Acknowledgements

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Abstract:

This project aims at designing a student attendance system which could effectively manage attendance of students at departments like computer science and engineering or any other departments of Rajshahi University. Attendance is marked after student identification. For student identification, a fingerprint recognition based identification system is used. Fingerprints are considered to be the best and fastest method for biometric identification. They are secure to use, unique for every person and does not change in one's lifetime. Fingerprint recognition is a mature field today, but still identifying individual from a set of enrolled fingerprints is a time taking process. It was my responsibility to improve the fingerprint identification system for implementation on large databases e.g. of a department or an university. In this project, many new hardware are used to develop an identification system which is faster in implementation and cost effective than any other system available today in the market. Although in this project this fingerprint identification system is being used for student identification purpose, but it could perform very well on other applicable areas like that of an industry or garments database.

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Chapter 1

Introduction:

1.1 Project Scope

User authentication have a great significance for organizational security. The main purpose of this project is not only to ensure organizational security but to also develop a completely **automated information system** (**AIS**) to allow the teachers of a department to control all affairs of student attendance more efficiently. We will use Raspberry Pi 3 and Biometric Fingerprint Scanner to implement the hardware portion of the AIS. And we will use Python to handle the backend processing and PyQt5 to create an interactive user interface. This will digitize the process of attendance management and make it more hassle less and dependable.

1.2 Problem Statement

Designing a student attendance management system based on fingerprint recognition using raspberry pi 3. Which will be faster and cost effective than many other identification system that manages records for attendance in department like CSE, RU.

1.3 Motivation and Challenges

Every organization whether it be an educational institution or business organization, it has to maintain a proper record of attendance of students or employees for effective functioning of department or organization. Designing a better attendance management system for students so that records can be maintained with ease and accuracy was an important key behind motivating

this project. This would improve accuracy of attendance records because it will remove all the hassles of roll calling and will save valuable time of the students as well as teachers. Fingerprint recognition are very advanced today in terms of technology. It was my challenge to implement a system using cost effective hardware that can digitize the attendance management system with better accuracy.

1.4   Using Biometrics

Biometric Identification Systems are widely used for unique identification of humans mainly for verification and identification. Biometrics is used as a form of identity access management and access control. So use of biometrics in student attendance management system is a secure approach. There are many types of biometric systems like fingerprint recognition, face recognition, voice recognition, iris recognition, palm recognition etc. In this project, I used fingerprint recognition system.

1.5   Why use Fingerprints?

Fingerprints are considered to be the best and fastest method for biometric identification. They are secure to use, unique for every person and does not change in one's lifetime. Besides these, implementation of fingerprint recognition system is cheap, easy and accurate up to satisfies ability. Fingerprint recognition has been widely used in both forensic and civilian applications. Compared with other biometrics features, fingerprint based biometrics is the most proven technique and has the largest market shares. Not only it is faster than other techniques but also the energy consumption by such systems is far less.

1.6 Using Fingerprint Based Recognition System for Attendance Management

Managing attendance records of students of an institute is a tedious task. It consumes time and paper both. To make all the attendance related work automatic and hassle free, I have designed an attendance management system which could be implemented in dept. of CSE, RU. It uses a fingerprint identification system using a fingerprint scanner module and Raspberry pi 3. It counts the attendance for every student present in a day and stores the attendance in a course specific database. A database is an organized collection of data. It is the collection of schemas, tables, queries, reports, views and other objects. The data are typically organized to model aspects of reality in a way that supports processes requiring information, such as modelling the availability of rooms in hotels in a way that supports finding a hotel with vacancies.

1.7 Core Objectives

The main objective of this application is to store database files which contain necessary information of the student for attendance records. Making an attendance sheet in manual system take more time and hassle. The main objectives of this project can be mentioned as

- To design a complete database of fingerprints and their corresponding employee profiles.
- To design an interactive UI to facilitate the handling of front end data.
- Make attendance sheet for any course easily and quickly.
- Efficient management of data.
- Saving manpower and valuable class time.

The core objective is to create and store database which contain necessary information of attendance management system and that information can be viewed at any time.

Chapter 2

Analysis:

2.1 Existing System

We are a civilization living in twenty first century. But still in our country, maximum educational institute manages the attendance records system in and old fashioned way. Most of the educational institute is managing their attendance records by using human and paper, without depending on computer based system. This increases the chance of errors and miss managements. Also this old fashion way of handling attendance is a hectic process. Teachers have to take attendance of all of the students everyday by roll calling. This eats up a significant amount of valuable class period. To overcome this some of the institutions in Bangladesh have implemented a system of fingerprint and RFID based attendance system. But those systems are way too expensive and less reliable as there are only one module installed on the main entrance. That is because the system is expensive and not mobile. This decreases the integrity and dependability of the system.

2.2 Proposed System

All the hassles of old fashioned attendance system can be computerized to increase efficiency, flexibility and dependability. This project aims at creating a pocket sized computerized system of attendance management using the Raspberry pi 3 that provides better efficiency, security and accuracy. This computerized system can provide us better result generating within a little time. As the whole system will be very small but efficient it will have much better mobility and as the system will be a lot less expensive every department can have their own multiple modules to handle attendance. This will reduce the dependability problem that exists among the currently available expensive systems. one of the biggest benefits this system for educational institutes is that students will be unable to clock in for one another. This will overcome the integrity problem that exists in the RFID based attendance systems

Chapter 3

Technology Used:

