UIU SMART CARD

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Abstract

Smart cards have been around for a while now. These days we see various use cases of smart cards based on a number of different technologies, mostly in banking sectors and in payments. Students are required to carry a separate identification card. These cards however don't allow the students to mark their attendance or make necessary payments in campus. Student attendance is a one of the important issues for any educational institution as it has shown to have an impact on the result of the students. Most of the universities in Bangladesh still uses the outdated paper or name-calling for recording student attendance. Moreover most of the educational institutions around the globe don't allow the facility of card payments in campus. Thus, there is a need to develop a system that reduces burden in analyzing the attendance and enhance smooth functioning of educational institutions. This report describes a brief introduction to a RFID based student smart card system that compiles all the different aspects of a students' in campus activities under one system. RFID or Radio Frequency Identification is an emerging technology which brings enormous benefits in applications where unique identification is required. With the usage of RFID cards to identify the students uniquely, coupled with a robust web application and an android application for convenience, this system is sure to improve upon the existing methods of attendance taking and in campus payments which would on terms greatly increase productivity and benefit the educational institutions.

Acknowledgements

The completion of the project was a team effort. Hard work, determination, compatibility and consistency of all the team members have made it possible. Throughout the entire project we have received great support from both our supervisor Assistant Professor Mr. Suman Ahmmed and course instructor Professor Dr. A.K.M Muzahidul Islam. Without their proper support and guidance we would have taken a longer time to achieve the progress we have made so far. We also acknowledge all the researchers and the studies they have published and made available which helped us learn a great deal about the related topic, which have been a great help throughout the project.

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Chapter 1

Introduction

This chapter is going to introduce the project in a systematic and brief manner by going through the overview of the entire project first. Then the chapter will talk about the motivation, problem statement, research objectives and expected outcomes of the project for the ease of understanding of the readers. The organization of the report would guide the readers throughout the entire report. And finally the research framework would paint a rough picture about the approach taken to implement the project itself.

1.1 Project Overview

Manually maintained attendance , library book issuing, waiting in the queue to make university related payments have always been cumbersome.
Our RFID based smart card system intends to enhance the experience of the students by automating the tasks that every student and faculty member encounter on a daily basis in the university premise. RFID student card coupled with web and android platform will ensure the fluidity, reliability and security.

1.2 Motivation

Educational institutions' administrations in our country and the whole world are concerned about the regularity of student attendance. Students' overall performance is affected by it. The traditional method of registering attendance by calling names or by signing in paper is very time consuming, not to mention inefficient as well. Moreover, students' interaction with other university activities such as tuition fee payments, library book issuing etc. are handled by various different authorities having no correlation or collaboration among them. Students have to maintain separate library cards and payment cards to take advantage of services offered by these authorities. All of the above mentioned problems have motivated us to take on this project to implement RFID based smart card system, which would solve the issues and improve efficiency in the aforementioned fields.

1.3 Problem Statement

Despite being of great importance there exists no robust method of tracking a students' attendance. No reliable means of on-campus payment is available as well. A well-rounded student smart card system needs to have a convenient way of recording attendance as well as provide a hassle free payment solution. The system needs to provide security for transactions. The android app needs to be intuitive for the users and provide convenience to draw the users' attention. The web application needs to be thorough about the information it displays, it needs to provide a front for displaying deeper information for the user to interact with, at the cost of some added complexity.

1.4 Research Objectives

The primary objectives of our research are:

- To thoroughly investigate and analyze the literature (literature review) of existing projects.
- To develop a research framework for the project.
- To implement hardware part of the system (RFID card reader).
- To design UI/UX and develop both android and web applications.

1.5 Project Outcome

The outcome of this project is to be able to implement an intuitive, highly efficient and safe system for both the students and teachers alike, where they will be able to use the RFID technology, coupled with our android and web application to record attendance without any wastage of time and make on-campus payments without having to carry cash, all with just one card.

1.6 Organization of the Report

Chapter 1 of this report provides a brief introduction of the project by talking about the motivation behind this project, formulating the problem statement and organising the research framework. **Chapter 2** provides review and analysis of related literature and summarizes the literature in a matrix form. **Chapter 3** talks about the design and implementation methodology by providing the requirement analysis and a basic block diagram of the the project. This chapter further talks about the outcome of the project and provides a list of accompanying tools. **Chapter 4** talks about the environment setup, implemented features and expected results of the project. **Chapter 5** talks about the various standards used, and the different design constraints faced during the development period of the project.

1.7 Research Framework

While developing the research framework for our project, first we reviewed and analyzed 12 papers on related topic to acquire in-depth knowledge about how we should approach the project. Analyzing the papers thoroughly allowed us to find a number of shortcomings in the existing systems and technologies. Having mentioned that, we proposed our idea of an intuitive and efficient system, following which came the analysing phase. While analysing the proposed idea, we focused on identifying each student uniquely. Finally, we implemented the project on Web and Android platform for widespread compatibility. The following diagram shows the research framework followed during the development of the proposed system which briefly describes how the system is implemented from the ground-up. Please see figure 1.1 .

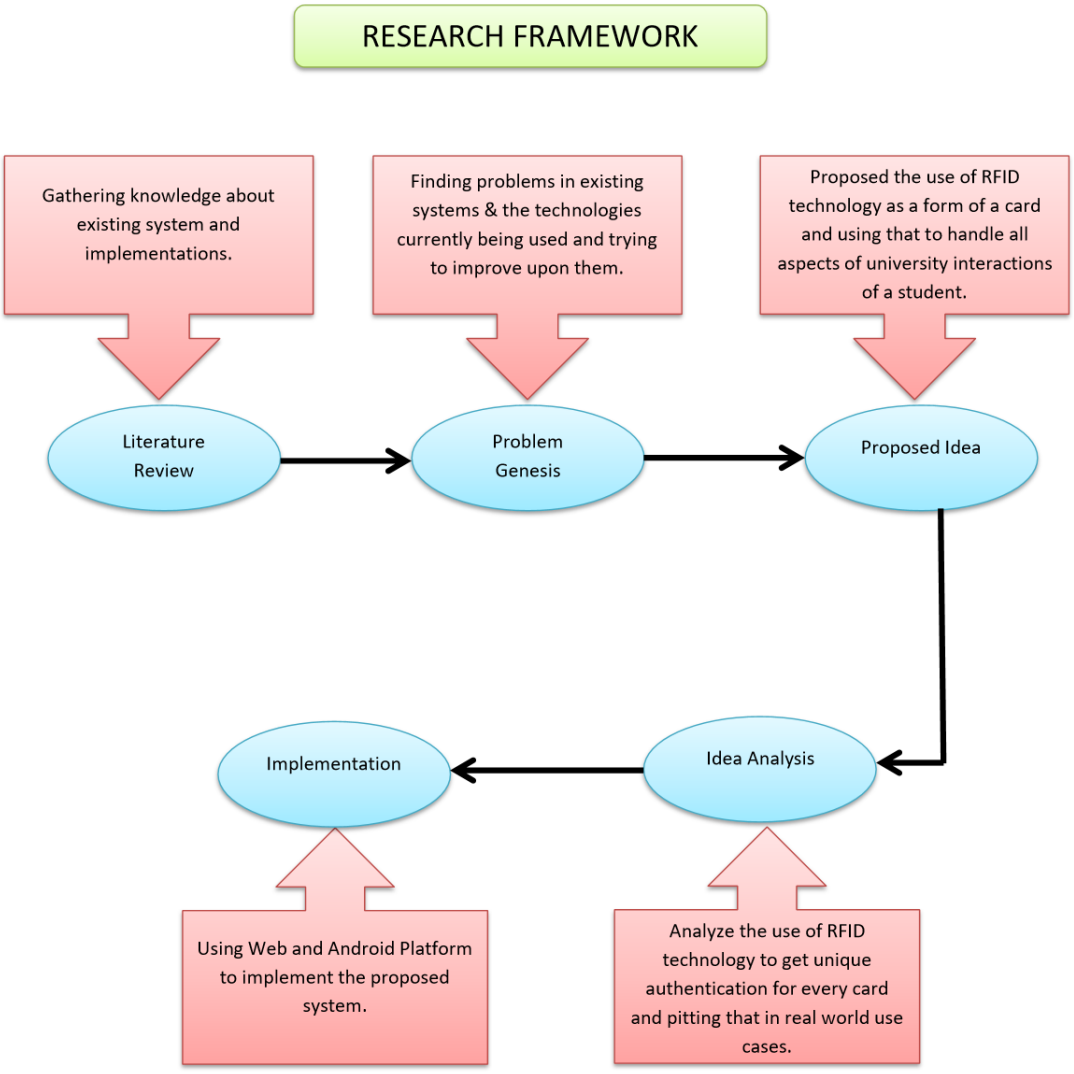

Figure 1.1: Research Framework

Chapter 2

Literature Review and Analysis

This chapter summarizes the related literature studied by the team to get a thorough understanding of the condition of the real world in terms of usability and research on the related sector. This would help the readers understand the lacking of the currently implemented systems, and help them understand why this project is unique to the others.

