Biometric Attendance System

Final Project Report

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Declaration

I, **Yashwanth K R**, hereby declare that the project entitled **"Biometric Attendance System"** is a result of my own efforts and research. It has not been submitted to any other institution or university for the award of any degree or diploma.

Signature

(Yashwanth K R)

Abstract

Biometric authentication has emerged as a reliable and secure method of identifying individuals. This project focuses on building an easy-to-deploy biometric attendance system that uses either fingerprint or facial recognition for marking attendance. It is built around a microcontroller (Arduino or Raspberry Pi) interfaced with biometric sensors. The project includes real-time data logging into an SQLite or MySQL database and provides hands-on experience in embedded systems and biometric security.

The objective is to help learners understand how biometric authentication works and how to design and deploy a complete attendance management system with real-time functionality. The solution can be scaled and improved further to meet institutional or enterprise-level requirements.

Contents

Introduction

Biometric technologies offer a promising solution for identification and authentication, providing higher security and convenience over traditional methods like PINs or swipe cards. This project aims to design and implement a simple yet effective biometric attendance system, capable of recording attendance automatically using either fingerprint or facial data.

The system is especially useful in academic and professional settings where monitoring attendance is critical. The motivation behind this project is to explore the integration of embedded hardware with secure biometric recognition algorithms and real-time database logging. Through this, the project demonstrates how embedded systems can be used to develop secure and efficient applications.

1.1 Project Type and Duration

- **Type:** Basic
- **Duration:** 6 hours (excluding documentation)
- **Complexity:** Easy
- **Portfolio Worthy:** Yes

1.2 Learning Outcomes

- Understand biometric authentication systems.
- Learn integration of biometric sensors with microcontrollers.
- Real-time attendance logging into database systems.
- Practical skills in embedded system design and database programming.

Requirements

2.1 Hardware Requirements

- **Microcontroller:** Arduino Uno or Raspberry Pi
- **Biometric Sensor:** Fingerprint sensor (e.g., R305) or USB webcam (for facial recognition)
- **Display Module:** 16x2 LCD / OLED (optional)
- **Power Supply:** 5V DC or USB
- **Storage:** MicroSD card or onboard memory (optional)
- **Other Accessories:** Jumper wires, breadboard, resistors

2.2 Software Requirements

- **Programming Language:** Python / C++
- **IDE:** Arduino IDE / Thonny / VS Code
- **Database:** SQLite or MySQL
- **Libraries:** OpenCV, pyserial, sqlite3, Adafruit$_{F}ingerprint, etc.$**Operating System:**$Windows/Linux($

2.3 Manpower

- 1–2 Students
- 1 Project Guide (Faculty)

2.4 Estimated Cost

- **Microcontroller:** 500 – 3000
- **Fingerprint Sensor:** 800 – 1500
- **Miscellaneous Components:** 200 – 500
- **Total:** Approx. 2000 – 5000

System Design

3.1 Workflow

The general workflow of the system is as follows:

1. User places their finger on the fingerprint sensor or face is scanned via webcam.
2. Sensor captures and processes biometric input.
3. The input is matched with stored data in the microcontroller's memory or database.
4. If a match is found, the system marks attendance with a timestamp in the database.
5. Optionally, the attendance can be displayed on a screen or transmitted to a server.

3.2 Database Schema

Table: attendance

- `id` (INTEGER PRIMARY KEY)
- `name` (TEXT)
- `roll_no` (TEXT)
- `timestamp` (DATETIME)

Implementation

4.1 Fingerprint-Based System

The fingerprint sensor module (e.g., R305) communicates with the Arduino Uno using serial communication. The Arduino stores enrolled fingerprints in its internal memory and compares captured fingerprints against them.

- Enrollment is done using the Adafruit Fingerprint library.
- Each fingerprint ID is mapped to a student's name and roll number.
- Attendance is recorded by writing the student's ID and timestamp into the serial monitor or stored in a microSD card.

4.2 Face Recognition-Based System (Python + OpenCV)

An alternative approach uses a USB webcam and OpenCV for real-time face recognition. The steps involved are:

1. Capture images of each student and assign labels (names/roll numbers).
2. Train the recognizer using the LBPH (Local Binary Pattern Histogram) algorithm.
3. During recognition, OpenCV compares faces in real-time against the trained dataset.
4. On successful match, attendance is marked in a SQLite/MySQL database with the timestamp.

4.3 Sample Code Snippet

```
import cv2
import sqlite3
from datetime import datetime

def mark_attendance(name):
    conn = sqlite3.connect('attendance.db')
    c = conn.cursor()
    c.execute("INSERT INTO attendance (name, timestamp) VALUES (?, ?)",
              (name, datetime.now()))
```

```
conn.commit()
conn.close()
```

Results

5.1 Observations

- The fingerprint system accurately identifies pre-enrolled users in under 2 seconds.
- The face recognition system works best under well-lit conditions and with frontal facial images.
- The attendance is stored in persistent memory (text/CSV/database).

Conclusion

This project successfully demonstrates an efficient, low-cost, and real-time biometric attendance system. It enhances traditional attendance mechanisms by automating the process and reducing human error. Both fingerprint and facial recognition approaches were explored, and each offers advantages depending on the environment and deployment needs.

Future Scope

- Integration with cloud storage (Firebase, AWS) for centralized attendance.
- Mobile application interface for admin and student access.
- Use of RFID or QR codes in combination for added flexibility.

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