3.1   Hardware

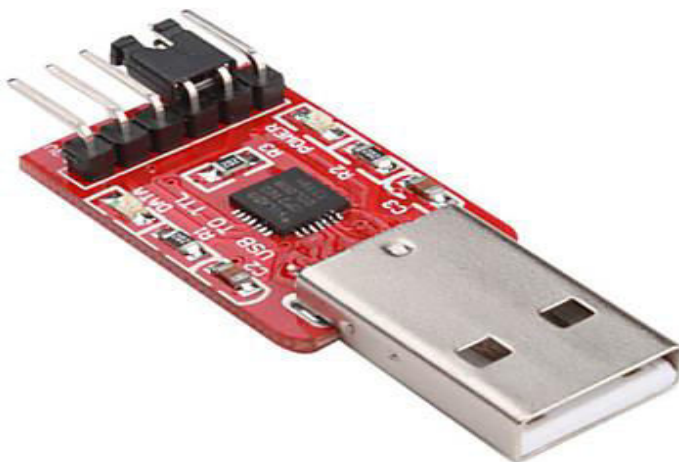1. Raspberry Pi 3
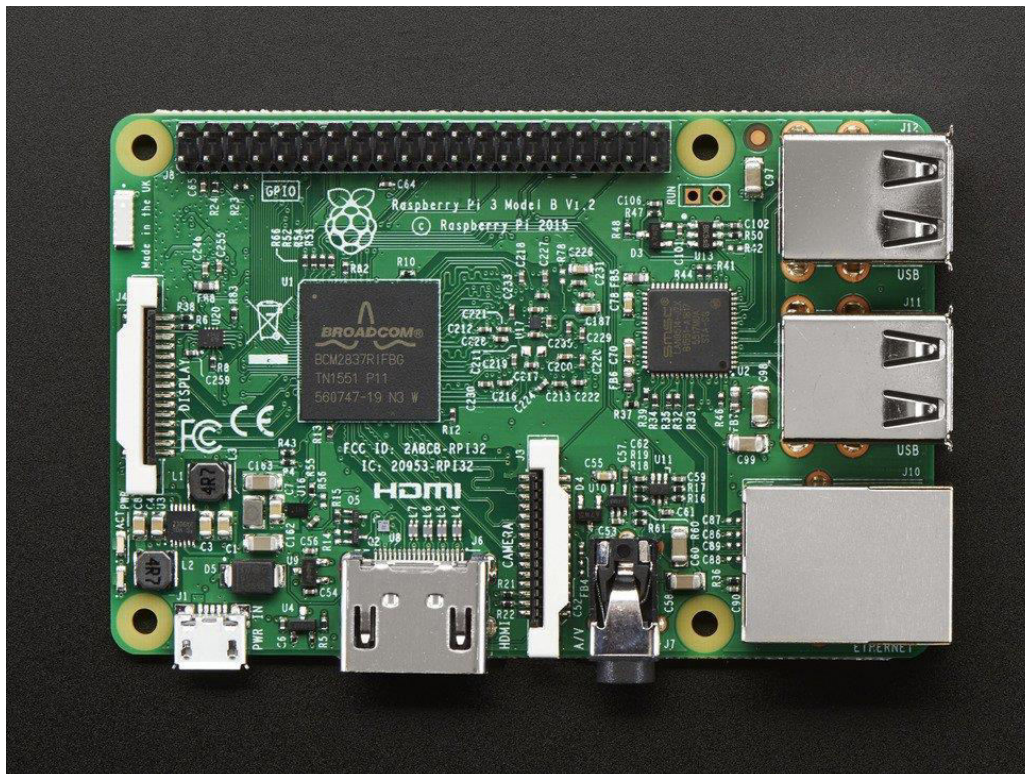
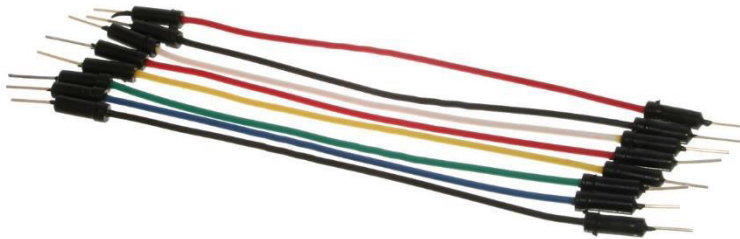## 2. R305 Fingerprint Scanner Module

Pic :- R305 Fingerprint Module

3. USB to UART Converter Module

4. Jumping Wires

3.2:   Software Elements

- Python
- PyQt5
- SQLite
- CSS
- Serial Interfacing

Chapter 4

Background Study:

4.1 Raspberry Pi 3

Raspberry Pi is a low-cost, basic computer that was originally intended to help spur interest in computing among school-aged children. The computer runs entirely on open-source software and gives students the ability to mix and match software according to the work they wish to do. The Raspberry Pi is contained on a single circuit board and features ports for:

- HDMI
- USB 2.0(4x)
- Composite Video
- Analog Audio
- Ethernet Port
- Wifi Module
- Bluetooth
- Power
- GPI/O Pins

4.2 R305 Fingerprint Scanner Module

Optical biometric fingerprint reader with great features and can be embedded into a variety of end products. This is a fingerprint sensor module with TTL UART interface for direct connections to microcontroller UART or to PC through MAX232 / USB-Serial adapter. The user can store the finger print data in the module and can configure it in 1:1 or 1: N mode for identifying the person. The fingerprint module can directly interface with 3v3 or 5v Microcontroller. A level converter is required for interfacing with PC

serial port. R305 has 4 pins to interface with outside world those are mentioned in the following table:

Name	Type	Function Description
+5V	in	Power input
GND	.	Signal ground. Connected to power ground (color: black
Tx	in	Data Output. TTL logic level
Rx	out	Data input. TTL logic level

4.3   R305 USB to UART Converter Module

These sensors were originally developed for the Arduino and can be read via UART. The Raspberry Pi has two pins (pin 8 / GPIO14 and pin 10 / GPIO 15), but they work with 3.3V. Since there are different fingerprint sensors, which do not all work with 3.3V, a USB UART converter is used. Some models can be used with both 3.3V and 5V voltage. These are particularly suitable for raspberry pi 3.

4.4   Python

Python is an interpreted, object-oriented, high-level programming language with dynamic semantics. Its high-level built in data structures, combined with dynamic typing and dynamic binding, make it very attractive for Rapid Application Development, as well as for use as a scripting or glue language to connect existing components together. Python's simple, easy to learn syntax emphasizes readability and therefore reduces the cost of program maintenance. Python supports modules and packages, which encourages program modularity and code reuse. The Python interpreter and the extensive standard library are available in source or binary form without charge for all major platforms, and can be freely distributed.

Often, programmers fall in love with Python because of the increased productivity it provides. Since there is no compilation step, the edit-test-debug cycle is incredibly fast. Debugging Python programs is easy: a bug or bad input will never cause a segmentation fault. Instead, when the interpreter discovers an error, it raises an exception. When the program doesn't catch the exception, the interpreter prints a stack trace. A source level debugger allows inspection of local and global variables, evaluation of arbitrary expressions, setting breakpoints, stepping through the code a line at a time, and so on. The debugger is written in Python itself, testifying to Python's introspective power.

Why to use Python:

- The Python Package Index (PyPI) contains numerous third-party modules that make Python capable of interacting with most of the other languages and platforms.
- Python provides a large standard library which includes areas like internet protocols, string operations, web services tools and operating system interfaces.
- Python has clean object-oriented design, provides enhanced process control capabilities, and possesses strong integration and text processing capabilities and its own unit testing framework, all of which contribute to the increase in its speed and productivity.

4.5   PyQt5

PyQt combines Python and Qt into a best-of-breed solution suited for Python developers looking for a GUI framework, and for technical professionals looking for a migration path from Visual Basic. In addition, PyQt is an excellent option for software professionals who need to use agile development practices to rapidly deliver large, scalable, GUI applications.

Since PyQt insulates programmers from platform differences and from Windows version differences, they can avoid spending unproductive time and energy on dealing with

platform and version issues, and focus on actually developing the software that needs to be delivered.

Why to use PyQt5:

- PyQt also is written in C++, but it does not use native widgets, and instead creates approximations of widgets depending on what OS it detects.
- PyQt support Linux, Windows, and Mac, so they're perfect for the famously cross-platform Python.

4.6 SQLite

A database-management system is a computer-software application that interacts with end users, other applications, and the database itself to capture and analyze data. A general purpose DBMS allows the definition, creation, querying, update, and administration of databases. A database is generally stored in a DBMS-specific format which is not portable, but different DBMSs can share data by using standard such as SQL and SQLite or JDBC.

SQLite is an embedded SQL database engine. Unlike most other SQL databases, SQLite does not have a separate server process. SQLite reads and writes directly to ordinary disk files. A complete SQL database with multiple tables, indices, triggers, and views, is contained in a single disk file. The database file format is cross-platform - you can freely copy a database between 32-bit and 64-bit systems or between big-endian and little-endian architectures. These features make SQLite a popular choice as an Application File Format. SQLite database files are a recommended storage format by the US Library of Congress.

