Biometric

Fingerprint based

Student Attendance System

Progress Report

In fulfilment of the requirements for the

NU 302 R&D Project

At NIIT University

Submitted by

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CERTIFICATE

This is to certify that the present research work entitled "Biometric Fingerprint based Student Attendance System" being submitted to NIIT University, Neemrana, Rajasthan, in the fulfilment of the requirements for the course at NIIT University, Neemrana, embodies authentic and faithful record of original research carried out by Siddhesh Nachane, Mridu Bhatnager, Aman Tyagi, Ruikmenmi Tairang, students of B Tech C.S.E and E.C.E at NIIT University, Neemrana,. She /He has worked under our supervision and that the matter embodied in this project work has not been submitted, in part or full, as a project report for any course of NIIT University, Neemrana or any other university.

Prof. Akhlesh Agarwal

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1. Rationale of Work

Attendance Management is one of the most basic and important activity in the administration of any organisation. It helps the organisation to maintain records of its employees, students etc. and plot necessary statistics that can be used as a measure of performance at individual as well as organisational level. (Our focus here mainly resides on Attendance System for Students/Universities.)

The most important phase of Attendance Management is the Attendance Record phase. Attendance record is a must in the academic environment. However, most of the Educational Institutes in India still follow the traditional methodology of Attendance Recording, i.e. by maintaining Manual Records! Some newer Institutes have also adopted RFID cards for this purpose. But though this method is flexible and practical, it has a lot of disadvantages. A manual sign can be put or the RFID can be swiped by any of the fellow classmates of a student. Thus, none of the above method guarantee uniqueness or validity of the attendance marked.

The human body on the other hand has the privilege of having features that are unique and exclusive to each individual. This exclusivity and unique characteristic has led to the field of biometrics and its application in ensuring security in various fields with various embedded controllers and embedded computers. Biometrics have gained popularity and has proved itself to be a reliable mode of ensuring privacy, maintaining security and identifying individuals.

Biometrics is the study of identifying a person by their physical traits that are inherent and unique to only the person concerned. Biometric identification include fingerprint verification, palm geometry, face recognition, iris recognition, etc. The above mentioned techniques work with different levels of functionality and accuracy.

Fingerprint verification is one of the oldest known biometric techniques known but still is the most widely used because of its simplicity and good levels of accuracy. So why not use this feature of human body, which is unique to each individual and not easily replicable, as an ID for marking/recording of attendance?

This project thus describes a method to develop a real time attendance management system using an electronic device and a computer software to gather, validate, process and store attendance data.

1.1 Introduction

The most common method of tracking Students' attendance in a classroom is asking them to manually sign the attendance sheet. This process is followed by most of the educational institutions of India. Some newer methods include the use of RFID cards for marking of attendance. The above methods have no guarantee if the person whose attendance is marked is actually present in the class.

Also to avoid the above problem the Faculty himself/herself can call out the attendance one at a time, but this would consume most of the precious class time. Also book-keeping or maintaining of

manual records is also a cumbersome process and wastes a lot of management time.

Keeping in mind the problems of the traditional methodologies, we have tried to design a system that is fool proof, fast, secure and works on the concept of Biometrics Identification using Fingerprint which is unique for each individual, permanent and most importantly not easily replicable.

Our system is created to be able to work with the NU ERP, so that the whole process of taking the attendance can be automated. The system consists of a small, portable **Attendance-Recording Module** that is passed in a class of students to record attendance and **Software on the host Computer (PC)** that interacts with the Module, to transfer fingerprint templates and attendance data between the two.

The main focus of the project was to make the Module is portable, low powered and not a Static/ Class specific module (i.e. the fingerprint data inside the module can be changed by the faculty as and when required) and also as compact as possible and cost-efficient.

2. Literature Review

2.1 FINGERPRINT BASED ATTENDANCE SYSTEM – By Rajat Choudhray, Priya Ranjan, Deepak Kumar, Durgesh Deep IIT KANPUR.

The record of fingerprints of various students was maintained in a database. The communication between the PC and the module was done wirelessly over Bluetooth. For controlling both these modules microcontroller board, Arduino Mega 2560 was used. Arduino converts the data received from the FingerPrintSensor (FPS) to a string that can be sent over the Bluetooth. It also parsed the data received from the PC and sends appropriate commands to the FPS. Students are supposed to enroll their fingerprint at the beginning of the semester for a particular course. During the class the fingerprint module would be passed among the students to mark their attendance. The fingerprint module does all the heavy work of reading, identifying and storing the fingerprint data. It issues several commands for all the functionalities. The module used in this project can store up to 200 different fingerprints and is capable of 360 degree recognition. For working the fingerprint must be registered by sending appropriate commands. On successful execution of commands the fingerprint module sends acknowledgement to the host PC otherwise returns an error. Bluetooth module used supports serial communication. The tools used for software included MySQL for database management and python's GUI package TkINTER. The student database included name of the student, name of the course, course code, roll no. , section, department and finger ID corresponding to roll no. Present or absent was marked as 1 and 0 respectively.

