Smart University Card

By

Qandeel Fatima

Ayesha Waheed

Ali Zaman

Tayyab Sattar

Supervisor

Assistant Prof. Dr. Abdul Wakeel

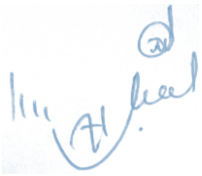
Submitted to the faculty of Department of Electrical Engineering,
Military College of Signals, National University of Sciences and Technology,
in partial fulfillment for the requirements of B.E Degree in Electrical Engineering.
(JUNE), 2021

In the name of Allah, the Most Beneficent, the Most Merciful

CERTIFICATE OF CORRECTIONS & APPROVAL

Certified that work contained in this thesis titled "Smart University Card", carried out by Qandeel Fatima, Ayesha Waheed, Ali Zaman and Tayyab Sattar under the supervision of Assistant Prof. Dr. Abdul Wakeel for partial fulfillment of Degree of Bachelor of Electrical Engineering, in Military College of Signals, National University of Sciences and Technology, Islamabad during the academic year 2020-21 is correct and approved. The material that has been used from other sources it has been properly acknowledged / referred.

Approved by:



Signature:

Assistant Prof. Dr. Abdul Wakeel

(Supervisor)

Department of EE, MCS

Dated: 13th June, 2021

DECLARATION

No portion of work presented in this thesis has been submitted in support of another award or qualification in either this institute or anywhere else.

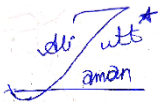
PLAGERISM REPORT (TURNITIN REPORT)

This thesis has been checked for Plagiarism. Turnitin report endorsed by Supervisor is attached.

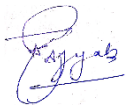
Signature of Student:

Qandeel Fatima

Ayesha Waheed



Ali Zaman



Tayyab Sattar

Registration Number:

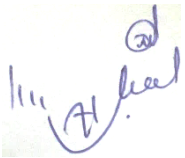
00000237581

00000240925

00000240969

00000240972

Signature of Supervisor:



Assistant Prof. Dr. Abdul Wakeel

ACKNOWLEDGMENTS

There is no power but in the hands of ALLAH Almighty. We are grateful to HIM for giving us direction and empowering us with the energy to achieve the required goals of this Final Year Project. We are also appreciative of those who have helped us throughout this journey to accomplish the required task at hand especially the helping hands that we received from our very helpful supervisor Assistant Prof. Dr. Abdul Wakeel, who has been there to help and guide us at every step of this project.

DEDICATION

With great joy, we dedicate our work to our beloved parents who have supported and encouraged us immensely, to our colleagues and most importantly to our supervisor, Assistant Prof. Dr. Abdul Wakeel, who have been our backbone of support throughout.

ABSTRACT

By nature, technology and advancements do not rest. One might assume that almost every kind of technology now exists in today's world. Yet, that assumption will surely be far away from the truth. As Albert Einstein has very well stated, "What we do not know is much more than what we know." Therefore, it is necessary to keep working in the direction to better the already existing technology and to discover new horizons. Such is the case with radio frequency identification (RFID) technology.

With the advent of RFID technology in the 20th century, it opened doors for a vast number of possibilities and technological development. Since then, the RFID technology has become widespread worldwide and is employed for the multitude of reasons ranging from electronic toll collection to being used in e-passports.

The key purpose of this project is to make use of RFID technology in order to combine data logging and transaction billing to make a multi-purpose system. RFID technology is not well known to the localities of Pakistan as it is scarce to witness RFID based systems in the country. One of the aims of this project is to hopefully implement a multi-purpose RFID based system in the campus of MCS, NUST. It can be observed that the campus does not have any sort of automated entry system to keep logs of the students who have entered the premises. Along with this, the cafeteria in MCS has suffered losses in the past due to students not paying back the lent amount. Also, keeping records of bills manually on paper is a tough job and is more prone to human error.

Smart University Card is designed to tackle the highlighted issues. It is a RFID based system that allow students access into the university premises, logs their entries and notifies their guardians. In addition, this system also has the capability to carry out transactions with the credit present in the Smart University Card at the cafeteria setup. The data that is logged at the entrance and the transactions that took place at the cafeteria can be viewed via the Android application.

Implementing the Smart University Card does not only make life easier for the students. It adds security to the campus as the guardians are notified of their child entering the premises. Also, the data logs can be accessed in case of an emergency to backtrack the student. Along with this, the Smart University Card setup eases a lot of workload for the staff, that comes with manually recording the cafeteria bills. The result is reduction of paper-usage, well-kept transaction records and an efficient environment.