Why to use SQLite:

- Better performance. Reading and writing from an SQLite database is often faster than reading and writing individual files from disk. It is 35% Faster Than the File system and Internal Versus External BLOBs.

- Reduced application cost and complexity. Content can be accessed and updated using concise SQL queries instead of lengthy and error-prone procedural routines.

- Portability. The application file is portable across all operating systems, 32-bit and 64-bit and big- and little-endian architectures.

- Reliability. Content can be updated continuously and atomically so that little or no work is lost in a power failure or crash.

4.7   CSS

Cascading **S**tyle **S**heets, fondly referred to as CSS, is a simple design language intended to simplify the process of making web pages and user interfaces presentable.

CSS handles the look and feel part of a web page. Using CSS, you can control the color of the text, the style of fonts, the spacing between paragraphs, how columns are sized and laid out, what background images or colors are used, layout designs, variations in display for different devices and screen sizes as well as a variety of other effects.

CSS is easy to learn and understand but it provides powerful control over the presentation of an HTML document. Most commonly, CSS is combined with the markup languages HTML or XHTML

Why to use CSS:

The reasons behind using CSS are shown below.

- CSS provides efficiency in design and updates.
- CSS use can lead to faster page downloads.
- CSS is easy to work with.

Chapter 5

Design Steps & Schedule:

The project design steps and time frame are shown in detail in the following picture

	Hot	Task Name	Duration	Start	Finish	Predecessors	Status
1		Bio-metric Attendance System Based on Raspberry PI 3	190d	10/03/17	06/25/18		
2		Planning and Hardware Collection	50d	10/03/17	12/11/17		
3		Project Planning	11d	10/03/17	10/17/17		Not Started
4		Collecting Necessary Hardware	31d	10/18/17	11/29/17		Not Started
5		Interfacing Fingerprint Module with Raspberry PI	8d	11/30/17	12/11/17		Not Started
6		Backend	100d	12/12/17	04/30/18		
7		Learning Python	24d	12/12/17	01/12/18		Not Started
8		Learning SQLite Database	28d	01/06/18	02/13/18		Not Started
9		Developing Backend and Database	57d	02/04/18	04/23/18		Not Started
10		Testing Backend	12d	04/15/18	04/30/18		Not Started
11		Frontend	42d	04/27/18	06/25/18		
12		Learning PyQt 5	12d	04/27/18	05/14/18		Not Started
13		Developing Frontend	19d	05/09/18	06/04/18		Not Started
14		Interfacing Hardware Functionality with Frontend	14d	05/29/18	06/15/18		Not Started
15		Testing Frontend	15d	06/05/18	06/25/18		Not Started
16							

Gantt Chart:

Task Name		Q4			Q1			Q2		
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
1	− Bio-metric Attendance System Based on Raspberry PI 3									
2	− Planning and Hardware Collection				Planning and Hardware Collection					
3	Project Planning	Project Planning								
4	Collecting Necessary Hardware		Collecting Necessary Hardware							
5	Interfacing Fingerprint Module with Raspberry PI			Interfacing Fingerprint Module with Raspberry P						
6	− Backend						Backend			
7	Learning Python				Learning Python					
8	Learning SQLite Database					Learning SQLite Database				
9	Developing Backend and Database						Developing Bac			
10	Testing Backend						Testing Backe			
11	− Frontend									
12	Learning PyQt 5							Learning F		
13	Developing Frontend							Deve		
14	Interfacing Hardware Functionality with Frontend							In		
15	Testing Frontend									
16										

Chapter 6

Implementation:

6.1 Hardware:

We first need to boot up Raspberry Pi 3 with an OS. For this project we will boot the Pi with Debian Linux based OS Raspbian. For Hardware implementation the R305 fingerprint module needs to be connected to the Raspberry Pi 3 through a USB to UART converter module. In this project The CP2012 USB to UART module is used. To connect those some Female-Female Jumping wires are used. There are four cables that comes out of our Fingerprint module. The four cables are red, black, yellow and green in color. And wired connection between The USB to UART module and Fingerprint Scanner will be as exactly shown in the table.

Fingerprint module Wires	CP2102 Pins
Red	+5V
Black	GND
Yellow	RX
Blue	TX

The red wire will be connected to the +5v port of the CP2102, the black wire will be connected to GND of CP2012, the yellow and blue wires will be connected to RX and TX pins of CP2012 respectively.
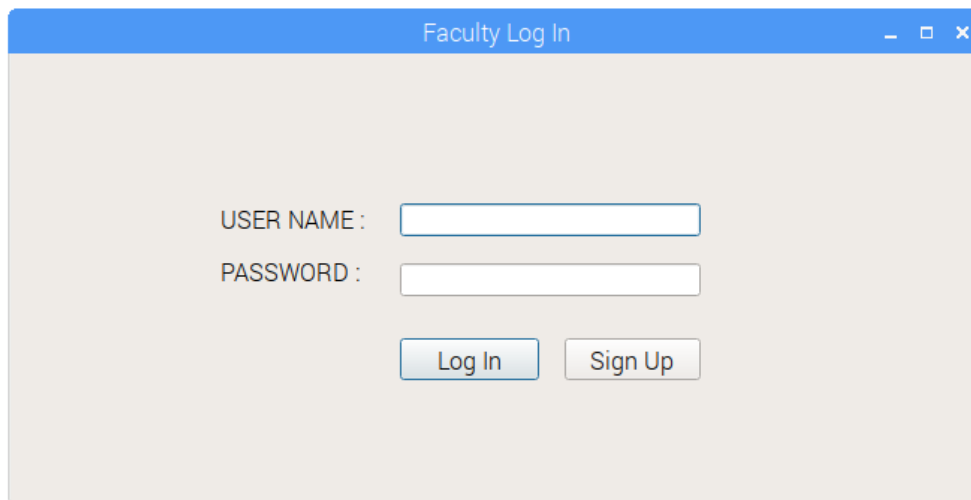
After this connection is established the CP2102 will be connected to Raspberry pi 3 via USB 2.0 port.

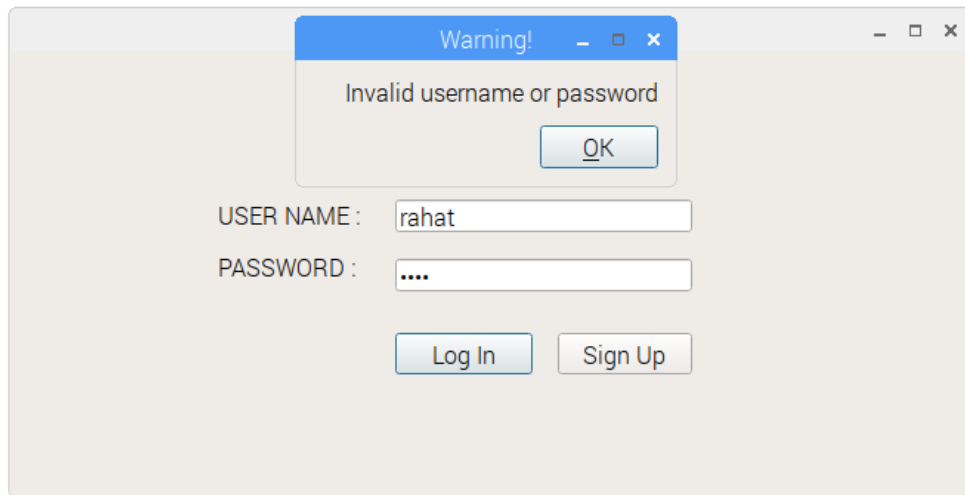# 6.2 Front End Technology:

6.2.1 Log in UI

Log form contains mainly two options. i. Log In ii. Sign Up

Whenever a teacher opens the application he/she has to provide their Faculty id and password to log in to the biometric attendance system. A default user id and password will be provided to all the teachers at first for log in and later they can create their own user id and password through sign up UI. But he/she needs to enter a valid user id and password first to sign up.