2.2 WIRELESS FINGERPRINT ATTENDANCE MARKING SYSTEM – By Aarushi Jhalundhwala, Pratik Jhaveri, Sandeep Khudanpur, Amit Deshmukh DJ Sanghvi College Of Engineering, Mumbai

A wireless fingerprint attendance marking system based on ZigBee Technology is proposed. Fingerprint module was connected microcontroller. Microcontroller is then connected to an Xbee Transmitter. The Xbee transmitter is then connected to host PC and the host PC is connected with Xbee receiver. The fingerprint sensor used is R305 which has a capacity of storing upto 256 fingerprints. The four major parts of project include Storing, Searching, Transmission, and Database. In the storing part first fingerprints of all the students have to be stored. For this microcontroller sends command to the Fingerprint Sensor (FPS) to get the image. For this the student is asked to place his or her finger thrice on the module every time the fingerprint image gets converted into a template. When number of presses are equal to three all the fingerprint templates are merged and stored as a single template. In searching phase the finger placed on the module has to be compared with each one stored in the module. When the finger is placed on module an image of finger is captured which is then converted into a template and is then compared with the already stored templates. If a template is identified the sensor returns an integer ID to the microcontroller. Then transmission happens. In this phase now the returned

integer ID has to be transmitted to the computer. For this process to take place the Xbee modules have to be set up. The Xbee network is given a Pan ID, this allows other Xbee boards to identify the network. Both the boards have to be given an address. These are used while communicating. The transmitter Xbee transmits the integer ID returned from fingerprint sensor to the receiver Xbee which is connected to the computer.

2.3 A FULLPROOF BIOMETRIC ATTENDANCE MANAGEMENT SYSTEM – by Karthik Vignesh,Shanmuganathan S, A. Sumithra , S Kishore and P. Karthikeyan Velammal College Of Engineering And Technology ,Madurai

The proposed module consists of components such as Arduino UNO Board, Wi-Fi Shield, GSM Shield, Keypad, LCD Display, Adafruit fingerprint Sensor and Raspberry Pi. The Arduino Uno board acts as an interface to all the devices such as Wi-Fi shield, GSM shield, Raspberry, Keypad, LCD Display and the server in which database is maintained. The optical fingerprint sensor helps in identification and verification of the fingerprints. Raspberry Pi is a small credit card sized single board computer. The Arduino sketch is first uploaded on the board. Whenever power is supplied, the arduino runs a particular program uploaded. The program is then inserted into the OS that is installed on Raspberry Pi and make it to run automatically so that it records the fingerprint and device becomes automatic. The arduino Wi-Fi shield connects the arduino to the internet wirelessly. The arduino is then programmed to send the fingerprints taken to the server using Wi-Fi shield. The staff is first asked to enter the day order, period number, and their fingerprint. It is then checked with the database and then the module is passed to the students. Then the students keep their fingerprints and their presence is stored in the database. The keypad is used to enter the period number and day order. This information will be passed to the database and then checks to which staff the percentage has to be calculated and to which period the presence has to be updated. This is also connected with Arduino and the programming is done using Arduino compiler. The Arduino GSM Shield allows an Arduino board to connect to the internet, make/receive voice calls and send/receive SMS messages. Whenever the student or staff keeps his finger his/her id will be displayed for confirmation. Also the inputs we give are shown in the display. A web interface for staff is created where they can upload the attendance of students.

2.4 MOBILE BASED ATTENDANCE MARKING SYSTEM USING ANDROID AND BIOMETRICS – by Mr Gautam Shanbhag, Mr Hussain Jivani , Mr Sushil Shashi Rajiv Gandhi Institute of Technology , Mumbai