TABLE OF CONTENTS

TABLE OF FIGURES

ABBRIVIATIONS

1. RFID: Radio Frequency Identification
2. WMS: Warehouse Management System
3. ERP: Enterprise Resource Planning
4. IT: Information Technology
5. RCA: Radio Corporation of America
6. IBTTA: International Bridge, Tunnel and Turnpike Association
7. CMOS: Complementary Metal–Oxide–Semiconductor
8. EEPROM: electrically erasable programmable read-only memory
9. LOS: line-of-sight
10. UHF: ultra-high frequency
11. QR: Quick Response
12. SMS: short message service
13. MCS: Military College of Signals
14. LCD: Liquid Crystal Display
15. RTC: Remote Time Clock
16. SoC: System-on-a-Chip
17. IoT: Internet of Things
18. UAV: Unmanned Aerial Vehicles
19. SIM: subscriber identification module
20. IMEI: International Mobile Equipment Identity
21. MMS: Multimedia Messaging Servic

CHAPTER 1: INTRODUCTION

1.1 Overview

The project is needed by the security systems installed at the entrance of a particular place, the people who keep a check on the attendance of students may be benefited by its use, this would be of great use to the catering and management teams since they keep a written record of the bills of cafeteria so in that case there is a greater chance of human error. This system will lend a helping hand in maintaining transparency of the billing in cafeterias. The system will play critical role in accessing multiple points in university, housing society or any other company. Science and technology is playing a critical role in all fields nowadays. The project can be used for multiple purposes in every sector of life. It can be used for authentication, securing the records and many more. The card is embedded with microchip for storing and accessing information. A mobile app will give an additional help to the system because it would be connected to the card and incase the card is lost or taken away by someone else, the card can be easily blocked. This is done to prevent the misuse of anybody's personal data and information. The additional advantages include reduced workload, increase authentication and improvement of services.

1.2 Problem Statement

Personnel entering the premises of any company, organization or educational institution is usually not monitored which results in illegal and unauthorized access of people to the organizations. Furthermore, people buy the cafeteria items which can be a reason of billing record loss or theft. Implementation of the project makes it possible that the entrance access and cafeteria management records are dealt without manual data logging.

1.3 Approach

The project has two parts: one for the main gate and other for the cafeteria. The device at the main gate is used to keep a record of entry access. The device at the cafeteria is used to make transactions. The project uses RFID cards/tags for unique identification. Both the parts are interconnected with an online database where all the information about the students is stored. A notification appears on the android application whenever the Smart Card is used.

The Smart University Card along with a designed application allows students to deposit money which can be used to buy goods from the cafeteria. Also, the application allows to block the Smart University Card in case of theft or fraud.

The project can be easily adapted. In this time and age, keeping accurate records along with an efficient system is necessary for any firm or institute that deals with masses. This project takes leverage of the fact that all these premises make use of an identification card that is dedicated to personnel and is unique to everyone. This project has wide range of functions incorporated in a single card. It deals with entry logging, transactions with an Android application to keep a track of entry access, and cafeteria records for staying notified.

The major use of the RFID technology is the security it offers to its users. The project enables its user organization or companies to secure themselves against illegal unauthorized users. Shopping is made easy by their usage.

It reduces the time to receive payments, reduced leakages, and increased beneficiary satisfaction. When the person holding the smart card gains full trust over it, that his information, payments, data and transactions will be kept fully secure then he will surely adopt this comparatively new system or technology. In this case educational institutions need a special mention. By using this system, the staff will come to know how easy and fast use it has and so they will have lesser workload. The attendance of students will be continuously monitored by this system making them more regular and serious towards their studies and will shape their future in a wonderful way.

1.4 Scope

The project has a very wide scope and is applicable everywhere in all the sectors including educational sectors, industrial sectors, e.t.c..

The project can be applied and extended to various organizations, companies, institutions, libraries, housing societies, e.t.c., for keeping record of the staff members. It is also applicable in educational institutions for authentication and keeping record of the students. It is basically applicable everywhere where there is a requirement of keeping a record of entrance to avoid unauthorized access and record of credit. This will reduce manual work and helps in digitizing the environment.

1.5 Aim & Objectives

Radio Frequency Identification is cost efficient and effective technology. RFID applications have been spread in diverse domains such as engineering, robotics, IOT, etc.