6.2.2 Sign Up UI

Signing form contains mainly three fields. i. Username, ii. Password and iii. Confirm password.

During sign up process if the password and confirm password do not match the he/she won't be able to sign up. Any new user can sign up, and register himself as a new user. And after registering the new account he/she will be able to access the biometric attendance panel. Also only after registration, only can add students, and see the course wise attendance sheets.
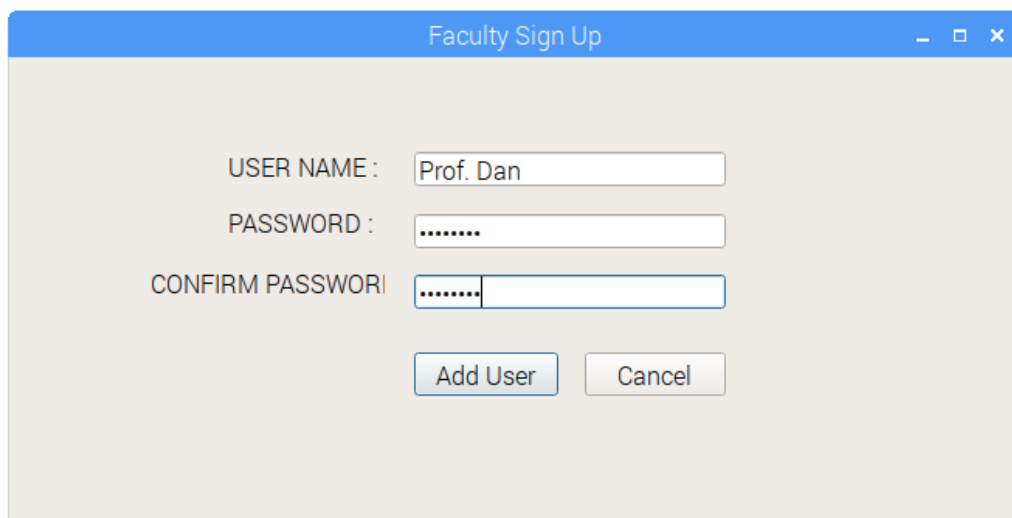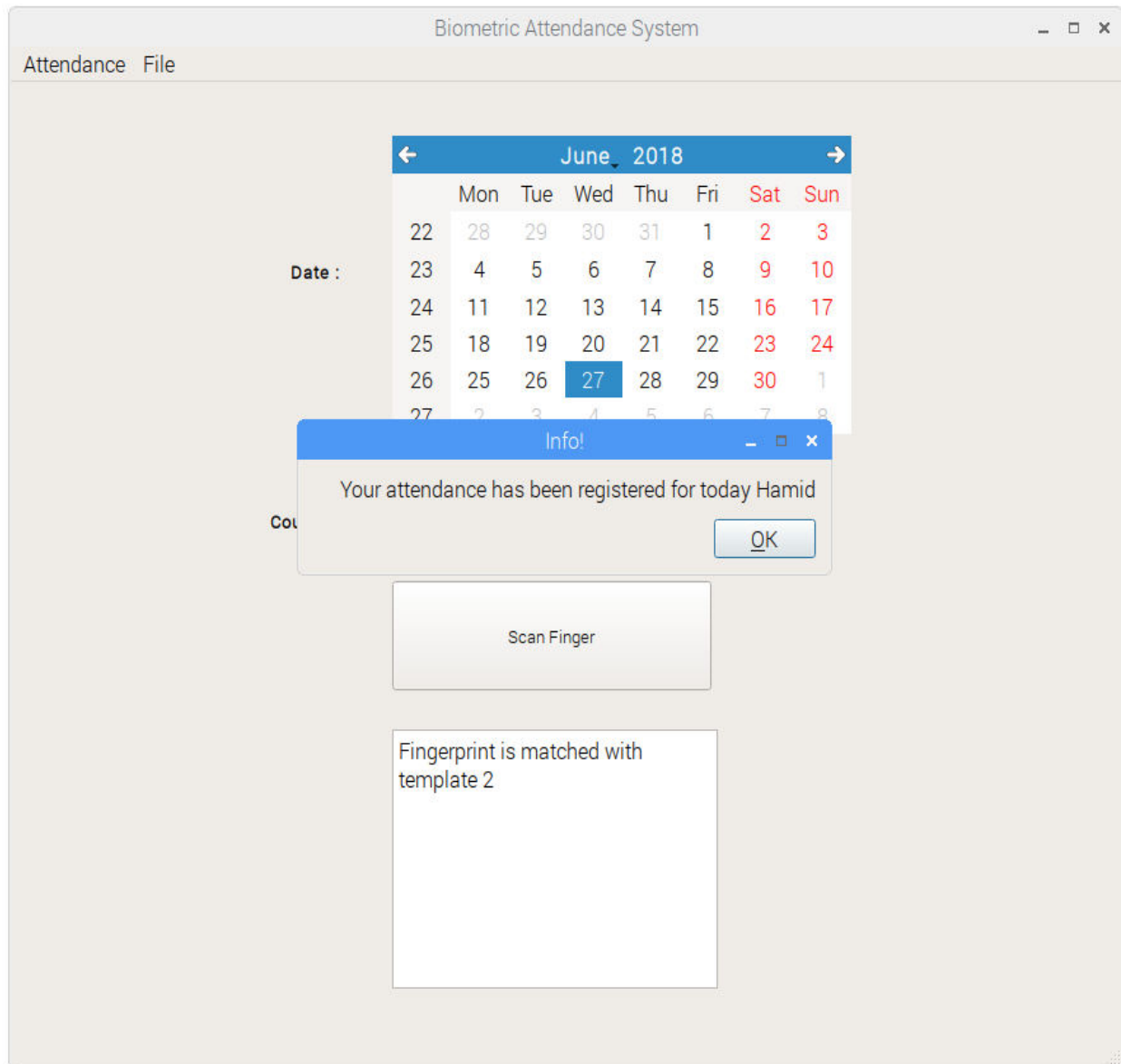
6.2.3 Biometric Attendance UI

This is the main window of this project. Here the teachers will be asked to enter a valid course name and students will be prompted to give their fingerprint. If their fingers are matched with the template stored. Then their attendance will be counted for that current date. They application will take date and time input via system OS. Neither Teacher nor students will have to control dates. This will reduce the risk of any kind of attendance theft. After Entering the valid course, the Scan finger button needs to be clicked to start counting attendance for that particular subject. If a student who already gave attendance for that date places his/her finger again on the scanner, the application will prompt as message that his/her attendance has already been counter for that date.