2.1 Literature Review

Rehman, abbasi and shaikh (2008) [1] conducted a study on building a smart university using RFID technology. This paper highlights the benefits of using RFID technology in development of smart university which will contribute in improving room security, equipment tracking, automation of electrical appliances and attendance record maintenance. ZigBee, which is a wireless communication technology for Wireless Personal Area Network is selected for this research due to its low cost, long communication range and low power consumption. For their system, each employee, each student and different office items will be tagged accordingly using smart employee card, having their unique ID i.e. roll number and using RFID based labels. Furthermore, RFID reader unit will be placed next to the door of each room, at the university entrance and exit. Though their intentions were to curb the power loss working on room automation, a general perception of electrical power loss remains with the administration. Some of the facilities like room automation, object tracking, theft control and power conservation have been built effectively through users' unique ID which is broadcasted to the control circuit and the database server.

Liu, Zhao, Zhao, Li, Zhong, Zhou, Fu, and Kwak (2006) [2] worked on the GPRS mobile payment system based on RFID. In this paper, the authors have introduced a design of the GPRS Mobile Payment System based on RFID as a transitional solution before the prevalence of the NFC cellphone. The system's framework is easily understandable and takes full advantage of the existing GSM mobile communication network. Besides, this system does not require their user to change their cellphone to support RFID chip. It provides an integrated and safe GPRS Mobile Payment System based on RFID which is

composed of mobile terminal, Mobile Payment Platform, communication network, banks and Certificate Authority. The RFID MPS could support existing MP Services provided by the 'Cellphone Wallet' and realize ordinary functions of Bank Card. Because of the RFID functions of tagging and saving, this system could also support off-line micro-payment and ID service. Along with this, this system can also pay the living-fare bills, give mobile insurance, give E-ticket service and provide cash, credit, membership card service.

Rinky Yadav et al.[3] worked on a multipurpose student smart card system by implementing the hardware part with RFID tags, RFID readers and NodeMCU and used a web page and database to implement the software side of their project. In their system, they replaced a conventional student identification card with RFID card and used NodeMCU with RFID readers that allowed their system to be OTA(over the air). Using NodeMCU allowed their system to communicate with their web server via TCP/IP protocol stack. When RFID cards get scanned by RFID reader, the associated NodeMCU with the reader makes a HTTP request to the server and both credentials get verified and necessary data gets exchanged from the database. Moreover, Their system allows a student to recharge an amount via their web page which enables the students to enjoy cash-free daily campus life and purchase various services without the hassle to wait in a queue. Though the system is solely related to the transactional activities of the students and does not necessarily provide other automated facilities such as attendance.

K.Sree et al.[4] developed bus surveillance and notification system using RFID cards and reader, various sensors such as level and speed sensors, PIC micro-controller and Android device coupled together. They aimed to determine the precise location of an ongoing bus and monitor if everything is safe for the on-board students. RFID cards and reader identifies every student on-board. Speed and level sensors paired with WIFI and GSM module collect and sends data to the cloud. An android device used to provide internet connectivity to the whole system. Using this framework data gets collected and saved in the cloud database. Sensors collect data such as fuel level and speed and GSM provides the GPS location of the bus to the cloud to save in the database. During an emergency situation there is a mechanical switch on board that triggers the system to send a notification to the concerned authority and guardian of the students. As previously mentioned, the detection of an emergency incident relies on pushing a manual mechanical switch which might not be an optimal choice and it should have been replaced with a more logical software solution.

Davinder Parkash et al. [5] in their paper "The RFID Technology and Its Applications: A Review" presents an overview of current state and trends of RFID technology. In this paper, they give a consolidated introduction to principles of RFID, an overview of current applications, frequencies used, types of RFID tags reader, its benefits also the limitations. RFID is known as Radio Frequency Identification which is a generic term for

technologies that use radio-frequency waves to transfer data. It can automatically identify people/objects from a distance of several inches to hundreds of feet. An RFID system is known as the combination of RFID technology and computing technology and it consists of five components those are: Tag, Antenna, Reader, Communication infrastructure Application software. In RFID technology four types of frequencies are mostly used: Low, High, Ultra High Microwave.In this paper, they have mentioned the privacy issue of the RFID technology but they did not elaborate or explain anything about this topic. Thus, in the first part of their paper, they have explained the RFID technology its components, the authors have discussed the terms of advantages limitations in the second part and in the last part, explored RFID technology applications. The paper considers providing new capabilities and efficient methods for several applications.

Leandre Nsengumuremy et al. [6] worked on a Smart id card system using RFID technology in which their system will ease the work of the student by helping to track money transactions spent around the campus at a given time and also keep track of the attendance reports. In this system, the administrator will be able to make reports easily by one simple click. There are two major parts include in the system one is hardware and another is software. The system will provide multiple functionalities such as managing student information, attendance management, conducting various reports. They have developed this system specifically for colleges and universities. In the development process, some reviews were conducted to understand the basic theory, system requirements, hardware requirements, methodologies that can be used to achieve the objectives of the system. By these reviews which were conducted, research on the existing system was also enlightening which gave them insights about the current system, requirements like hardware as well as software to develop a system that can be related to the current one but with a better approach.

Agarwal and Bansal (2013) [7] in their paper "Online Attendance Management System Using RFID with Object Counter" proposed a RFID based attendance system to mitigate the wastage of time in taking attendance during class hours and came up with a solution to counter the practice of "Fake/Proxy Attendance". They have discussed various methods and systems for taking attendance and chosen RFID technology (with all of its imposed limitations) to implement the system. The authors then characterize RFID technology in great detail, mentioning the physical structure of a RFID tag, different types of RFID tags and their features, applications of RFID in various scenarios. They continue by explaining their proposed system in a step by step manner in which the data from RFID tags is recorded into the RFID card reader, then it gets sent over to a middleware device which saves the data in a back-end database. Furthermore, the authors discuss the implementation of an object counter to tackle the proxy attendance situation, in which they are somewhat lacking in my opinion. In our project, we will try improving on the said topic. The paper is concluded by debating the advantages of the system against the conventional methods of taking attendance.

Bose, Ngai, Thomposon and Spiekermann (2009) [8] in their paper "Managing RFID Projects in Organizations" review the several existing and emerging use cases of RFID technology. Bose et al.[8] first introduces RFID as a technology and then states, the key advantage of RFID is that it leads to increased visibility of items, pallets or people on the move and allows for real-time querying of the location of these entities[8]. The authors then talk about the various applications of RFID including, but not limited to, in healthcare eg: keeping track of pharmaceutical inventory, managing patient identification and medication etc. , in natural disaster sensing using RFID and USN (ubiquitous sensor networks) and livestock and food traceability applications: which would be able to produce many benefits such as: fast withdrawal of various products, providing consumer protection, higher efficiency etc. Additionally, the authors talk about the issues associated with using RFID such as cloning RFID tags, using spy-chips to fool the RFID reader and several other privacy concerns while also mentioning several campaigns against the use of RFID, with hopes that with the advancement of time these issues will be addressed accordingly. Finally, Bose et al.[8] scrutinize the value of RFID both in individual use cases and RFID industry as a whole by reviewing several other papers on the said topic.

A.A. Olanipekun and O.K. Boyinbode [9] in their paper "A RFID Based Automatic Attendance System in Educational Institutions of Nigeria", address issues involving current manual attendance systems, which include delays regarding documentation, human errors such as forgetfulness, and misinformation as a result of violation of the usual proper procedures. The issues are solved using Radio frequency identification (RFID) which involves machines into the process, therefore allowing for better accuracy, fast implementation of additional tasks such as processing student information regarding their eligibility for an exam. Automated warnings are also implemented to allow for awareness among students regarding their lack of presence in class. However, they have not given any solution for the anti-proxy attendance issue which can be handled by implementing an object counter that we have decided to add to our project. The implementation procedure discussed in the paper uses a graphical user interface integrated into the host system, which consists of login, admin, database, main menu, class record and admin registration. A database record is also interfaced with USB UART serial communication with the RFID reader which handles data records over 7 tables built in Microsoft Access. Eight frames were designed by the team using vb.net which include frame login, class record, admin, database, student evaluation, admin registration, student record and course record.

Srujana, Rama, Tanveer, Sunitha, Mahammad and Thimmaiah [10]have proposed a RFID based system for library management in their paper. Radio Frequency Identification (RFID) technology has spread all over the world through different sectors of our life. It is better than bar code technology in terms of accessing and retrieving data, environment, reliability, readability and many more. The proposed RFID system for library management has been developed by MATLAB and MySQL Server. DLP RFID1 method has

been used to read or write necessary information to the tags. To create the user interface of the system, MATLAB Graphical User Interface Development Environment (GUIDE) tool has been used. For being so much secured and user friendly, the database has been maintained with MySQL using MATLAB. As it's range of frequency is 13.56 MHz's and it can read up to 15 tags at the same time, the end result after using this proposed system in the library is very much pleasing though an additional web technology to search available books could have made the experience better. Soon enough, this RFID technology will take over all the current technologies due to its vast possibilities.