The proposed system intends to provide an interface to the professor who will require minimal details to input for marking of attendance of a particular class of students. The application supports strong user authentication and quick transmission of data. The system thus build would also help to avoid proxy as the system has biometric scanning which will serve the purpose of authentication. Other noticeable feature included an option for feedback provision, messaging between user and professor, campus notifications

like low attendance reminder, lecture amendments etc. Initially, when the professor runs the application for the first time, a login screen will be displayed that will prompt the professor to enter the username and password required for authentication. The professor will be provided with a unique username. Only when the professor enters the correct username and password, a “success” message will be displayed and the professor will get authenticated and directed to the next screen. In this module, the professor will need to select details such as the name of the subject, date of lecture and the particular semester. After doing so, the professor needs to call the web service by clicking a button provided on the screen. The web service thus invoked sends all this data to the server via GPRS or Wi-Fi. The respective PHP files are executed on the server with the SQL queries and the result of queries is sent back to the application. After the activation of lecture is completed. Students’ would receive a notification to login using their respective phones running android OS. They use their username and password which is matched with the values stored in the database. Response is sent back to the user. Biometric fingerprint scanner circulated in the class and verification is done by matching the obtained fingerprint image with the fingerprint images stored on the server, and the student is notified for the same. If verification fails, then attendance marked, is deleted from the database. The fingerprint images matching can be done in Matlab.

3. Objectives

3.1 Non-technical objectives:

1. Create a Fingerprint Based Time Attendance System that is fast, efficient, secure and reliable.
2. The System must be integrate able with (NIIT University) NU-ERP.
3. The System must reduce the manual work done by a Faculty and make it for the faculty to upload attendance to NU-ERP.
4. The complete System must be cost-effective.
5. A module (which is a part of the system) must be flexible, i.e. It should be Faculty specific and interchangeable, and not contain fixed set of student data.
6. The system should be able to work on the process flow depicted in Figure1.

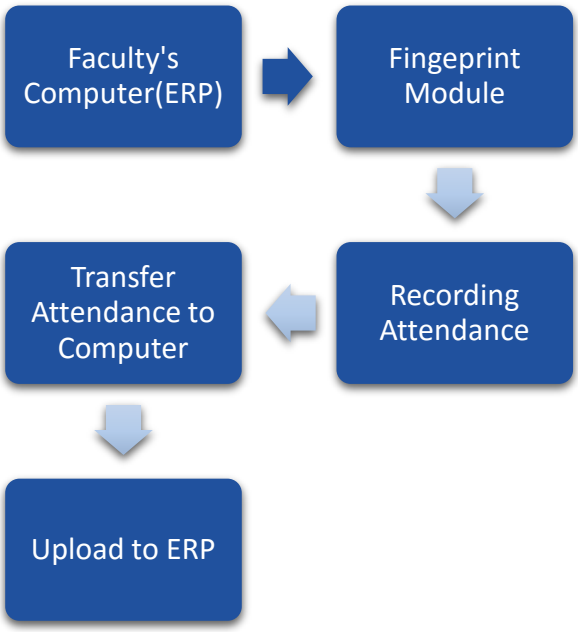


Figure 1 - Process Flow

3.2 Technical objectives:

Create a system comprising of the following:

1. A hardware module (Module1) that is able to perform the Enrolment of fingerprints of students.
2. A code that runs on the Module1 during the above.
3. A Windows Presentation Foundation (WPF) App that communicates with Module1 to transfer instructions, show status and receive fingerprint template data, which can be stored on NU-ERP database.
4. Another hardware module that is capable of taking attendance and storing it through fingerprints.
5. Another piece of code the runs on Module2 to perform the above specified function.
6. A second WPF App that would work on a Faculty's computer and would be used to communicate with Module2 for various functions explained below.
7. Generate an Excel Sheet (which would contain the attendance of the students) similar to the one upload-able to NU-ERP as output.

4. System Description

4.1 Fingerprint Module

The Fingerprint Module shown in Fig. 2.1 (GT-511C5 from ADH Tech) is used to scan the finger and perform all the necessary processing. It can store up to 2000 fingerprint templates in it and perform a 360^0 recognition. All the steps from capturing the image to comparing it with the internal database and returning the matched ID is done by the scanner itself.

For working the fingerprint must be registered by sending appropriate commands. On successful execution of the command it sends acknowledgement for success and Error code otherwise. The database of the prints can even be downloaded from the unit and distributed to other modules. The raw images of the fingerprints can also be retrieved from the module.

Figure 2 - Fingerprint Sensor (GT-511C5)

4.1.1 Operating Principle

Fingerprint processing includes two parts: fingerprint enrolment and fingerprint matching (the matching can be 1:1 or 1: N). To enrol the fingerprint the finger is to be pressed to the module thrice. All the three times it captures an image of the finger that was put on the optical sensor and creates a template for each image, added to that, the third time it also merges the three templates to create the final template. For fingerprint matching, the user again has to place his finger on the optical scanner. The template generated can then be used for 1:1 matching or 1: N matching. For 1: N matching, the template is compared with all the templates in the library. The system returns the result of success (ID) or failure.