Pic :- Student Hamids Attendance has been counted.
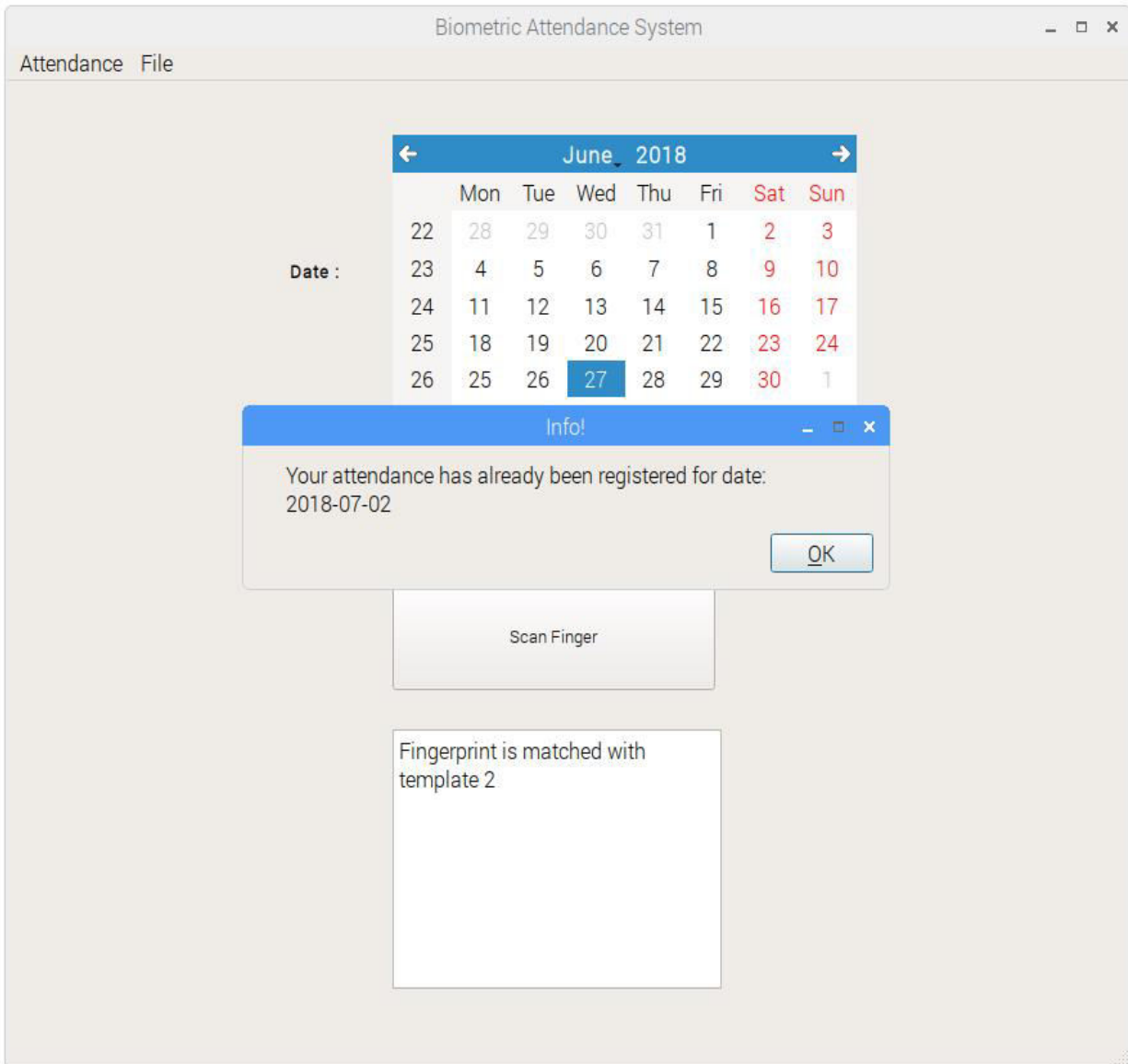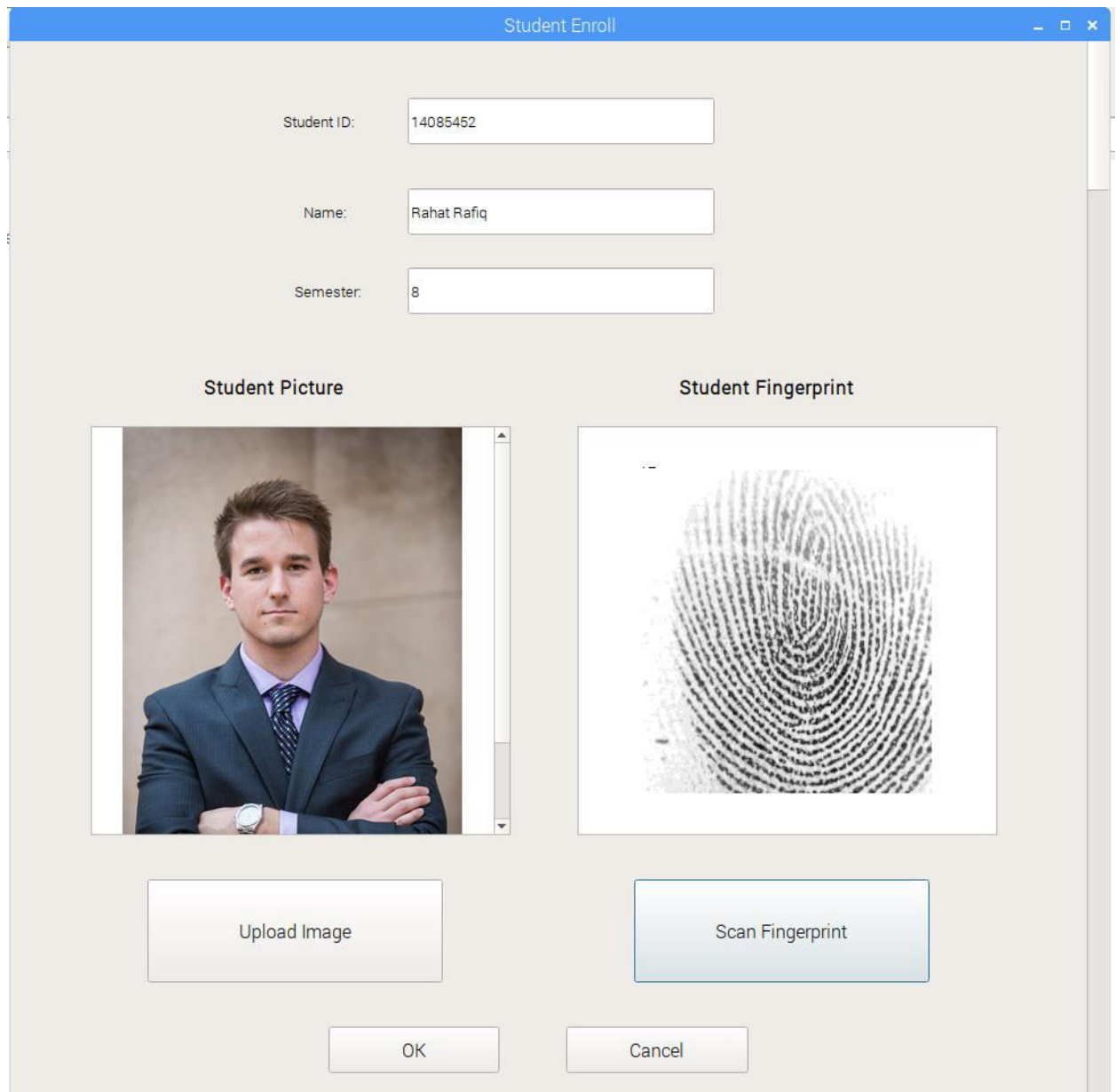
Pic:- If Hamid Tries to give his attendance again for the same date.
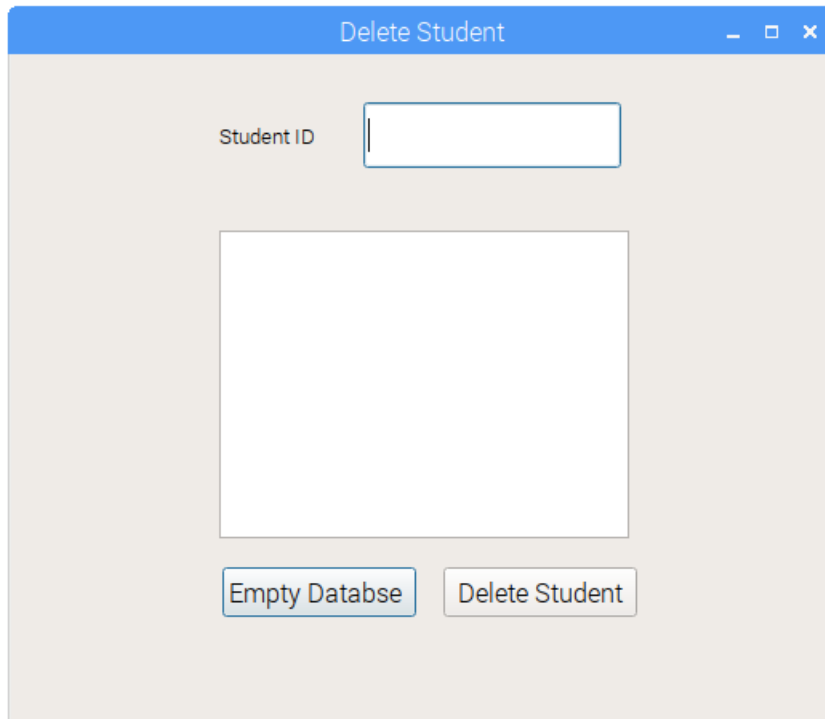
6.2.4 Student Enroll UI