Peter et al. [11] worked on a project "RFID Based Security Access Control System with GSM Technology" based on RFID and GSM technology. This entire system prevents unauthorized access to controlled environments such as secured premises. To achieve this, they have used RFID System with an operating frequency of 125 KHz, microcontroller programmed to send control signals, DC motor, relay, buzzer, Liquid Crystal Display (LCD) and GSM/GPRS Modem. When the RFID tag, which contains the users information, is scanned by the RFID reader and confirmed the match between the information stored previously in the microcontroller, the microcontroller[11] turns on the DC motor through L293D driver, displays "RFID tag" and "username" on the LCD display, turns on the GPS/GPRS to send SMS alert "AUTHORIZED" to the security personnel. And if not matched then the DC motor remains off, LCD displays "RFID not valid" and "UNAUTHORIZED" SMS is sent to the security personnel via GSM system. The electronic circuit was implemented, the codes for microcontroller were written in assembly language, debugged and compiled using the KEIL Micro vision 4 integrated development environment.[11] Being cheap and more efficient compared to the manual operated systems or key lock systems is one of the most important implication of this paper.

Dr. Manoj Kumar Sinha and Anupam Chanda worked on a library management system based on Radio Frequency Identification (RFID) technology in their paper "EXPLORING RFID TECHNOLOGY APPLICATION FOR MANAGING LIBRARY AND INFORMATION SERVICES IN UNIVERSITY AND INSTITUTIONAL LIBRARIES OF NORTH EAST INDIA: AN OVERVIEW"[12]. The first part of the paper is about the historical development, concept, components of RFID technology. And second part describes about the application of RFID technology for managing housekeeping operations. Whole RFID system for library management has been described as combination of six components as RFID tag, a staff checkout station, self return book drop with automatic check in feature, a tagging station, a security gate and a shelf scanner for inventory as well administrative station. One can borrow books and return them without help of staffs. And staffs are also benefited by having the re-shelving of books and updating database faster. Shelving station and self-check-out station make these returning books and sorting them for shelving tasks easy and fast. Basic RFID system contains of three main components which are RFID tags, Sensors or readers and docking station. The tags are programmed electrically

with unique information and readers are the devices that gather information from RFID tags. Docking station or servers are considered as the heart of RFID system. It is told that to enhance the performance of the RFID system and fix the existing gaps, soft computing techniques, genetic algorithms, advance techniques like CDMA etc are yet to be added to the system.

2.2 Summary

Rehman et al. (2008) [1] worked on building a smart university using RFID technology to improve room security, equipment tracking, automation of electrical appliances and attendance record maintenance. With this system, employee and student can be identified along with the theft of costly equipment can be avoided too. Their system will work by detecting RFID card and forward that to microcontroller which will generate a specific number after authenticating that ID. Then this specific number will be forwarded to the Zigbee where it is broadcasted to receiving nodes. Although they wanted to minimize the level of power loss, a general perception of power loss still persists. Liu et al. (2006) [2] conducted a study on the GPRS Mobile Payment System based on RFID. The authors proposed this system, which would provide many services like online E-commerce payment, pay the living-fare bills, off-line micro payment, mobile bank transactions, ID service, give mobile insurance, give E-ticket service and provide cash, credit, membership card service, after analyzing the MP service. Moreover, they also discussed about the disadvantages of Cellphone wallet payment system like not being able to provide as many services as the credit card or cash card could do. In their paper, they described the current status of the mobile payment in china and why they took initiative to implement the GPRS mobile payment system. The system structure of GPRS Mobile Payment System based on RFID is composed of communication network, mobile terminal, Mobile Payment Platform (MPP), banks and certificate authority. Rinky Yadav et al.[3] worked on a multipurpose student smart card system. This system replaced a conventional student identification card with RFID card and used NodeMCU with RFID readers. Moreover This system, was implemented by implementing the hardware part with RFID tags,RFID readers and NodeMCU and the software part with a web page and a database, allows the students to enjoy cash-free daily campus life by recharging an amount via their web page. K.Sree et al.[4] developed bus surveillance and notification system using RFID cards and reader, various sensors, PIC micro-controller and Android device coupled together. Their target was to determine the location of an ongoing bus and monitor if everything is safe for the on-board students. Sensors collect data and then send to the cloud. At the same time, GSM provides the GPS location of the bus to the cloud. In their system, they also provided an emergency service using a mechanical switch on board. Davinder Parkash et al. [5] discussed about the RFID Technology and it's applications. RFID is known as Radio Frequency Identification which is a generic term for technologies that use radio-frequency

waves to transfer data. In the first part of their paper, they have explained the RFID technology its components for instance it's current applications, frequencies used, types of RFID tags and reader, it's benefits and limitations. The authors have discussed the terms of advantages limitations in the second part and in the last part. Leandre Nsengumuremy et al. [6] worked on a Smart id card system using RFID technology which will track money transactions around the campus and keep track of the attendance reports. In this system, making reports will be done with just one simple click. They also conducted some reviews to build a system that can be related to the current one but with a better approach. Agarwal and Bansal (2013) [7] implemented online attendance management system using RFID with object counter which came up with a solution to counter the practice of "Fake/Proxy Attendance". The authors discussed how the data from RFID tags is recorded, it gets sent over to a middleware device and implementation of an object counter. Furthermore, the paper is concluded by debating the advantages of the system against the conventional methods of taking attendance. Bose et al. (2009) [8] in their paper "Managing RFID Projects in Organizations" review the several existing and emerging use cases of RFID technology. The authors talked about the various applications like in healthcare, livestock and food traceability applications. Moreover, they also conducted a study on the issues associated with using RFID such as cloning RFID tags, using spy-chips and several other privacy concerns. A.A. Olanipekun and O.K. Boyinbode [9] worked on a RFID based automatic attendance system. This system can give automated warnings regarding their lack of presence in class along with other tasks. The authors designed eight frames using vb.net, a database record form with USB UART serial communication and a graphical user interface into the host system. C. Srujana et al. [10] developed a RFID based library management system using MATLAB. The system consists of RFID reader/writer, RFID tag, serial to USB converter and personal computer. The authors used MATLAB database toolbox which supports communication using ODBC or JDBC driver with some compatible database. In the last part, the authors talked about how versatile the RFID is in many real time applications, mainly in library management system. Peter et al. [11] developed a RFID based security access control system with GSM technology. This system prevents unauthorized access using RFID with an operating frequency of 125 KHz, microcontroller programmed, DC motor, relay, buzzer, Liquid Crystal Display (LCD) and GSM/GPRS Modem. Moreover they implemented electronic circuit, used assembly language for microcontroller code and then debugged and compiled using the KELL micro vision 4. Dr. Manoj Kumar Sinha and Anupam Chanda worked on a library management system based on RFID technology [12]. In the first part the authors discussed about the historical development, concept, components of RFID technology and in the second part they described about the application of RFID technology for managing housekeeping operations. But for fixing the existing gaps, soft computing techniques, genetic algorithms, advance techniques like CDMA etc are yet to be added to the system.

Table 2.1: Summary matrix of literature review

Research Papers	**Introduced RFID**	**OTA(Over The Air) Compatibility**	**Security Concerns Addressed**	**Systems Implemented**	**Technologies Used**
Building a smart university using RFID technology[1]	Yes	Yes	Yes	Attendance, Equipment tracking, Automated appliances	Zigbee, RFID tag, RFID reader
The GPRS mobile payment system based on RFID[2]	Yes	Yes	Yes	Mobile Payment	RFID tag, RFID reader, Java cell-phone MP software
Multipurpose Student Smart Card[3]	Yes	Yes	No	Debit Payment, Recharge	RFID card, RFID Reader, NodeMcu, Webserver
Acute school bus surveillance and notification system[4]	Yes	Yes	No	Bus Surveillance	RFID card, RFID Reader, GPS-GSM
The RFID Technology and Its Applications: A Review[5]	Yes	No	No	None	None
Smart ID Card System using RFID Technology[6]	Yes	Yes	Yes	Attendance Management, Transaction Model	RFID Reader, RFID Tag
Online Attendance Management System Using RFID with Object Counter[7]	Yes	Yes	No	Attendance System, Object Counter	Active RFID Tag, RFID Reader, Proprietary Software.
Managing RFID Projects in Organizations[8]	Yes	No	Yes	None	None
A RFID Based Automatic Attendance System in Educational Institutions of Nigeria[9]	Yes	No	No	Attendance System	RFID tag and reader, USB UART
Development of RFID based library management system using MATLAB[10]	Yes	No	No	Library Management System	MATLAB, MySQL, DLP
RFID Based Security Access Control System with GSM Technology[11]	Yes	Yes	Yes	Entering premises	RFID tag,RFID reader,GSM, Microcontroller
Exploring RFID technology application for managing library and information services in university and institutional libraries of north east India: An overview[12]	Yes	Yes	No	Library services	RFID tag,RFID reader, Docking station

Chapter 3

Methodology

This chapter first describes why we chose this project and whether or not there is actually a need for such a system. After that this chapter allows the readers to understand how our project is being implemented step by step manner.

3.1 Requirements Analysis and Initial Planning

For the first phase of developing this project, an extensive survey has been performed on 112 UIU students as part of requirement analysis, where they were requested to answer some strategically formed questions. From the feedback of 112 students, we have found that 91.1% students have claimed that they feel distracted to manually present ID card at the exam halls during exams. Moreover 90.2% students have voted yes when they were asked if they felt insecure to carry large amounts of cash at the university premise. 96.4% students have agreed that it would be helpful if there existed a system in which no manual attendance or queue for making tuition fee payment is needed. Finally, 99.1% students have responded positive to the fact that they are interested in an "ALL IN ONE" card based solution, given the proper security. Figures of the results have been attached as a mean of transparency. Check figure 3.1 .