4.2 Microcontroller

The Arduino Nano as shown in Fig. 2.2 is a microcontroller board based on the ATmega328. The Arduino is a simple system designed for beginners as well as people with experience. Arduino is an open-source electronics platform based on easy to-use hardware and software. It's intended for anyone making interactive projects.

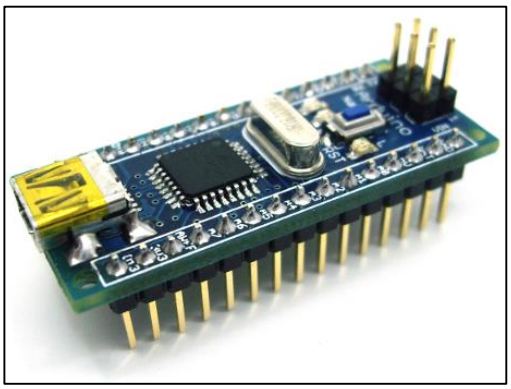


Figure 3 - Arduino Nano

4.2.1 Communications

The Arduino Nano has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega168 and

ATmega328 provide UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An FTDI FT232RL on the board channels this serial communication over USB and the FTDI drivers (included with the Arduino software) provide a virtual com port to software on the computer. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the FTDI chip and USB connection to the computer (but not for serial communication on pins 0 and 1).

A SoftwareSerial library allows for serial communication on any of the Nano's digital pins.

4.2.2 Programming

The Arduino Nano can be programmed with the Arduino software directly through USB. The language used for programming in C++.

4.2.3 Characteristics of Arduino Nano

1. Inexpensive - Arduino boards are much cheaper as compared to other microcontroller platforms.

2. Cross-platform - The Arduino software runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows.

3. Simple programming environment - The Arduino programming environment is easy-to-use and has several features for more experienced programmers.

4. Extensible software- The Arduino software is published as open source tools. Users can create their own libraries.

5. Open source and extensible hardware – The Arduino design is available on their website. Experienced circuit designers can create their own Arduino board and make extensions to the available designs.

6. Small in size and portable.

4.3 Technologies Used

1. Arduino CC Compiler
2. Visual Studio 2013
3. Windows Presentation Foundation(WPF)
4. .NET Framework 4.5.0
5. SQL Server Compact 4.0

4.4 Languages Used

1. C#/XAML for WPF
2. C++ for programming Arduino

4.5 OS Support

Windows 7, Windows 8/ 8.1, Windows 10

4.6 System Components

1. **Module1 (Wired)** – Hardware module used for enrolment process. (= GT-511C5 + Arduino Nano)

2. **NU Biometric Enrolment App** – Used for interacting with Module1 and storing the retrieved fingerprint template to NU-ERP Database.

3. **Module2 (Portable)** – Hardware Module used during the Attendance Phase. (= GT-511C5 + Arduino Nano)

4. **NU Biometric Attendance App** – Interacts with Module2 and resides on Faculty’s computer.

5. Methodologies

5.1 The Complete System

The complete System is basically divided into two phases/parts:

1. **The Enrolment Phase**
2. **The Attendance Phase**

5.1.1 The Enrolment Phase

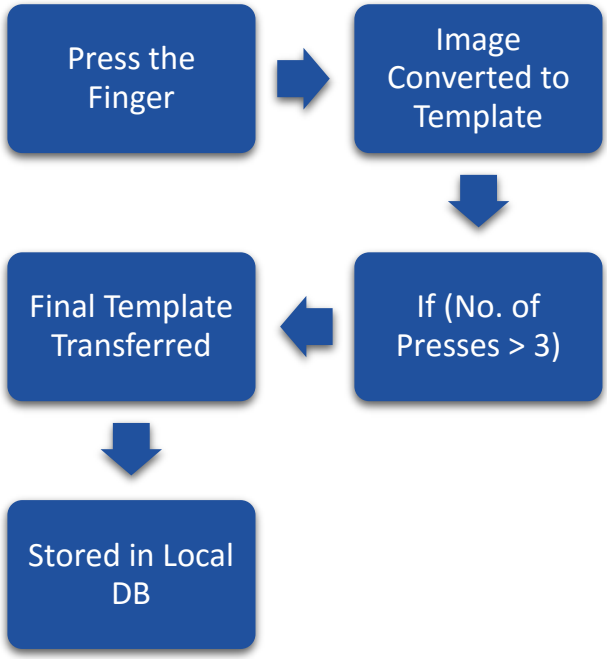


Figure 4 - Enrolment Process

This comprises of Enrolment of Student Fingerprint data which is a one-time process and is done at the start of every year (only for the new batch of Students.