The objective is to explore the field of embedded systems to create an effective system that allows easy access to certain locations on the campus with a single smart card and making use of SQL for effective data handling.

The goal is to enable students to use the Smart University Card to access multiple points of the campus. The main objectives that this project focuses to achieve are the following: -

- Students are able to authenticate themselves at the entrance of the campus using the Smart University Card.
- Students are able to use the Smart University Card to pay their cafeteria bills.
- They are able to deposit money into the card via an app.
- For cafeteria payments, students receive message on their phones after a successful transaction.
- Students are able to block the Smart University Card in case of fraud or theft.

1.6 Contributions

This project is designed and developed mainly for the entrance access and cafeteria billing to create an effective and hassle- and stress-free environment by digitalization and would contribute the most towards the transparency, authorization, billing theft issues.

1.7 Organization

The first part of the thesis is the abstract which gives a basic insight of what the project is about. It is the crux of the thesis. The division of the chapters and the material included in them are as under:

Chapter 1 This is the introduction section where a brief overview of the project has been given. It deals with the problem statement, approach to be followed, scope and objectives of the project.

Chapter 2 provides us with the literature review regarding how RFID has evolved in the 20th and 21st century. The concept of RFID and how they differ from barcode has also been explained. Moreover, the components of Radio Frequency Identification (RFID) have also been highlighted.

In **Chapter 3**, the design and the development of the project is explained using flow charts exhibiting the various stages involved in this project. Chapter 3 also includes a description of the software and hardware requirements of the project.

Chapter 4 describes in detail the analysis and evaluation of the techniques used to create the Android application and the cafeteria desktop application. It also gives an account of the tested results that were obtained after the system was run.

Chapter 5 sheds light on future work that may be implemented and explains further improvements that can be incorporated in the existing project and the additional developments that can be made to enhance the scope of the project.

The conclusion, appendices and bibliography are given at the end of the document.

CHAPTER 2: LITERATURE REVIEW

An extensive and detailed research was conducted on our part before undertaking the design and development phase of the project. This section deals with a brief review of what RFID is, how it is different from barcode technology, and the work already done in the field of RFID.

2.1. RFID

RFID uses radio frequency waves that are wireless and non-contactable for the purpose of transferring information. RFID technology sends and receives data with the help of RFID system that includes an RFID reader, RFID tags/cards, an antenna and a transceiver. RFID technology has improved over the recent years and the implementation cost has been reduced and its efficiency has improved, making it cost effective and efficient technology.

RFID tags/cards have a reading range from few centimeters upto 20 meters, determined on the basis of RFID type being used. The RFID tags/cards that lie within range can be detected easily and matched with the information present in the database, thus, automating the data collection and significantly reducing the human effort and error.

The fact that communication between RFID tags/cards and readers does not depends on orientation or position of the RFID card/tag, information can be read and written automatically. RFID tags/cards have different and unique codes, products can be labelled independently but read collectively, the tag data is warehouse management system (WMS) and Enterprise Resource Planning (ERP) system compatible, and tags are almost impossible to copy makes them significant part of many applications. Applications that make successful use of RFID technology are countless ranging from supply chain management to tracking of inventory, information technology (IT) assets, file, vehicle, hospital infant's jewelry, logistics, laundry and textile, and so on.

2.1.1. RFID in the 20th Century

The 20th century was a blooming era for technologies such as radio communication and RFID. With achievements such as continuous wave radio generation, transmission of radio signals and the development of radar, it was not far in the future that RFID would have been the next big step in the technological advancements.

Before RFID technology could be deployed, other major developments had to be made such as transistors, microprocessors, integrated circuits, e.t.c.. One of the early works that recognized the RFID technology was the paper published by Harry Stockman titled "Communication by means of Reflected Power" in 1948. In the 1950s, research and developmental work was focused on the development of RFID and famous works such as the long-range transponder systems for aircrafts used for the identification of friends of foe (IFF) and "Radio transmission systems with modulated passive responder" by D.B. Harris. [1]

By the 1970s, the developments in the field of RFID were sky rocketing. Works of R.F Harrington (1964) like "Theory of Loaded Scatters" which included the study of electromagnetic theory with regards to RFID were published [1]. Along with this, inventions like "Remotely activated radio frequency powered devices" by Robert Richardson and "Passive data transmission techniques utilizing radar echoes" by J.H Vogelman were developed. RFID technology was entering the commercial sector as well. RFID based companies were established and companies like Knogo were developing electronic article surveillance (EAS) and 1-b tags in order to deal with the merchandise thefts that took place in the commercial markets. Such type of systems used either of the two mechanisms, i.e., microwave or inductive technology. EAS became widely used in the commercial market as a single bit EAS tag and multi bit EAS tags were introduced. Single bit EAS tags were still widely used as their size was considerably smaller than the multi bit EAS tags which were as big as a loaf of bread due to its circuitry. [1]