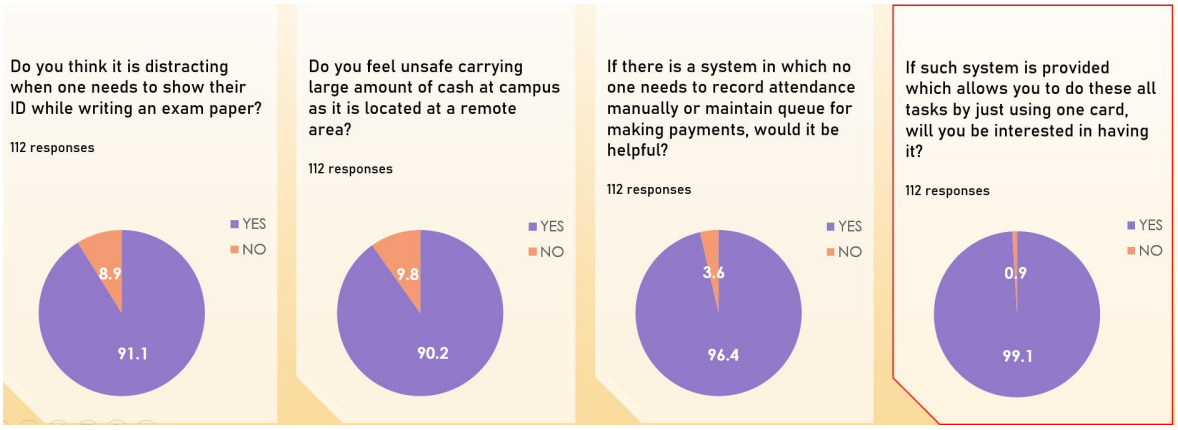

Figure 3.1: Survey Results of 112 Responses of UIU Students

After receiving such feedback we decided to start working on implementing attendance system first, as it was proven to be of the most concern to the students, and then move on to implementing payment system. Moving onto phase two, we reviewed 12 journal papers related to our project and based on the takeaways of the reviewed literature we have decided to use the following hardware and software to implement the system.

Table 3.1: Required Hardware and Software

Hardware/ Software	**Description**
NodeMCU ESP-12E	ESP-12E CP2102 NodeMcu Lua V2 Wireless Module Wifi Internet of Things (IOT) Development Board Based On ESP8266.
RFID Tag	NFC compatible 13.56MHz HF RFID tags with 1K byte EEPROM memory (768 FREE BYTES availability), Reading distance is 0 - 10cm.
RC522 RFID Reader	13.56MHz reader supporting all 13.56MHz, S50, Mifare One cards with a maximum data transfer rate of 10Mbit/s.
Arduino IDE	The Arduino Integrated Development Environment(IDE) is a cross-platform application that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of 3rd party cores, other vendor development boards ie: NodeMCU.
Android Studio	Android Studio is the official integrated development environment for Google's Android operating system, built on JetBrains' IntelliJ IDEA software and designed specifically for Android development.
MySQL Database	MySQL is an Oracle-backed open source relational database management system (RDBMS) based on Structured Query Language (SQL). MySQL runs on virtually all platforms, including Linux, UNIX and Windows.
HTML5	HTML5 is a markup language used for structuring and presenting content on the World Wide Web. HTML5 was the fifth and last major version of HTML that is a World Wide Web Consortium recommendation.
Bootstrap Framework for CSS3	Bootstrap is a free and open-source CSS framework directed at responsive, mobile-first front-end web development. It contains CSS- and JavaScript-based design templates for typography, forms, buttons, navigation, and other interface components.
Laravel Framework for PHP	Laravel is a free, open-source PHP web framework, intended for the development of web applications following the model–view–controller architectural pattern.
JavaScript	JavaScript, often abbreviated as JS, is a programming language that conforms to the ECMAScript specification. JavaScript is high-level, often just-in-time compiled, and multi-paradigm.
AJAX	Ajax is a set of web development techniques using many web technologies on the client side to create asynchronous web applications. With Ajax, web applications can send and retrieve data from a server asynchronously without interfering with the display and behavior of the existing page.

3.2 Methodology and Design

In the third phase, we finalized the data flow of the entire system and designed a block diagram. The data-flow starts with the interaction of RFID student id card to the RFID reader. Every RFID reader has its associated service to perform. As RFID reader is coupled with NodeMCU it allows the reader to collect the data from the RFID card and make an HTTP request using TCP/IP stack to the appropriate API. RFID reader makes requests to the attendance module API that creates an entry to the database in case it is used to keep track of the attendance record. The payment related RFID reader makes the HTTP request to the payment module API. Payment module API is created in such a way that it receives the request and robustly makes the transaction between service providers such as the canteen, book store, and the students and makes entry to the database accordingly. Moreover, students and service providers can track their detailed activities throughout the system that includes details of attendance records or any payment activity they make either via the Android app or Web app which gives them the flexibility of accessing the system regardless of their device. All of the information related to the user's activities gets directly fetched from the database. Please see figure 3.2 .

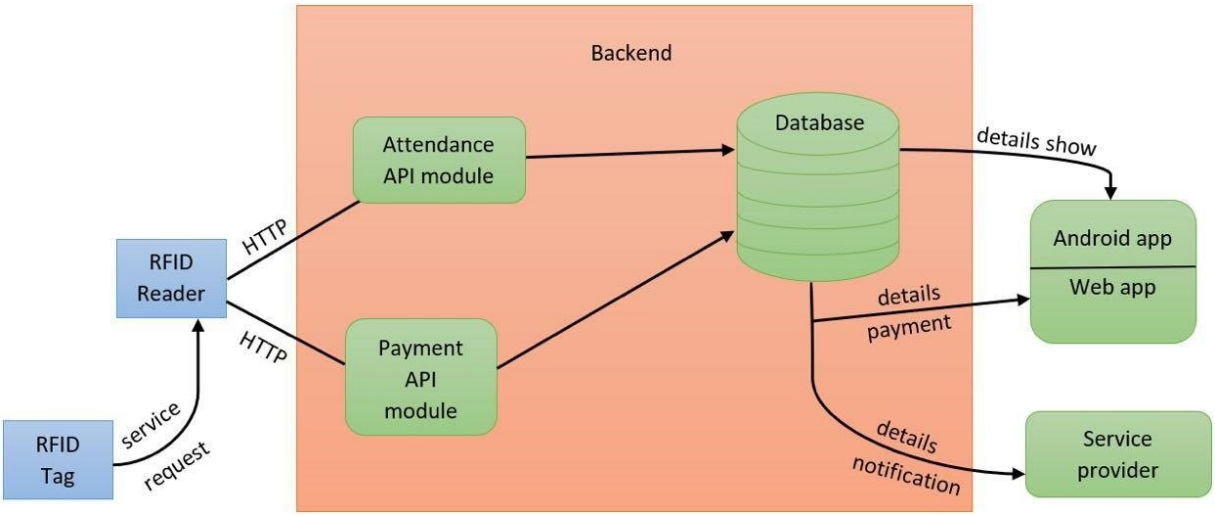

Figure 3.2: Block Diagram of the Project

Moreover, we also designed the activity diagrams for all of our actors that will aid the development process of our system. It illustrates a clear view of how the actors will avail their services and also their interaction with the system. These diagrams will ease the development process when we will be implementing the sytem. Please see the figures below.