The steps of this phase are as follows:

1. The user enters the University enrolment Number of the student to be enrolled.
2. The machine running the Enrolment program is connected to Module1 and displays status messages during the Enrolment process.
3. The user is asked to press his/her finger (he/she wishes to enrol). This is the finger that will be used for marking of attendance.
4. The user is then asked to remove his finger and a template (a packet of 504 bytes) is generated in the fingerprint sensors buffer from the finger's captured image.
5. Points 3, 4 repeat until the number of presses < 3.
6. After three presses the generated templates are merged into a final template and transferred to PC using UART-2-USB.
7. This template is then stored into a local database and later synchronised with NU-ERP.

(* In case of any error in the above procedure, the device sends an error code.)

5.1.2 The Attendance Phase

This is the main phase of the System and comprises of major modules including transfer of faculty data to module, recording of attendance, marking of attendance and creation of Excel sheets.

The steps of this phase are as follows:

5.1.2.1 Faculty Data Download and Registration

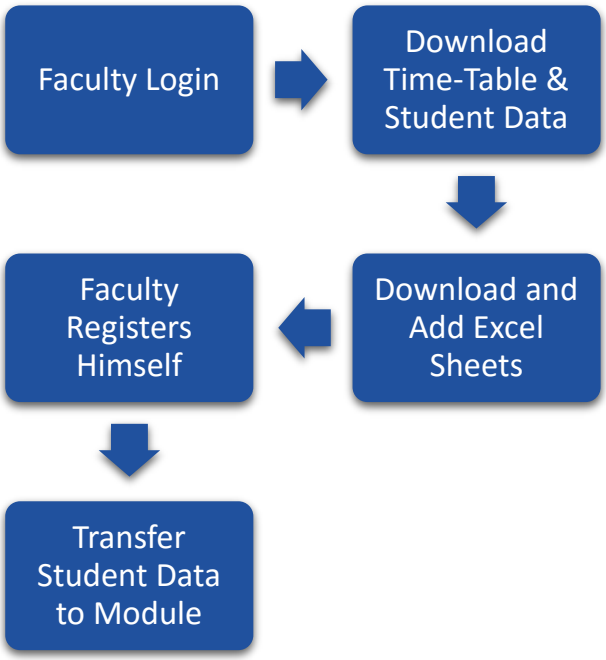


Figure 5 - Faculty Data Download and Registration

1. The Faculty logs into his/her ERP account and downloads their time-table and student data to their PC.
2. The NU biometric Attendance App access the data and creates the Time-Table grid in displayable format.
3. The faculty downloads NU-ERP generated Excel sheets for each and every batch and lecture types and adds then to the auto-generated folders in the Documents Directory.
4. The next step is to register the Module to the faculty himself/herself. The faculty goes through the enrolment process described in Phase I.
5. The most important step of this phase is to transfer the Student Fingerprint Template Data from the faculty's computer to the *Module2*.
6. In this part the fingerprint template of each student (a package of 504 bytes) is transferred to Module2.

5.1.2.2 Record Attendance

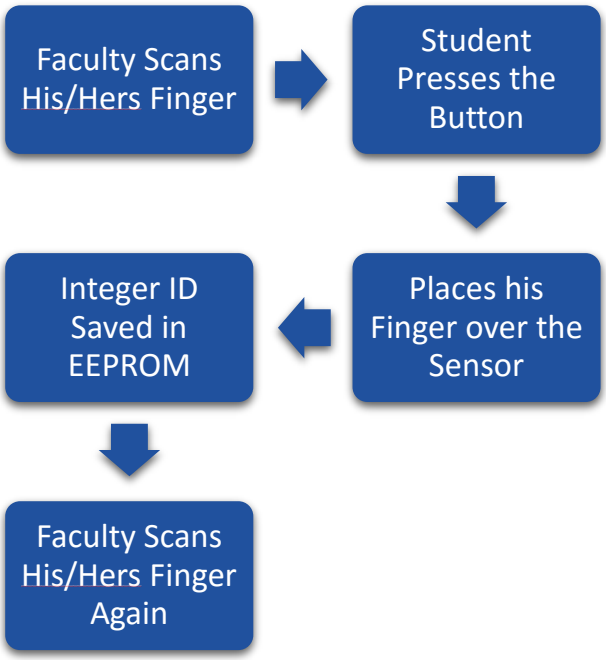
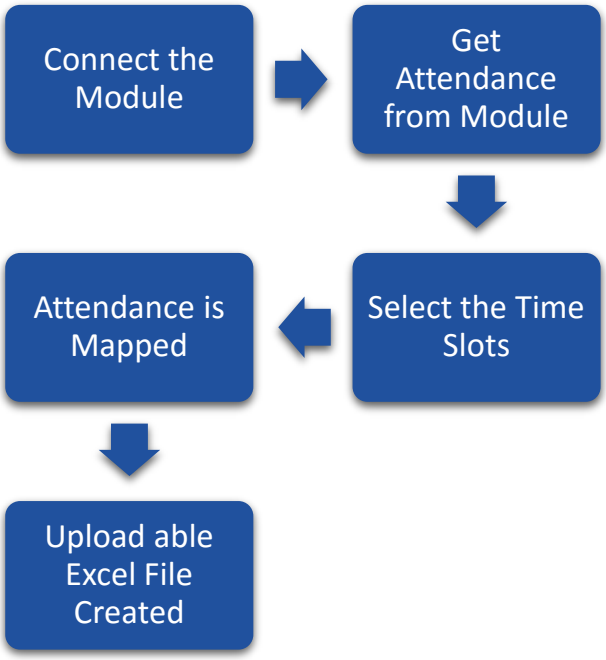