This is where all student information will be enrolled in database along with his/her finger print template. The UI is as simple as possible. It only contains a minimal number of fields like student id, student name, semester, student picture and student fingerprint. Once all the information are filled up then the student will be enrolled into the database.
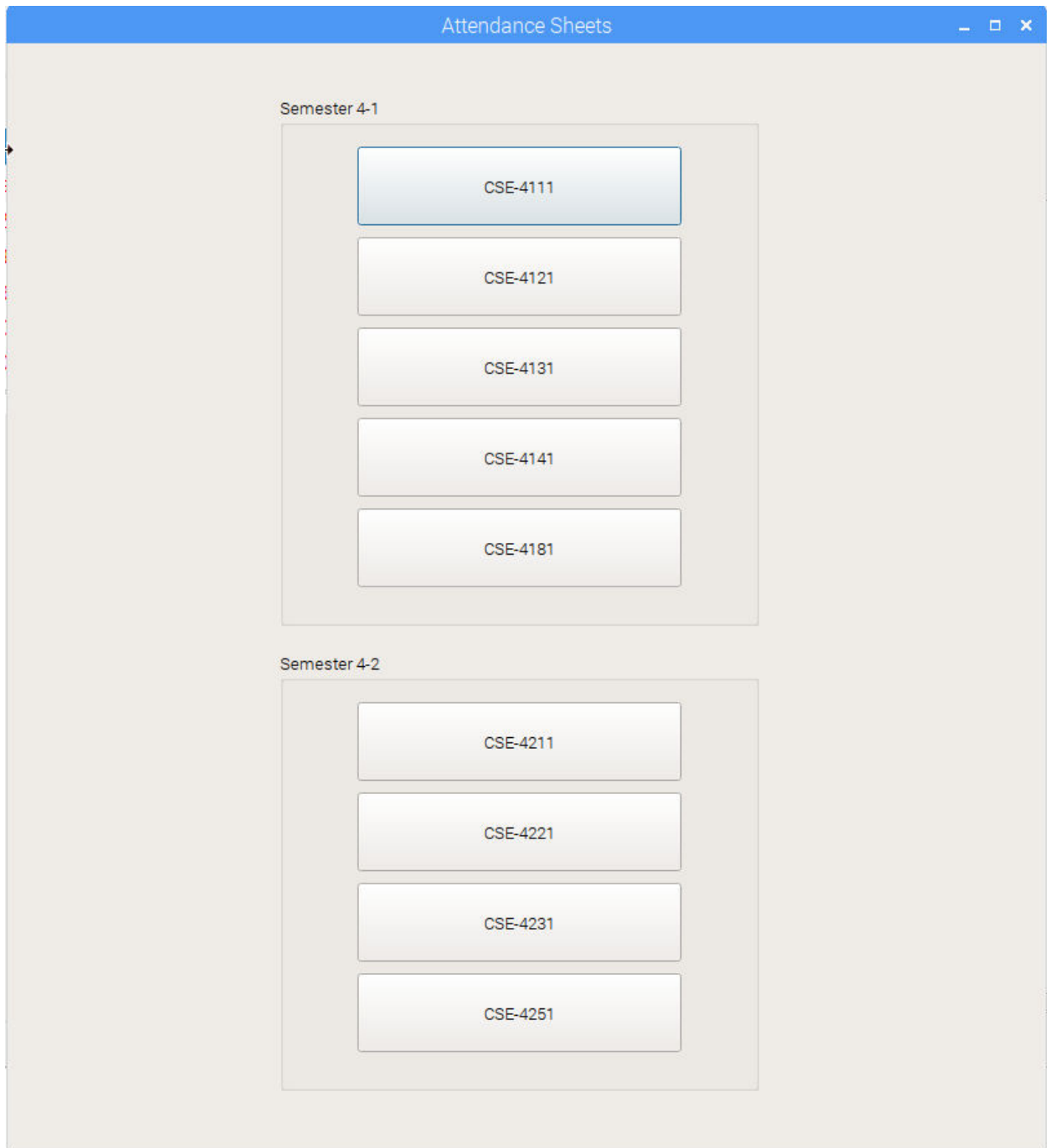
6.2.5 Student Delete UI

Using this user interface any student can be deleted from the database. Even the whole database can be emptied in a single click.

6.2.6 Attendance List UI

In this user interface all the course list will be listed. Teachers will be able to select any course he/she wants to inspect. An attendance sheet will prompt up as per the teachers selection.

6.2.7 Attendance sheet UI

Here the teachers will be able to see the present sheet for a particular subject. Only the student that were present in a particular class date of a course will be registered.