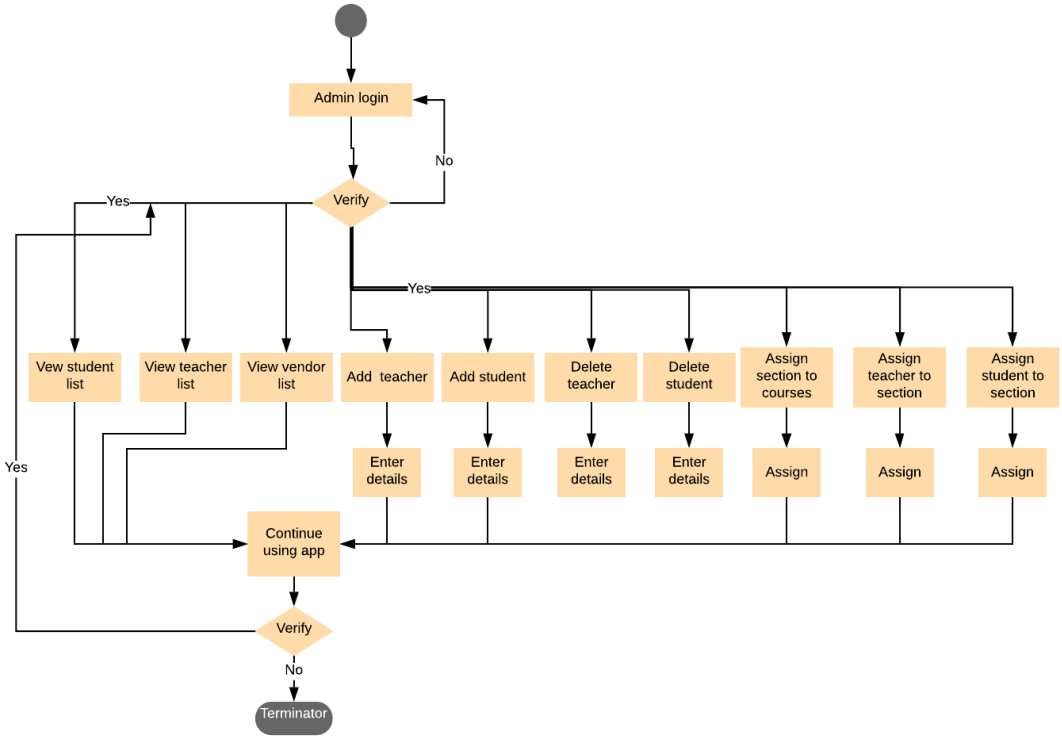

Figure 3.3: Activity diagram of Admin

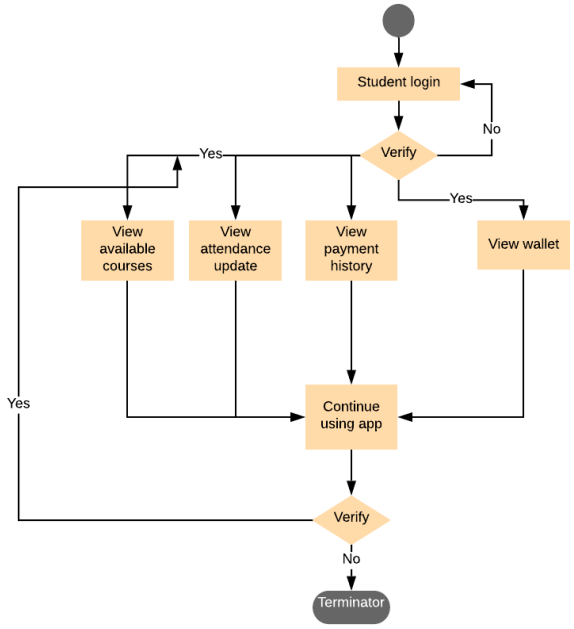

Figure 3.4: Activity diagram of Student

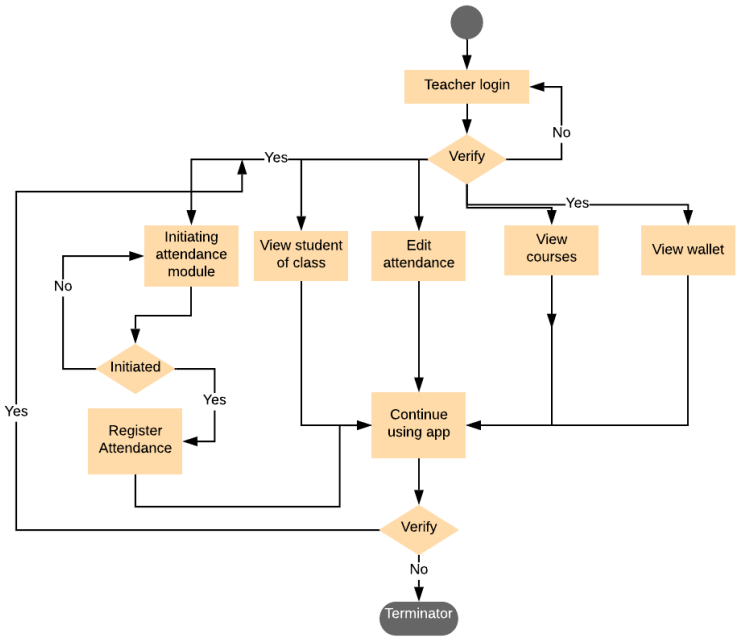

Figure 3.5: Activity diagram of Teacher

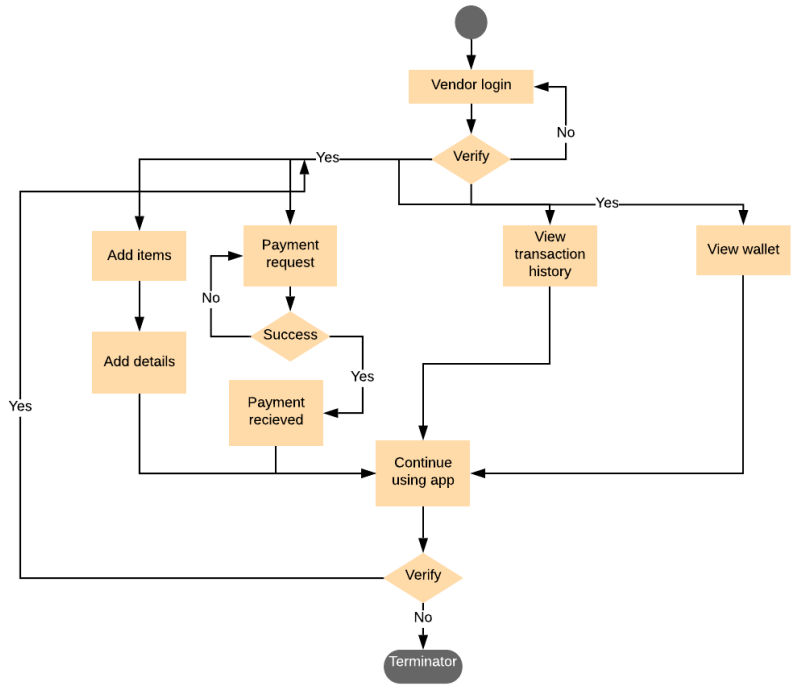

Figure 3.6: Activity diagram of Vendor

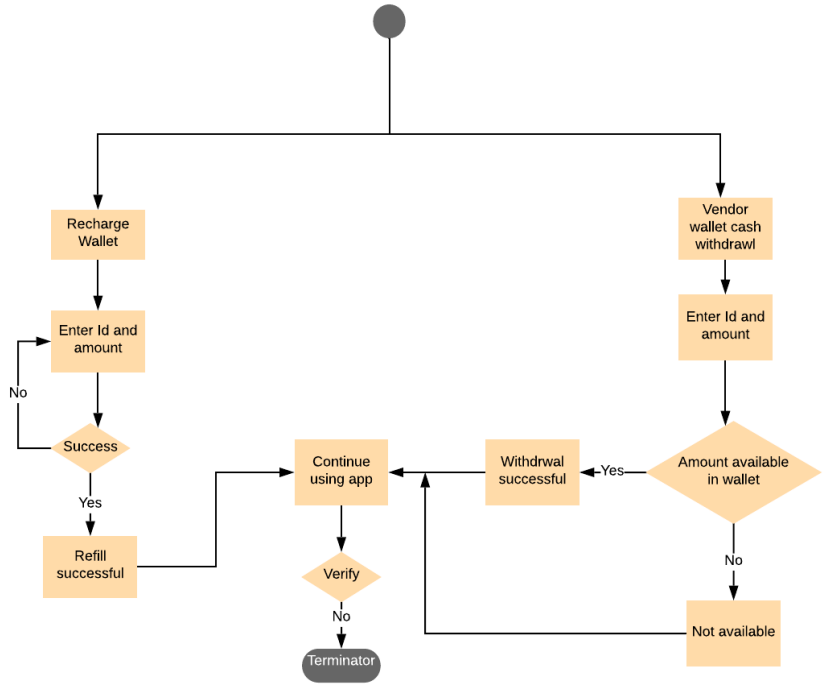

Figure 3.7: Activity diagram of fill-up process

Progressing onto phase four, we developed the UI (User Interface) for the student front of our android application. We chose orange as the main color, symbolizing signature color of our very own United International University. We went with a Materialistic Fluid design for the android application for its' smooth, pleasing, attractive and very natural feeling interface. We were mindful to add all the necessary features such as: smart suggestive login, logging in with the RFID card, payment and attendance systems, all the necessary animations and custom GIF's during the design phase so that later on during the coding and implementation phase, there is no confusion among the programmers, all the while trying to keep the UI fairly minimalistic as well, always displaying only what the user needs to see. While designing the UI we were very cautious not to clutter the interface with too many elements that might overwhelm the users. For better understanding of the readers, we arranged the UI in a wireframe design at first and later replaced that with proper mock-ups of the actual android application. Please check figure 3.3 .

