims to create a desktop based face recognition attendance system that first begins with core face recognition module and gradually adds features for mask detection and anti-spoofing.

# 3. Objectives

The primary goal of this project is to develop a robust and intelligent desktop-based Face Recognition Attendance System enhanced with mask detection and anti-spoofing mechanisms. The system aims to:

* Replace manual attendance systems with a real-time facial recognition-based solution using computer vision techniques.
* Integrate a mask detection model that verifies whether users are wearing masks correctly and flag or deny attendance otherwise.
* Implement liveness detection techniques such as blink detection and head movement to resist spoofing via static images or videos.
* Maintain real-time attendance records in CSV format or a relational database, with timestamps and session tracking.

# 4. Methodology

For the development of the Face Recognition Attendance System with Mask Detection and Anti-Spoofing, we will adopt an Iterative Development Model. This approach suits our project well, as we are actively learning, experimenting, and refining features during development.

We will begin with the core face recognition module, then gradually add features such as mask detection, anti-spoofing (blink and head movement detection), and finally database integration. Each module will be independently developed, tested, and refined before moving on to the next, ensuring that the system remains functional and adaptable throughout the process.

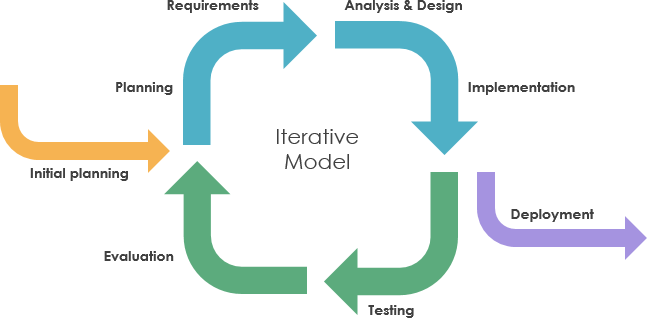


Figure 1: Iterative Software Development Model

## 4.1 Requirement Identification

Face recognition technology has advanced quickly, leading to its use in security, authentication, and attendance systems. To improve accuracy and prevent impersonation, modern solutions now include mask detection and anti-spoofing, especially in response to health and digital security concerns.

### 4.1.1 Study of Existing System/ Literature Review

**Smart Attendance Systems (SAS)**

Systems like SAS use facial recognition to automate attendance marking. These are typically built with OpenCV and Haar Cascades or LBPH algorithms for face detection and recognition. However, many such systems are limited to basic recognition and fail to consider real-world complications like face masks or spoofing threats [4].

**SecurOS® FaceX**

SecurOS® FaceX is a commercial face recognition attendance system used in corporate environments. It supports real-time recognition and stores attendance logs on the cloud [5]. However, its reliance on consistent network access and commercial licensing can limit its accessibility for smaller institutions.

**Real-Time Mask Detection Models (MobileNet, ResNet)**

Following the COVID-19 outbreak, several open-source projects (e.g., by Prajna Bhandary, 2020) integrated real-time mask detection into facial recognition pipelines using CNN models like MobileNetV2 [6]. While effective, most of these systems focused solely on detecting masks, without connecting to larger attendance systems or databases.

**AI Thermal Scanners with Mask Detection (used in airports)**

Some high-end commercial systems, especially in airports or hospitals, integrate mask detection with thermal scanning and face verification [7]. However, these are hardware-intensive and not easily replicable in educational or budget-constrained settings.

### 4.1.2 Requirement Analysis

Requirement analysis focuses on determining the needs of a system. The purpose of this analysis is to ensure that the software or system meets the desired goals. This system enables users register their face, mark their attendance and view the attendance log as well.

1. **Functional Requirement**

Functional requirements define the core functions the system must perform to meet its purpose.

1. User Face Registration

* Users should be able to register their face data through the system, which will be used for future identification and attendance tracking

1. Real-Time Face Recognition

* The system must detect and recognize registered users in real-time using a live camera feed

1. View Attendance Records

* Users or administrators should be able to view daily attendance records, preferably with filtering options such as date or name.

1. Mask Detection and Anti-Spoofing Mechanism

* During recognition, the system should detect whether the user is wearing a mask correctly. Attendance may be flagged or denied based on the result.
* The system should prevent fake attendance through photos or videos by incorporating liveness detection methods like blink detection and head movement.

1. Database Integration

* All user data and attendance logs should be stored in a structured and persistent MySQL database.

1. **Non-functional Requirement**

Non-functional requirements define the quality and performance aspects of the system, ensuring it works efficiently and reliably.

1. Performance: Face recognition and mask detection should happen in real-time with minimal delay.
2. Security: The system should prevent fraudulent entries using liveness detection and secure data storage.
3. Usability: The interface should be user-friendly and intuitive for both technical and non-technical users.
4. Portability: The system should run on Windows desktops with minimal installation/configuration steps.

## 4.2 Feasibility Study

The purpose of the feasibility study is to consider all the aspects of the proposed project and determine its success. It also evaluates the project for its practicality. In this chapter we determine if we have the right technology, financial resources, and time required to complete the project and whether the project will be completed in time.

### 4.2.1 Technical

The required technologies such as Python, OpenCV, MySQL, and deep learning libraries (Keras, dlib) are accessible and compatible with the system. Hardware requirements (webcam, computer) are minimal. So tei vayera fesible cha elkhnii

### 4.2.2 Operational

Our system is easy to use with a simple interface. Users can perform tasks like registration, attendance tracking, and dataset management with minimal training.

### 4.2.3 Economic

The system uses open-source tools, reducing costs significantly. It can run on standard computers without requiring high-end hardware or paid licenses.

### 4.2.4 Schedule

The project is estimated to take 2-3 months to complete. Based on the available resources, skills of our team members, and the tasks we need to complete, the proposed schedule is feasible. We can make sure the project is finished on time by keeping a close eye on the project and regularly checking for progress.

## 4.3 High Level Design of System

System Flow diagram

# 5. Expected Outcome

Upon completion, our system is expected to have the following functionalities and features:

1. Automated Attendance System: A fully functional face recognition-based attendance system capable of recording attendance in real time.
2. Mask Detection Feature: Ability to detect if a person is wearing a mask correctly, with options to flag or deny attendance.
3. Anti-Spoofing Mechanisms: Integration of liveness detection techniques (e.g., blink detection, head movement) to prevent fraudulent attendance.
4. User-Friendly Interface: A simple and accessible desktop GUI for student registration, live monitoring, and attendance viewing.
5. Accurate Attendance Logs: Attendance data stored in a structured format (CSV/database) with timestamps and duplicate prevention.
6. Expandable Design: System architecture that supports future enhancements, such as deeper model integration or cloud syncing.

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