Academic institutions, research laboratories and companies were paving their way into the further development of the RFID technology. One such developmental work is of the Los Alamos Research Laboratory titled, "Short Range Radio Telemetry for Electronic Identification Using Modulated Backscatter" by Alfred Koelle and et.al. in 1975, which gave rise to the passive tags that could perform from a distance of tens of meters [1]. Companies were also doing their part in the development and spread of the newly introduced technology such as electronic identification

systems developed by Richard Klensch of Radio Corporation of America (RCA) and Raytheon's Raytag in 1975 and 1973, respectively. Other companies that were working on their fair share in the further development of the RFID technology include Westinghouse, Glenayre, Philips and General Electrics. Further works were done for the application of automated factory works, animal tagging, building RFID systems and electronic toll collections.

Since there was no interest in creating a standard for the identification of vehicles, it provided for an opportunity for the development of multiple types of RFID based systems for vehicles. The developmental works for the transportation systems using RFID were contributed by Los Alamos, International Bridge, Tunnel and Turnpike Association (IBTTA), and the United States Highway Administration.

Books were published which became a collection of knowledge were utilized in the establishment and development of early backscatter RFID systems such as the book authored by R.J. King about microwave homodyne techniques in 1978. By the late 1970s, RFID tags had improved quite a lot as they were now smaller in size and used complementary metal–oxide–semiconductor (CMOS) logic circuits that utilized less power. Along with this, tags now used switches and fusible link diode arrays.

With the invention of the personal computer, it had given a boost to the expansion and implementation of RFID technology as it was now easier and economical to collect and manage the data retrieved from the RFID systems. In the 1980s, RFID technology had touched different countries in the world and now was widespread with it being utilized for transportation and personal access in the United States, short range systems for animal tracking and industrial applications in Europe, and toll roads equipped with RFID systems in Norway, France, Spain Italy and Portugal. The first commercial application for collecting tolls was introduced by Norway in 1987 and it was soon followed by the United States. Along with this, RFID systems were implemented for buses going through the Lincoln Tunnel in New Jersey and New York.

In the 1980s, the tag technology was further subjected to advancements with the tags now being manufactured using the CMOS integrated circuits in combination with discrete components. Also, with electrically erasable programmable read-only memory (EEPROM) becoming the first choice for non-volatile memory, individualization of the tags was possible through programming over a large scale which also led to the size reduction of the tags.

In the 1990s, North America had installed over 3 million RFID tags on rail cars. Oklahoma opened the first open highway electronic tolling system in the world in 1991 which allowed the vehicles to pass the tolling points without slowing down was further strengthened using video cameras. In 1992 was installed the first combined toll collection and traffic management system by the Harris County Toll Road Authority in Houston. Also, the first RFID systems were installed that could perform on different protocols. In 1990, E-Z Pass Interagency Group (IAG) was formed in the Northeastern United States which modelled the development of an electronic tolling system using a single billing account per vehicle and a single tag, therefore, multiple bridges and tolling stations can be accessed.

Along with these advancements came the development of multiple use of tags over different segments. This meant that the same tag can be used for paying tolls, parking access and payment, campus access, etc. The first such use of multiple access using the same tag was implemented by the Dallas-Ft. Worth metroplex. Further development of the RFID technology was taken into notice as CMOS integrated circuits were now able to be fabricated with microwave Schottky diodes. Along with this, research work and books were still being published like Klaus Finkenzeller's book in 1999, dedicated to RFID [1].

2.1.2. RFID in the 21st Century

The advancements in the RFID technology were not only limited to the 20th century. In the 21st century, microwave tags could be built using two components, i.e., an antenna and a CMOS integrated circuit. The size of the tags were restricted by the size of the antenna used in the manufacturing of the said tag. Also, different forms of tags were now available, for example, sticky labels in order to make is easy for handling and sticking it wherever desirable.

2.2. RFID versus Barcode

Although barcode technology serves almost the same purpose as RFID, it has multiple limitations. To avoid those limitations, RFID technology is preferred.