3.3 Outcomes

The outcome of our project is to implement a secure, efficient and well-organized system for both the students and teachers. For implementing our system, we have chosen RFID technology which has been coupled with android and web application to record attendance and make on-campus payments, such as canteen bills, tuition fees possible without

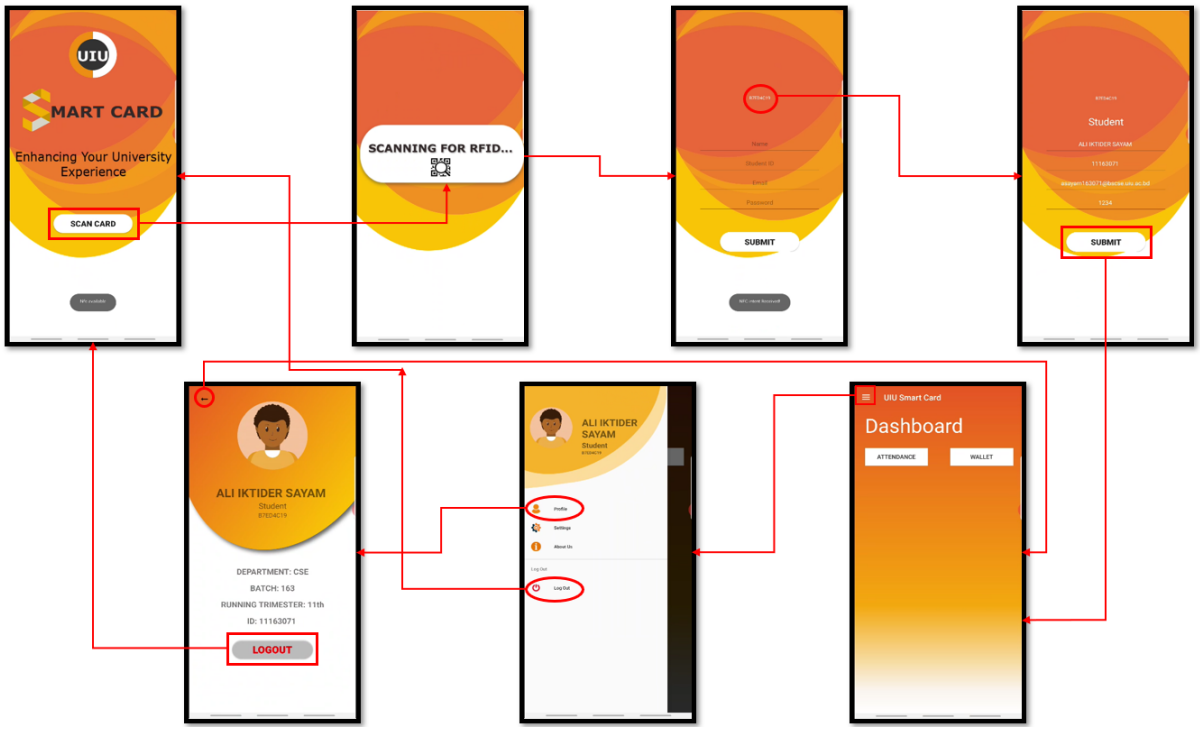

Figure 3.8: Wireframe Design of the UI

having to carry cash, which is not only safe and secure but also convenient. All of the aforementioned systems are to be made available to users with only one card. The attendance system offers significant speed and reliability benefits over the current backdated method of recording attendance. In the payment process, the use of RFID technology has a very short time which implies RFID-based payment systems have succeeded in shortening payment times. With the use of our system, students and faculty members can easily make the payments in the canteen which will save a lot of time for both the buyers and the service providers alike. Furthermore, students will not have to wait in a long queue for tuition fee payments anymore. Finally, with an All-In-One RFID based smart card system implemented, the users will be provided with an intuitive and convenient system creating an advanced digitalized environment which will help everyone to keep pace with the modern era of fast and rapid technological growth, all the while offering a peace of mind in terms of security.

3.4 Accompanying Tools

There are several accompanying software that has been used throughout the development of our system. Adobe XD has been utilized extensively to design the User Interface and make prototypes of both the android application and the web application. This software has allowed us to come up with a fluid design that is aesthetically pleasing to our users. Moreover, Adobe Photoshop and Adobe Illustrator have been used to make animated custom GIF's that have added extra fluid design elements to our system. This proved to

be rather challenging for us since our hardware wasn't up to the mark to render 1440p highly smooth frames. We had to settle for 1080p GIF's with fairly above average smooth frames for the time being. Secondly, Android Studio with various libraries has been used to develop the android application that serves the users with robust functionality. Thirdly, the XAMPP stack has been used to develop the entire web application along MySQL for implementing the database. The data flow between the android application and the database has been handled by several API's written in PHP, which was also developed from the ground up by us. Lastly, we have used Web-hosting and CPanel to make the web application and database online into the World Wide Web. We have been able to organize our resource files adroitly utilizing the vast functionalities CPanel provides.

3.5 Summary

With astoundingly positive responses from 112 UIU students, the necessity of such a system is greater than ever before. Students have shared with us their honest thoughts and suggestions, which honestly have overwhelmed us in the most humble way possible because of the sheer amount of positive support and response we received. From the comprehensive review of related literature that we did earlier, the required hardware and software have been selected. A deeper analysis of the system allowed for a brief data flow to conceptualize and a simple block diagram visualized that. This visualization of the data flow in form of a block diagram has proven to be immensely helpful later on during the implementation phase. The design of an aesthetic fluid android and web UI has gone a long way in attracting the users and being pleasing to the eyes. Having a good UI is always the first major step in terms of developing a project, because a bad UI can break an otherwise very well done project. Whereas a well-done UI would even mask many shortcomings of a mediocre one. This project offers a convenient and hassle free attendance and payment system with a All-in-one smart RFID card. This entire chapter paints a brief picture for the readers to understand the reasoning, inspiration and methodology behind the development of the project.

Chapter 4

Implementation and Results

This chapter sheds light on the detailed process of implementation phase by first talking about the environment setup in-depth. Then the chapter talks about the various implemented features for the system. The chapter ends by talking about the results/outcomes of the project.

4.1 Environment Setup

In order to begin developing this project we first had to make sure that our hardware part is fully functional. To ensure that, first we made sure that our RFID card reader of choice, which is RC522 is compatible with our NodeMCU microcontroller. We then had to ensure that the Mifare HF RFID tags that we are using is compatible with the card reader and most of the android devices that supports NFC. Having that done, we wired the components correctly, ran a sample code in the Arduino IDE to test that all of the hardware are in sync with one another and are in fact, reading and sending the correct data. Secondly, we went onto designing a proper and perfectly functional database system which will receive and send data to and from the hardware and android and web-based applications respectively. We then downloaded and installed Android Studio for android application development purposes and Sublime Text, which is our text editor of choice, for web application development.

4.2 Implemented Features

4.2.1 Android Application

We have developed an android application for ease of use of the students, we aim to extend this support to faculty members as well. The android application allows for a simpler and more intuitive interaction with the attendance and payment data for the students. It provides the ability to make secure payments on the go. It also acts as a security layer in conjunction with the unique RFID tag number so that the sensitive information regarding

student identification and amounts in wallet are not compromised simply by a stolen RFID card or a device for that matter.

4.2.2 Web Application

The web application provides an extensive access and control over application for every user. Teachers can view all the courses he is currently in charge of and can view any students history of attendance for that particular course at any time. They can also have a real time live feed while taking attendance of the students so that any proxy situation is avoided. Students can view his enrolled courses for the running trimester and can view his attendance history. Both teachers and students can check their wallet balance and top it up as per their need. The web app is also a control hub for the administrators of the system as well. The administrators can add and remove students and teachers to the main database and can assign them new tag id's if anyone of them loose theirs.

4.2.3 Smart Login

The login system on the android application is smart enough to detect whether there is NFC available on the user device and can recommend the best way to log in too the application based on that.

4.2.4 Real Time Attendance Update

In the web application the teacher can view in real time which student has recorded his/her attendance on the respective course including the time and id and all other necessary information. This feature is soon to be implemented on the android application in the near future as well.

4.2.5 Wallet For Payments

Both the android and web applications allows the users to maintain a wallet for on campus payments. The android application in particular allows the users to make on campus payments while ensuring the security of the transactions. It also allows for properly managed way to keep track of the money spent on campus.

4.2.6 Upload/Change User Details

Both the android application and the web application allows the users to change their passwords, upload photographs.

4.2.7 Vendor Dashboard

A dedicated dashboard to the service providers AKA vendors so that they can manage their menu items and sell them to the customer, namely the students and teachers, while

having an intuitive UI to interact with. This would also allow the vendors to have and provide visual feedback of their payments with card.

4.2.8 Admin Panel

An extensive admin panel allowing the admins to have the utmost control over what is going on in the system. The admins have the unique features of adding/removing new users into the system, assigning students to courses and binding them to sections, assigning teacher to their respective sections and courses and access to many other highly sensitive information that is otherwise not to be displayed to the users in general.

4.2.9 Multi-platform Compatibility

The android and web applications are always in sync. Both the applications are capable of displaying real time data and so any changes made in the database through any application are visible right away in the other in the connectivity is optimal. Users of each and every eco-system, whether it is of android or IOS can use our system with the utmost comfort.

4.2.10 Finesse and Control

Our developed system provides a level of finesse and control to every kind of users like no other solution out there. The teacher has utmost control over the attendance taken for his course. Both the teacher and the student has control over when and how they want to spend money from their wallets and when they want to top it off. The students will not have to run around in different banks to pay their tuition fees anymore. They will be able to do that directly from the android application itself. The administrators will be able to add and/or block/remove students and teacher according to the authorities decision. This level of absolute control for each of the actors is nowhere to be seen in the industry, at the very least in a compact and combo system like ours.

4.3 Application Outcome

This section briefs about the outcome of the system. The system runs on the web as well as on an android device.

4.3.1 Login

The system has a secured login process for each type of user that leads to their corresponding offered services. Furthermore, the android app has a smart login feature that facilitates fast and secured login to the system. Here is a glimpse of the login process.Figure 4.1 illustrates login on both web and android app.