Figure 6 - Record Attendance

1. The Faculty turns on Module2 and scans his own finger marking the start of attendance for that class.
2. Each student presses a button present on Module2 and presses his finger.
3. If the finger is valid the green LED blinks once else the red LED blinks.

4. If the finger is valid the attendance is stored in the EEPROM of Module2.
5. At the end Faculty scans his/her finger again to mark the end of that class.
6. The process can be repeated for multiple classes.

5.1.2.3 Attendance Marking/ Excel Generation



1. The Faculty connects Module2 to his/her PC and clicks the *Get Attendance Button* in the *NU Biometric Attendance App.*
2. The App displays the number of classes whose attendance has been recorded and is left to be marked.
3. The Faculty Graphical UI of displaying their respective time tables, from they are required to select the batches for which attendance is to be marked in order.
4. A separate Excel file for each of these batches is created in the NU Biometric directory in Documents.

5.2 Software Development Life Cycle

In the development of the complete System we have been using incremental model.

In incremental model the whole requirement is divided into various builds. Multiple development cycles take place here, making the life cycle a "multi-waterfall" cycle. Cycles are divided up into smaller, more easily managed modules. Each module passes through the requirements, design, implementation and testing phases. A working version of software is produced during the first module, so you have working software early on during the software life cycle. Each subsequent release of the module adds function to the previous release. The process continues till the complete system is achieved.

When we work incrementally we are adding piece by piece but expect that each piece is fully finished. Thus keep on adding the pieces until it's complete. As in the image above a person has thought of the application. Then he started building it and in the first iteration the first module of the application or product is totally ready and can be demoed to the customers. Likewise in the second iteration the other module is ready and integrated with the first module. Similarly, in the third iteration the whole product is ready and integrated. Hence, the product got ready step by step.

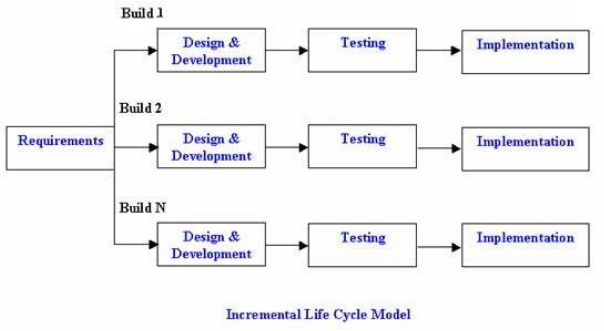


Figure 7 - Incremental Life Cycle Model

5.2.1 Advantages of Incremental Model

1. Generates working software quickly and early during the software life cycle.
2. This model is more flexible – less costly to change scope and requirements.
3. It is easier to test and debug during a smaller iteration.
4. In this model customer can respond to each built.
5. Lowers initial delivery cost.
6. Easier to manage risk because risky pieces are identified and handled during it'd iteration.

5.2.2 Disadvantages of Incremental Model

1. Needs good planning and design.
2. Needs a clear and complete definition of the whole system before it can be broken down and built incrementally.
3. Total cost is higher than waterfall.

5.2.3 Our Iterations

1. The Enrolment Phase:

Creation of Module1

Iteration 1: Interfacing of fingerprint sensor GT-511C5 with Arduino Nano and executing basic commands

Iteration 2:

Execution of more complex commands like *Get_Template* and performing data transfer using Software Serial*.

Iteration 3:

Creation of NU Biometric Enrolment App to receive data sent by Module1 on to the USB port.

Iteration 4:

Connecting NU Biometric Enrolment App to Local DB (SL Server Compact) for storing of Fingerprint template data against Students Enrolment number.