Barcode requires line-of-sight (LOS) access to each barcode and only one item at a time can be scanned by barcode. However, RFID tags do not need line-of-sight, and multiple RFID tags/cards can be automatically detected and read at the same time [2].

Barcode reads from several inches to several feet while RFID reader can read from a variety of distances based on the type of tag/card used even if they are located under anything and are invisible. The passive UHF RFID reader can read the tags/cards till 40 ft. (in case of fixed reader) and 20 ft. (in case of handheld reader), and active ultra-high frequency (UHF) RFID reader can read the tags/cards till more than 100 ft.

In RFID, metals, liquids, etc. can be interfaced with some radio frequencies while barcodes suffer from wear and tear more often and the obstructed barcodes, i.e., covered with dirt or torn barcodes cannot be read. RFID tags can read and write but barcodes and only be read. RFID readers are mostly automatic and do not require any manpower or labor, but barcodes require human labor to operate [3].

RFID technology is, therefore, more secure, accurate, efficient, cheaper and less labor-intensive than barcode technology.

2.3. RFID versus Quick Response (QR) Scans

QR codes and RFIDs are both great ways to keep and record collection of data. A QR code stored data not only from left to right like in a barcode, but also from top to bottom. These are also known as 2D barcodes or matrix barcodes. Along with more storage space, different types of data can also be stored on it, for example, short message service (SMS), emails, etc. QR codes can be easily decoded using the scanner applications which utilizes the camera on the smartphones. Whereas in RFID, a transponder (tag) and a reader communicate to relay information.

QR codes allow for a large data to be stored on them. Along with this, they also have the capability of being read along all 360 degrees. They do not have to be held in a specific position to be read which provides for an easier and greater readability. QR codes are compatible with every smartphone and can be read as soon as they are scanned. The user does not require a special device to read the QR scans making it very accessible and easy to use. As they are designed in 2-D format, error correction is ensured and reinforced which gives QR scans the capability to be read even if they are not quite clearly visible or are partly covered or distorted due to its error correcting algorithms. QR codes are also environment friendly as plain recyclable paper may be used instead of magnetic tapes. Also, QR scans can be backtracked and traced using web analytic tools.

RFID tags on the other hand can be operated and detected from long distances as much as 300 feet and do not in any way require for the tags to be placed in the line of the sight of the detector or reader. RFID tags are also efficient as multiple tags may be scanned at once and they have very high read rate capabilities therefore, saving time and increasing work efficiency. RFID tags are reusable as they are robust and resistant to extreme temperatures and humidity levels. The design of the RFID tags allows them to be easily programmable and handle large collections of data. In addition, they are very secure and encryption protected and also allow password protected features [5].

Along with the advantages, both RFID and QR scans have their fair share of disadvantages as well. QR codes require line of sight in order to be detected as well as the fact that they cannot be detected from a faraway distance poses as a disadvantage. To design QR codes, it is time consuming and not feasible to produce greater amounts of codes which restrict their scalability. Also, the user requires to have a smartphone that has a compatible software to read QR scans in order to scan the said QR codes. In addition, they also lack the functionality of writing. QR scans can only be read [6],[7].

On the contrary, RFID manufacturing cost is higher than QR codes as it involves the integration of a computerized chip. Also, the accurate detection of the RFID tags may be hindered when passing through any liquids or metals. In addition, the signals from two or more chips overlapping may cause the reader to not read either of the chips due to collision or overlapping of the signals.

2.4. Components of RFID

Usually, the three components that make up an RFID system are: -

- RFID reader
- RFID transponder / card / tag
- RFID antenna

2.4.1. RFID reader

RFID reader can send radio waves in the range of 1 cm to 30 m or even longer distances based on the type of RFID reader used. The information stored in the integrated circuit of the transponder (silicon chip) is decoded by the RFID reader which then communicates them to a host system.

The RFID readers support bidirectional communication as they have the ability to read and write, therefore, the transfer of the data also works in the reverse direction from the system to the RFID card. RFID readers are categorized into different types based on their features, i.e., stationary or mobile RFID readers.

2.4.2. RFID transponder / card / tag

The RFID transponder/tag/card's designs and modes of function, depending on their operating frequency range, are very different. They come in various sizes, designs and protection classes depending on their purpose. The most widely used include self-adhesive labels or chip cards. They come as "read only" versions that can only be read, and "read/write" versions that can be both read and written.

In the Low Frequency and High Frequency range, a different identification number is saved within the chip. In the ultra-high frequency (UHF) range, the tags have an Electronic Product Code (EPC) storage area, thus allows the customer to program it.