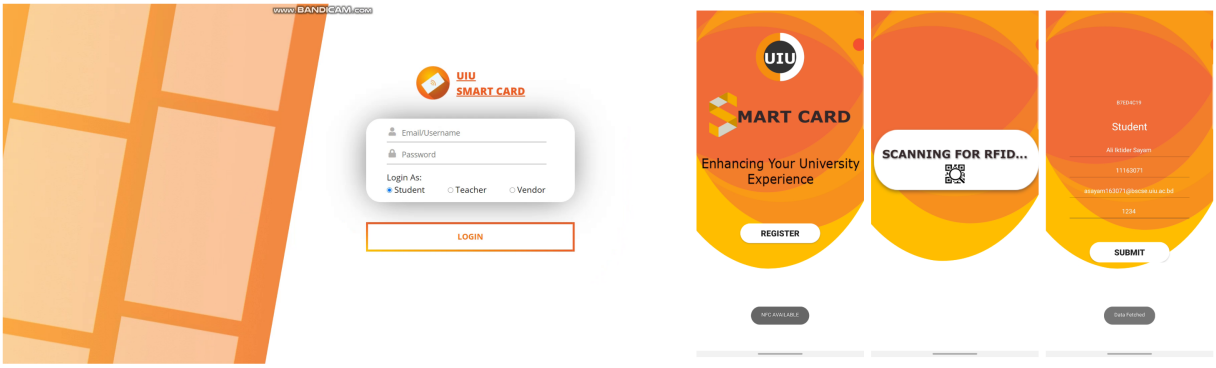

Figure 4.1: Login module

4.3.2 Admin Panel

The Admin panel provides the system administrator all the sensitive data that is not available to others. It allows the system administrator to issue a new RFID card to a new user and a lot of capabilities from managing courses to assigning sections to a student and a faculty. Here, in Figure 4.2 we have a look at the admin panel.

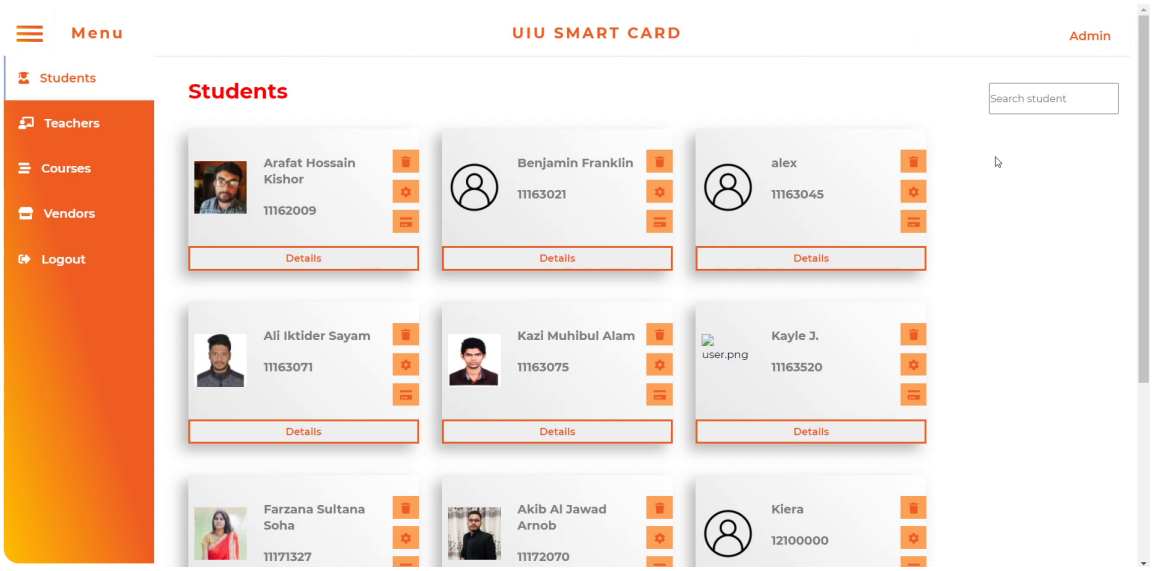

Figure 4.2: Admin Panel

4.3.3 Dashboards

The system greets the user with their respective dashboard after successful login.Each actor has his own dashboard which provides easier navigation to the services he intends

to use.Moreover, the simplicity of the dashboard design makes the interaction with the system fluid and to the point.The dashboards also contain profile details.The dashboards ensure that user can access all of the features of the system in one place and in a more efficient manner .Figure 4.3 shows a look of the dashboards.

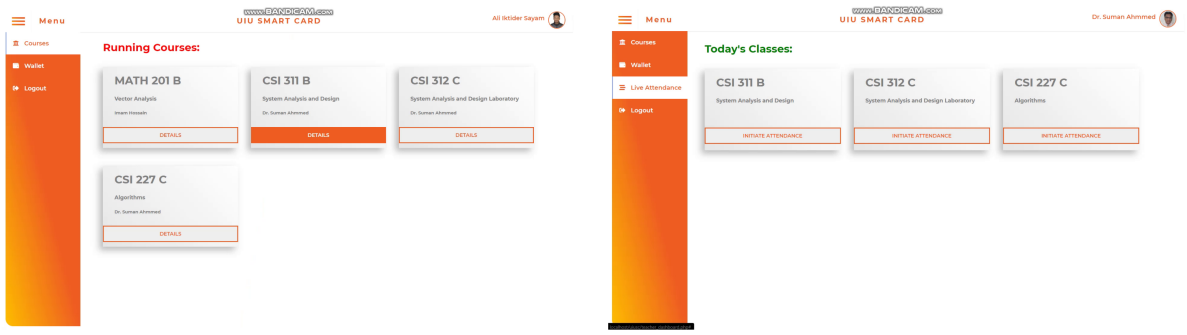

Figure 4.3: Dashboards

4.3.4 Attendance Module

Students and faculties both can access the attendance module from their respective dashboards that allow giving attendance for a particular class and also provides a real-time update. The faculty initiates the attendance module first and then the attendance module registers the attendance of the students for any particular class. Students can view their attendance update live on the android app too. Figure 4.4 demonstrates the attendance module.

Figure 4.4: Attendance Module

4.3.5 Payment Module

The payment module handles the transactions between the users and the service provider AKA vendors. Upon buying items the user needs to touch the RFID card to the RFID reader provided at the vendor's location and the payment module makes the transaction. The module is available on the user dashboards. Apart from handling the transactions it also provides the transaction history to the users which are available on both web and the android app.We see the payment module on of the system in figure 4.5.

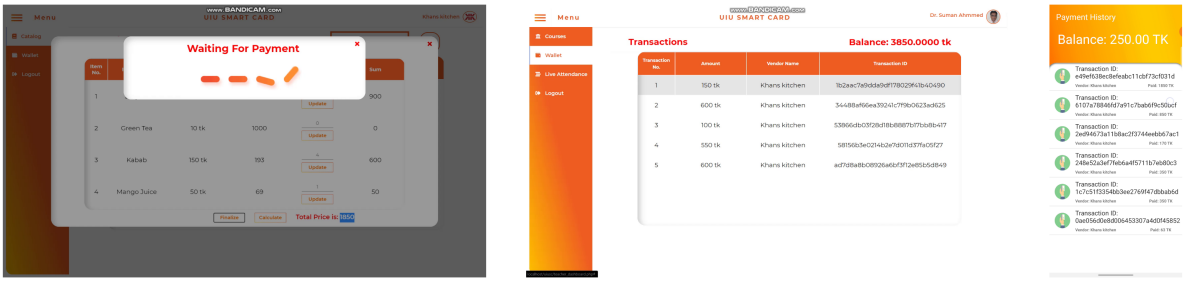

Figure 4.5: Payment Module

4.3.6 Wallet Fill-up Module

As the system has a feature to load cash against the RFID card to make payments, the system features a nifty solution to recharge the card. The institutional account division has access to the module and they will use the module to recharge the RFID card upon recieving cash from the user. Here is a look at the fill-up module in figure 4.6.

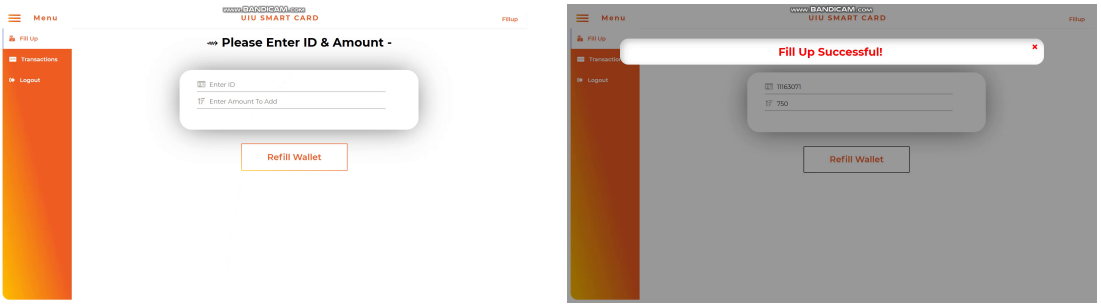

Figure 4.6: Fill-up Module

4.4 Summary

The implementation of this system, however difficult has been worth it. The system has been of tremendous help to both the students and the teachers alike, not to mention to the vendors and the authority as well. Through the implementation of this system we have been able to offer an entirely new experience to the users; offering fast, secure and convenient method of recording attendance and making payments that have not yet been introduced in our institution well enough. This system focuses on the ease of use and proper visual feedback for the users, while also providing very sophisticated technical benefits and control over the system.