1. The Attendance Phase:

Iteration 1:

Writing the sketch for Arduino (Module2) to interface with GT-511C5 for Record of Attendance.

Iteration 2:

NU Biometric Attendance App to interact with Module2, code to receive attendance through Serial Port and divide it into different batch of students based on Faculty's print.

Iteration 3:

Filling the Grid View by Faculty's Time-Table and add event handlers to each slot.

Iteration 4:

Reading, Updating and Saving of Excel sheets (stored by Faculty) with the Attendance of Students using Microsoft.Office.Interop.Excel library.

Iteration 5: Adding the functionality of transferring fingerprint templates from the Attendance App to Module2. (Major Step)

5.3 Technical Details/ Operating Principle

5.3.1 Fingerprint Sensor GT-511C5

Uses three types of Packets for Communication with the Master using Serial TTL UART.

1. Command Packet (12 bytes)
2. Response Packet (12 bytes)
3. Data Packets (n bytes)

For details about the packets, Command Codes and Response Codes check Datasheet.

Enrolling Procedure (Code Snippet):

1. EnrollStart(ID);
   // Issue command to start enrolling over the passed ID as parameter.
2. CaptureFinger ;
   // Take snapshot of the finger
3. Enroll1;
   // Create template of the 1st Image
4. Remove and press finger again
5. CaptureFinger;
6. Enroll2;
   // Create template of the 2nd Image
7. Remove and press finger again
8. CaptureFinger;
9. Enroll3

The sensor can work in two modes:

1. Identification (1:N)
2. Verification (1:1)

Identification is the process when the sensor takes a finger as an input and compares it with all the templates in the internal database and returns the integer id (offset) of the template whose match score is highest.

While verification on the other hand is the process where the input finger is compared with a supplied offset or template and returns whether both match or not.

For our purpose we use the identification mode.

Identification Procedure (Code Snippet):

1. CaptureFinger
2. Identify1_N
3. If(ID < 2000) EEPROM.write (nextLoc, ID)
4. Else Invalid Finger

Note:

During Enrolment the finger has to be pressed thrice but during Verification it has to be pressed only once.

Connections:

The fingerprint module has JST-SH connector with 4 pins. It needs a power supply of 3.3V-6V. But the Rx – Tx Communication voltage is 3.3V.

So a potential divider is required to preventing the fingerprint module from the 5V Rx-Tx of the Arduino. The connections are as follows:

1. FPS Tx -> Arduino Rx (Serial 2)

2. FPS Rx -> Arduino Tx(Stepped down to 3.3V using potential divider of three 1K resistors).

3. FPS Gnd -> Gnd

4. FPS VCC -> 3.3V

The serial communication is set at 9600 bps on both the devices (Arduino and Fingerprint

module) for correct synchronization. The fingerprint module has a default baud rate of 9600bps.

Commands that were useful in the project:

1. Open
2. Close
3. CmosLed
4. GetEnrollCount
5. CheckEnrolled
6. EnrollStart
7. Enroll1, Enroll2, Enroll3
8. IsPressFinger
9. DeleteID
10. DeleteAll
11. Identify
12. CaptureFinger
13. GetTemlpate
14. SetTemplate

5.3.2 Arduino Nano

Arduino microcontroller acts as the link between the fingerprint module and the Faculty's PC whenever data transfer is required.
It parses the data received from the PC and sends appropriate commands to the FPS. It also interprets the button inputs and runs appropriate commands when used in portable mode.

The most important factor in selecting Arduino Nano was its size and cost effectiveness.

But with being small, the Nano also has some limitations. The micro-processor on Arduino Nano is Atmel ATMega 328p.

1. This has only one hardware Serial port.
2. Has only 2KB of SRAM on it.

These limitations created some major problems:

1. The only hardware serial port was interfaced with the UART to USB chip and communicated with the master PC. But we also required a serial port to interact with the Fingerprint Sensor.
2. Each Fingerprint template is about 504 Bytes thus storing even a single complete template in Nano's RAM was not possible. Then how to transfer about 2000 templates?

The above problems were solved as such:

1. The Fingerprint Sensor was interfaced using the Software Serial Library of Arduino which creates a virtual Serial port.
2. Each byte was transferred to its destination as soon as it arrived at Arduino.

In Module1:

1. FPS -> Arduino [Software Serial] (baud rate = 9600bps)
2. Arduino -> PC [Hardware Serial] (baud rate = 115200 bps)

In Module2:

1. FPS -> Arduino [Software Serial] (baud rate = 9600bps)
2. Arduino -> PC [Hardware Serial] (baud rate = 9600 bps)

Power Options:
Module1: Only through USB
Module2: USB and Battery (for Portability)

6. Results

We were able to achieve all our initial objectives and make the complete system.