	TID	ID	Name	Date	5	6	7	8	9	10	11	12	13
1	0	14005401	Farhana	2018-07-05									
2	1	15005401	Linkon	2018-07-05									
3	0	14005401	Farhana	2018-07-07									
4	2	14085451	Hamid	2018-07-07									

PushButton   PushButton
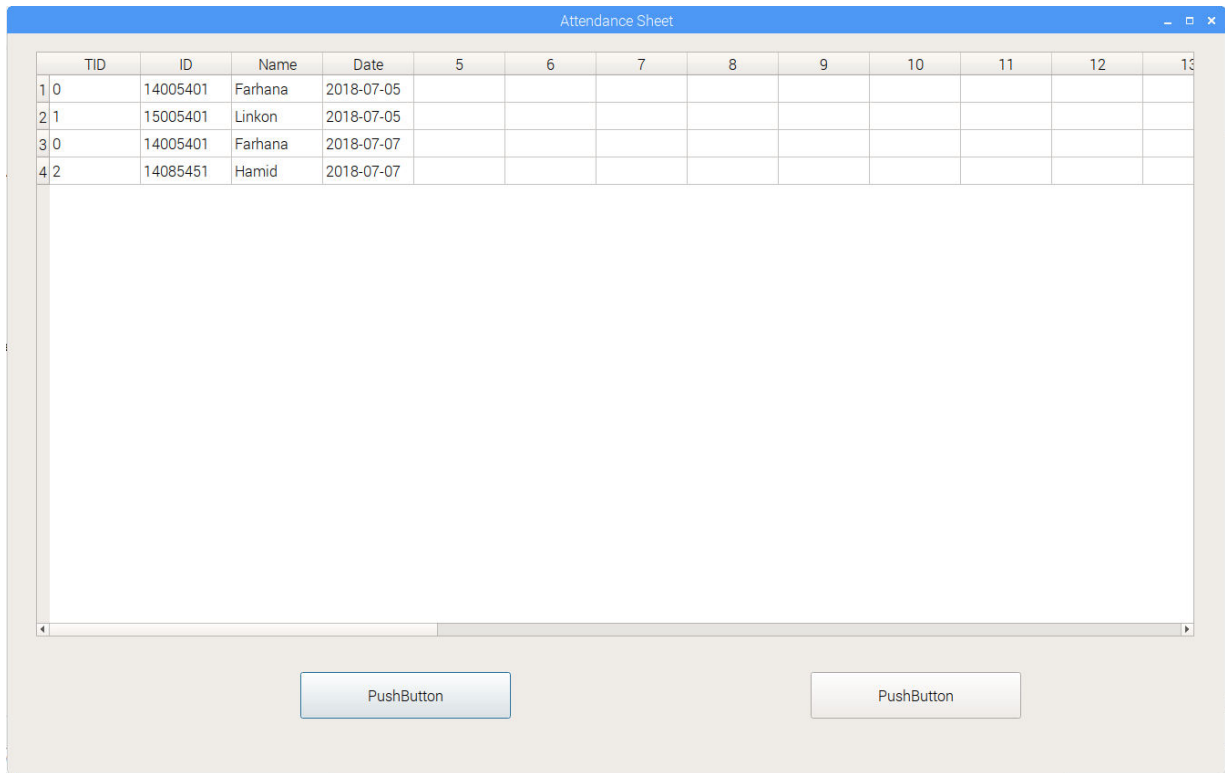
6.2.8 Back End Development

For back end development Python 3 is used here. There are many other languages that can be used to develop the back end structure because we are using the Qt framework front end design here. Qt supports other languages such as C++ to be used as back end. But here I used python because python is much faster and technologically advanced language. Also the hardware used in this project, Raspberry Pi has a better built in support for python. Not to mention Python provides a large standard library which includes areas like internet protocols, string operations, web services tools and operating system interfaces. Python will be used to handle all the hardware interfacing and event handling of the front end.

Chapter 7

Database Design:

7.1 Student Enroll Table

As every student have their unique ID and their name, picture etc. So one table is necessary for keeping that information. And that one will look like.
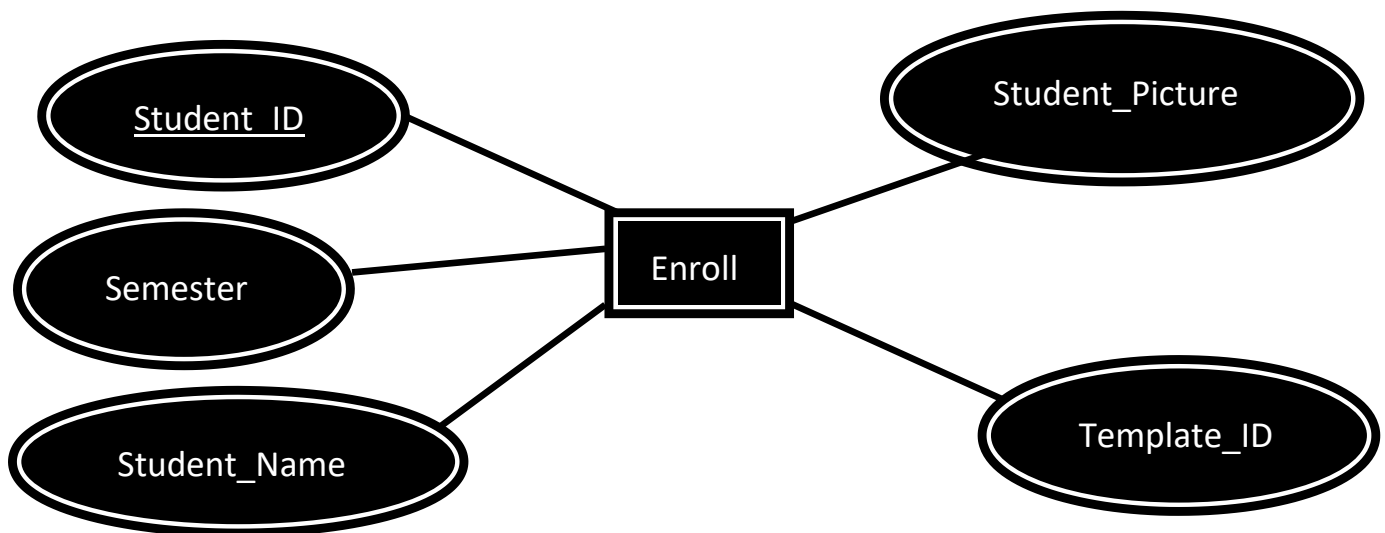
7.2 Course Wise Attendance Table