Chapter 5

Standards and Design Constraints

This chapter talks about the various standards used in order to implement the project in the first section. And in the second phase this chapter sheds lights to the various impacts and constraints of the project on various aspects of the environment, society and the industry in general.

5.1 Compliance with the Standards

There are no known standards and constraints in Bangladesh. As a result, international standards are being followed:

5.1.1 Software Standard

- International Organization for Standardization (ISO)
- American Standard Code for Information Interchange (US ASCII)

5.1.2 Hardware Standard

- Universal Serial Bus (USB) used to power hardware

5.1.3 Programming Languages

- JavaScript used for front-end programming
- SQL used for database manipulation
- PHP used for back-end programming
- Arduino Programming Language used to write sketches for NodeMcu
- Java used for android app development

5.1.4 Communication Standard

- W3C used for web development
- HTTP used to make HTTP requests
- Wireless IEEE 802.11b used to connect devices through WiFi
- RFID ISO/IEC 14443 used for RFID data read and write

5.2 Design Constraints

The constraints listed below reflect our implemented systems' impact on the market, the environment and other related fields such as social impact, ethical impact, health, manufacturability, sustainability etc . Basically it points out the key factors that had been considered during the development phase of the entire system.

5.2.1 Economic Constraint

This system is an enormous improvement on the existing market products. The holy-grail of RFID access control system is thought to be BioStar SUPREMA, which despite providing a finely tuned product, is far more expensive than it should be even at the entry level.Which takes it far away from many out there who might be beneficial by getting the services this system offers.But We are able to provide the same level of security and finesse, with a much more streamlined and finely tuned software experience, at a fraction of the cost for which people out there can be benefited by being valuable user of this system.

5.2.2 Environmental Constraint

The system doesn't consume much energy and it doesn't emit any waste at all, discarding the possibility of any negative impact on the ecosystem. The wastage of energy due to system loss is very minimum which is almost is negligible. It is ensured maintained very carefully that the system doesn't have any negative impact at all on environment and ecosystem.

5.2.3 Ethical Constraint

As the entire system is fully automated, no question on its fairness will be risen. Every actor will exactly be served as they have been promised by the system. It is designed and implemented in such a way that no data or security breach is possible whatever the consequences are.And It can not be used for unfair means at any situation.

5.2.4 Social Constraint

People of all sectors can use this system if the environment they are surrounded by has this system installed. Especially the people working on a place where their activities are

being recorded and are eligible to be fully automated will have the ultimate benefit of this system.

5.2.5 Political Constraint

We have been concerned regarding the fact that the system doesn't break any law during its' usage period or when the system is being implemented in a institution. As it is all legal the system doesn't need any approval from government or any organizations which reduces the trouble which may occur while implementation of some other systems.

5.2.6 Health Constraint

We have been very mindful of the fact that the system doesn't cause any health issues to the users and it has been one of our top most priorities during the development period of this system. We have utmost concern of the well-being of our users in mind at all times.

5.2.7 Manufacturability and Cost Analysis

We have thoroughly went through the system's feasibility analysis and have been convinced that we can produce this system in vast numbers as per requirement and might even be able to upgrade the product with more advanced technologies which are yet to come. Manufacturing the product in vast quantities would definitely be cost efficient and profitable at the same time.

5.2.8 Sustainability

The entire system is designed in such a way that it is very durable during its usage period. Any person related to the concerned institution in which the system has been implemented, would have the eligibility of using the system without any hassle or trouble.

5.3 Summary

Our goal is to lessen the inconvenience and hassle of recording attendance and making on campus all kind of payments. We have been aware of the fact during the development phase that the whole system will be used by different level of people and everyone's capability of using a system can never be of same standard.So that, we have developed this system with the ease-of-use and convenience in mind. We have opted for the highest international standards and were mindful of various constraints during the development phase to ensure the quality and credibility of our system.

Chapter 6

Conclusion

This chapter closes the curtains on this report by summarizing the project first. Then the chapter goes on to talk about some unwanted limitations that this project faces while implementing in real life. And finally, this chapter ends the report by discussing the future scope of our project.

6.1 Summary

Implementing any system in a real-world scenario is always a heavy task, especially when the system takes on a challenge to improve existing systems. Our journey to implement and introduce this new technology to our superiors wasn't an easy task. But through the numerous ups and downs we faced, we learned a lot of new things and discovered an entirely new world of access control systems. We first conducted a survey on our system's acceptance and feasibility. We wanted to check the public response to our system. There were several questions about this system and we have received tremendous positive feedback from almost everyone which has given us more motivation to make this system stand. Another purpose of conducting this survey was to find out if the system we want to build is suitable for everyone or if everyone wants something like this. Since we have not received any negative feedback, we are optimistic about our system. Our implementation improves upon the conventional method of taking attendance and hazardous on-campus payments and takes it to an entirely new level with the integration of android and web applications and real-time visual feedback and wallet management. We, however, did not stop there. We improved upon several other implementations of all-in-one student id cards, by improving on checking the proxy attendance situation. At the same time, we have tried to emphasize privacy and security in our system, because we think everyone deserves privacy with their data. Security has also been emphasized so that everyone's privacy is maintained properly. We have made our attendance system proxy free. However, we have big plans for new updates in the near future.

6.2 Limitations

Although trying our very best to rid the system of any major limitations or loopholes, we still have some features to be desired, which is always the case with any and all first generation products. We tried our best to extend our support to any and all users from different ecosystems of technology. However, due to a shortage of time, we could not make a native IOS application to support IOS users. Not to mention, our system requires a constant supply of power and an "always connected" environment to operate, which might not always be possible in an underdeveloped or even in a developing country 24/7. Although to be fair, as previously mentioned the power consumption of our device is very minor in real world comparisons. But for the sake of transparency and argument, even that should not be a concern in a perfect world or vacuum. Provided enough resources and time, We hope to mitigate these limitations soon enough.

6.3 Future Work

Future work for our system includes implementation of a ticket checking system for university bus services and implementation of an automated library book issuing system through the usage of RFID in a similar manner. This would allow us to expand our services to various new sectors and allow for an overall all-rounded experience for the users as well. In terms of improving our already implemented system, we are looking forward to implementing HCE(Host Card Emulation) and two-factor authentication for payments on the android application side. We also have a big plan to implement an AI-based notification system on the native android application that will notify the students to join classes if they have less than minimal attendance in a particular course. Our main purpose in creating this system is to bring an end to the previously cumbersome manual methods of making payments and taking attendance. We are trying to eliminate the wastage of time that used to be a constant in previous systems through the implementation of our newly improved system so that these certain tasks can be executed in a hassle-free and less time consuming manner. Moreover, we will try to get important feedback from our respected users in the future should they face any problems or have complaints or suggestions about our system. We will be mindful to fix bugs and update the system as per user requirements in timely manner for the betterment of both the system and the respected users. With enough time and proper resources, we are confident that we can truly make this system into a market-ready product that offers the best security and convenience at a fraction of the price of current market standards.

References

[1] Abu Zafar Abbasi, Zubair A Shaikh, et al. Building a smart university using rfid technology. In *2008 International Conference on Computer Science and Software Engineering*, volume 5, pages 641–644. IEEE, 2008.

[2] Wei Liu, Chenglin Zhao, Wei Zhong, Zheng Zhou, Feng Zhao, Xiaoji Li, Jielin Fu, and KyungSup Kwak. The gprs mobile payment system based on rfid. In *2006 International Conference on Communication Technology*, pages 1–4. IEEE, 2006.

[3] Rinky Yadav, Rutuja Kadam, and Viraj Kolekar. Multipurpose student smart card. 2019.

[4] K Sree Veda Samhitha and Abdul Gaffar. Acute school bus surveillance and notification system. 2019.

[5] Davinder Parkash, Twinkle Kundu, and Preet Kaur. The rfid technology and its applications: A review. 2012.

[6] Leandre Nsengumuremyi. Smart id card system using rfid technology. 2018.

[7] Ankita Agrawal and Ashish Bansal. Online attendance management system using rfid with object counter. *International Journal of Information and Computation Technology*, 3(3):131–138, 2013.

[8] Indranil Bose, Eric WT Ngai, Thompson SH Teo, and Sarah Spiekermann. Managing rfid projects in organizations. *European Journal of Information Systems*, 18(6):534–540, 2009.

[9] AA Olanipekun and OK Boyinbode. A rfid based automatic attendance system in educational institutions of nigeria. *International Journal of Smart Home*, 9(12):65–74, 2015.

[10] C Srujana, B Rama Murthy, K TanveerAlam, U Sunitha, Mahammad DV, and P Thimmaiah. Development of rfid based library management system using matlab. *International Journal of Engineering and Advanced Technology*, 2(5):480–483, 2013.

[11] Peter Adole, Joseph M Môm, and Gabriel A Igwue. Rfid based security access control system with gsm technology. *American Journal of Engineering Research*, 5(7):236–242, 2016.

[12] Manoj Kumar Sinha and Anupam Chanda. Exploring rfid technology application for managing library and information services in university and institutional libraries of north east india: An overview. *Int. J. Inf. Sour. Serv*, 1:72–85, 2014.