We were able to successfully:

1. Create an Hardware Module1 for Enrolment Purpose
2. Create a WPF App (NU Biometric Enrolment App) for the same.
3. Create Module2 for Attendance Purpose that will be used by every Faculty.
4. Create the NU biometric Attendance App that will help the faculty to easily interact with the module.
5. Create an Excel sheet (with marked attendances) that can be directly uploaded to ERP.

Below are some screenshots depicting the above achievements:

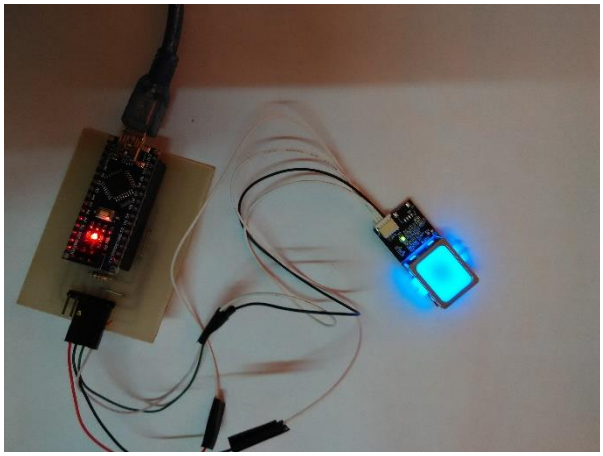


Figure 8 - Module1,2

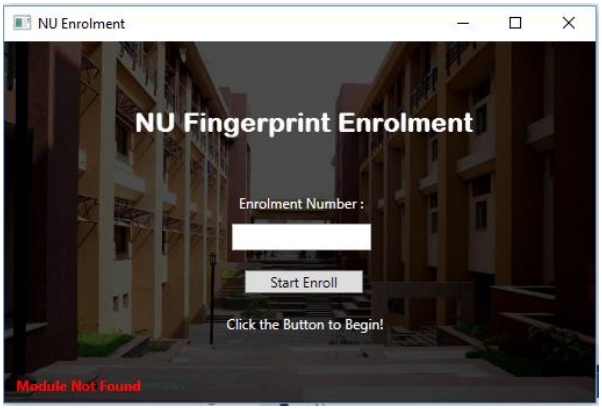


Figure 9 - NU Biometric Enrolment App

Figure 10 - NU Biometric Attendance App Page1

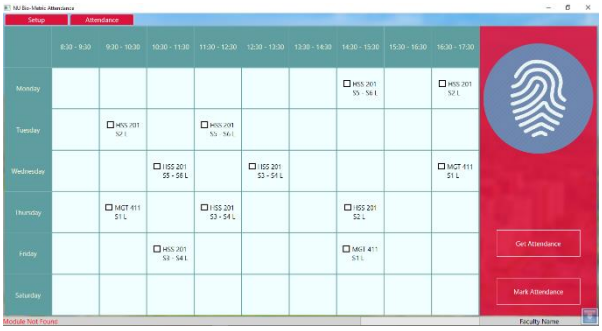


Figure 11 - NU Biometric Attendance App Page2

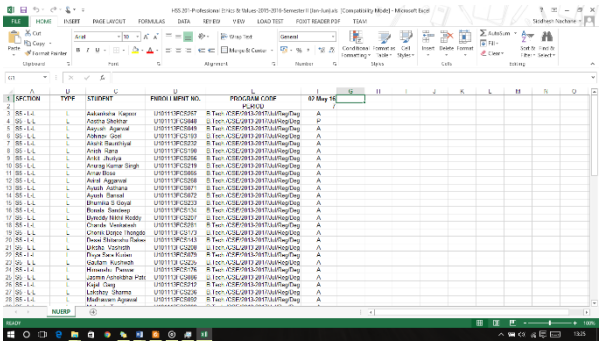


Figure 12 - Software Generated Excel Sheet

We were successfully able to generate attendance of all different Courses and Batches taught by a NU Faculty [Anuradha Parasar Ma'am] using our System.

7. Future Work:

Instead of generating Excel Sheet the attendance could be directly uploaded to NU-ERP. Also, the transfer of attendance which requires connection of Module2 to the PC can be made wireless by using a Bluetooth or Wi-Fi module.

The creation of Excel sheets requires some time, which could be made even faster. The System also requires some fine tuning and exception handling to be added to make it more user friendly.

Instead of using LED, a small LCD screen could be added to the Module to make it more User friendly.

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