When students will register their finger on the scanner using the attendance ui their student name, student id and attendance date will be stored in the course wise database. Every course has its particular database to store attendance. A general example is will look like
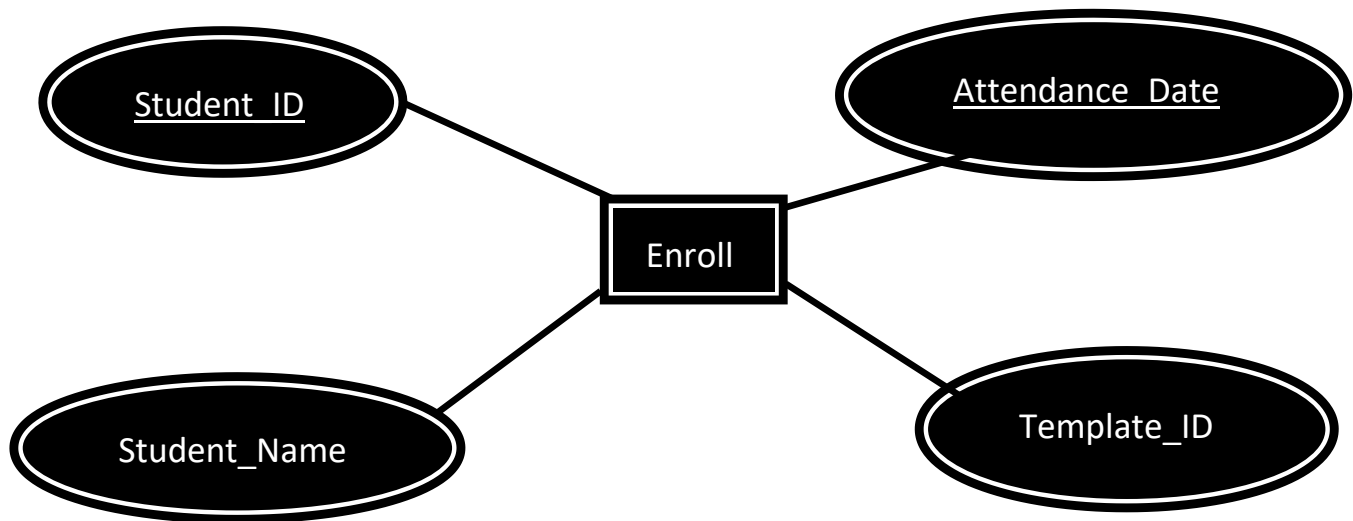
Chapter 8

8.1 Attendance Management Approach

This part explains how students and teachers will use this attendance management system. Following points will make sure that attendance is marked correctly, without any problem.

- All the hardware will be inside classroom. So outside interference will be absent.

- To remove unauthorized access and unwanted attempt to corrupt the hardware by students, all the hardware except fingerprint scanner could be put inside a small cabin.

- When teacher enters the classroom, the attendance marking will start. The Raspberry Pi software will start the process after inputting the user and password of teacher. It will get the student ID, and Students Name using the template id caught after student fingerprint authorization and it will push those information along with an attendance date into the course specific database.

8.2 Teachers manual

A teacher's duty is minimal and hassle free in this automated attendance system. Teacher has to just enter the room and start attendance application with his or her user id and password and then only select the course id he/she is taking attendance for. Then he/she can see the attendance sheet whenever he/she wants by using the attendance list UI.

8.3 Students manual

A student's duty is much simpler. He or she just needs to push the scan finger button and place the finger that registered in the system and their attendance will be counted.

Chapter 9

9.1 Feasibility Study:

9.1.1 Technical Feasibility

Technical feasibility is attainability of a system using currently existing technology. Technical feasibility takes into account whether the required technology is available or not and whether the required resources are available in terms of manpower and equipment.

The technical feasibility assessment is focused on gaining an understanding of the present technical resources of the organization and their applicability to the expected need of the proposed system.

After taking all these technical factors as in consideration, we can conclude that this project will be technically feasible because

- Raspberry Pi 3 available for open source programming and project building.
- Inexpensive fingerprint scanner module available for integrating into project.
- This project requires very little manpower.
- It is easy for connecting to network and even easier to install.

9.1.2 Economical Feasibility

Economic Feasibility requires one to make the cost benefit analysis. It is a comparison of the cost of installing system and benefits accruing from it.

- Raspberry Pi 3 will cost only 3000 BDT
- R305 fingerprint scanner module will cost only 2000 BDT.

- CP2102 USB to UART module will cost only 300 BDT.

So it is possible to build the whole system under (3000+2000+300) = 5300 BDT. Which is not a huge amount for any department of a university.

9.1.3 Operational Feasibility

The system will be easy to understand and interface for different modules. It does not require any programming skill to use the system. After a little training the users will be able to work with it. The student database can be updated at any time through the application.

Chapter 10

10.1 System Performance testing:

System testing or end-to-end testing, tests a completely integrated system to verify that it meets its requirements and performance testing is designed to test the run-time performance of software within the context of an integrated system.

The established system has a false acceptance rate of only 0.0001% which means a false acceptance once in a thousand test case. Which is pretty impressive for an inexpensive system. It also has a false rejection rate of only 0.01%. The fingerprint scanning time is only 0.5 sec and verification time is only 0.3 sec. The system has a template size of only 512 bytes. Which facilitates more template storage and better performance.

10.2 System Security testing:

As any unauthorized personnel won't be able to access the biometric attendance panel it will be secure from any misuse. The system takes the date input implicitly through the system OS. SO nobody will be able to exploit the system to register attendance for further dates in future. The system will reject any student trying to register his/her attendance twice or more times in a single day after the first time. The implementation of biometric security negates the chance of 'buddy punching' where a student can give proxy attendance for another. This problem can also be seen in smart attendance systems like RFID based attendance systems.

Chapter 11

11.1 Applications:

- This AIS can be used in all of the educational institutes to acquire and store and mange student attendance in a really effective and efficient and dependable manner.
- This system will provide better institutional security for any organization if properly implemented and maintained.
- This AIS can be used in most of the industries and offices for various purposes. Such as keeping records, work hour calculation etc.
- This system can also be used as a biometric lock to protect valuable information.
- Biometrics in Healthcare Biometrics bring security and convenience wherever they're deployed, but in some instances they also bring increased organization. This system can bring an overall effective organization in healthcare system.

11.2 Limitations:

- If a Student or Employee is missing a major organ such as Hand or finger due to some accident, the whole system will render useless for him/her.
- Faded fingerprint due to various illness or heavy work can create problem to identify personnel.
- Image captured at 500 dots per inch (dpi). Resolution: 8 bits per pixel. A 500 dpi fingerprint image at 8 bits per pixel demands a large memory space, 240 Kbytes approximately. Compression is required to store the template in a efficient way.
- Providing security of the database containing valuable personnel and organization information.
- Environment and usage can affect

11.3 Expected Outcome:

- Fully operational database of student profile based on fingerprints.
- student identity authentication system.
- Better attendance management and organizational security.
- An applicable attendance system will be designed for educational organizations.
- An improved and mobile fingerprint identification system will be developed for student attendance management system.

11.4 Future Plan:

In this current project all the data will be stored and processed locally. But there is immense opportunity to expand this project. There is future plan to build a web data server and store all the information and fingerprint templates there. By achieving this we will be able to expand the project and we will be able to implement the system for a whole university rather than a single department A website will be hosted on the server for online access to attendance reports. This biometric authentication system can also be implemented as an industry employee management system. Where similarly employee attendance will be counted and a specific amount of salary can be deducted according to absent work hours.

Chapter 12

12.1 Conclusion

This project mainly comprised of development of attendance management system and fingerprint identification system. Attendance management is very helpful in saving valuable time of students and teachers, paper and generating report at required time. This project presented a framework using which attendance management can be made automated and on-line. Also this project made the system very mobile so it will be possible to move the system from hand to hand. Almost like we pass a paper for counting attendance. This system will greatly reduce the hassle of our teachers and make the whole process very easy. Also, it reduces most of the administrative jobs and minimizes human errors, avoids proxy punching, eliminates time-related disputes and helps to update and maintain attendance records.

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