The transponders also have a feature of power supply. Both active and passive transponders are easily within reach in the market.

Passive transponders/cards/tags, not having own power supply, get their power supply by making an inductive field from the radio signals. Due to their no need for maintenance and cheap availability, they are used for product authentication and tracking, and as data storage media for

access control systems. Passive transponders with up to 10 kbit storage capacity are easily available in the market, so they allow additional data to be stored within them.

Active transponders, by getting their power supply from a built-in battery, can themselves transmit signals for the purpose of data transfer. They are more expensive than passive transponders due to their integrated power supply. Due to their wider scanning range of up to 100 meters, they are used for object identification with a long lifetime.

2.4.3. RFID antenna

An RFID antenna is composed of a single or multiple winded coil/coils and a matching network. The RFID reader generates the electromagnetic signals and all RFID antenna radiates the waves and also receives the Radio Frequency (RF) signals from the RFID card/tags.

Antennas come in multiple designs, sizes and structures based on the need of the system of which they are part of and depending on the frequency used. The most commonly used antennas are rod and loop antennas. Multiple antennas can be integrated into one RFID reader for increasing the reading range or different orientations of the transponder.

The Low Frequency (LF) antennas with the range of 10 cm and low data rate have an operating frequency range of 120-150 kHz.

The High Frequency (HF) antennas with the range of 10 cm to 1 m and low to moderate data rate have an operating frequency of 13.56 MHz.

The Ultra High Frequency (UHF) antennas with the range of 1 m to 100 m and moderate data rate have an operating frequency range of 433 MHz and are made up of dipole and patch antennas.

The Ultra High Frequency (UHF) antennas with the range of 1 m to 12 m and moderate to high data rate have an operating frequency range of 865-868 MHz (Europe) and are made up of dipole and patch antennas.

The Ultra High Frequency (UHF) antennas with the range of 1 m to 12 m and moderate to high data rate have an operating frequency range of 902-950 MHz (North America) and are made up of dipole and patch antennas.

The microwave antennas with the range of 1 m to 2 m and high data rate have an operating frequency range of 2450-5800 MHz.

The microwave antennas with the range of up to 200 m and high data rate have an operating frequency range of 3.1-10 GHz.

CHAPTER 3: DESIGN AND DEVELOPMENT

This chapter clarifies the undertaking design and venture specifications including the equipment required and programming required for the implementation of this project. It explains in detail the proposed methodology and how the application will work. Also, a brief description of the programming language used is given at the end of the chapter.

3.1. Project Design

Moreover, this project was designed after analyzing the flaws in our university campus Military College of Signals (MCS). Along with this, the lack of multipurpose RFID based systems in Pakistan was also a driving force to design a project that could cater to the problems identified as well serve as a cost-effective venture. The project design of Smart University Card consists of mainly a main gate setup, a cafeteria setup, an Android application, RFID tags and a database.

3.1.1. Main gate setup

Before coming to the working of the main gate setup, it is necessary to know some key factors about the project's database. The Arduino pings the database every 24 hours and the data retrieved is saved in the SD card. The data present in the secure digital (SD) card is refreshed every time the database is pinged. The fields 'RFID key', 'Registration Number', 'Name', 'Batch' and 'Guardian Number' are sent from the student database to the SD card module through a Wi-Fi module.

The RFID tag is detected by the RFID reader and the RFID key is matched with the keys present in the SD card. If the key does not match, then access is simply not granted, and the liquid crystal display (LCD) displays "no access". If the key is matched, then the corresponding student information such as name and batch is retrieved from the SD card and displayed on the LCD display.

Simultaneously, time stamp is fetched from the remote time clock (RTC) timer and displayed on the LCD along with the other information. Besides this, the corresponding guardian's number is fetched from the SD card and an automated message is sent on the guardian's phone using the GSM module. A notification is also generated and is issued to the Android mobile application of the user.

One of the issues that could have been a hinderance in the proper working mechanism of the main gate setup is the lack or disturbance in internet connectivity. Since all the data cannot be stored in the SD card for security reasons, it is necessary to forward the recorded data to the database for updating and data logging. In order to counter that issue, once the RFID key is detected and access is granted, the Arduino checks whether the Internet is established or not. In case the Internet is already established, the time stamp is sent to the database through the Wi-Fi module. However, if there is no Internet connectivity, the time stamp with the corresponding RFID key is saved in a separate table in the SD card. Once the Internet is restored, the data in this table is then sent to the database for updating the data logs.

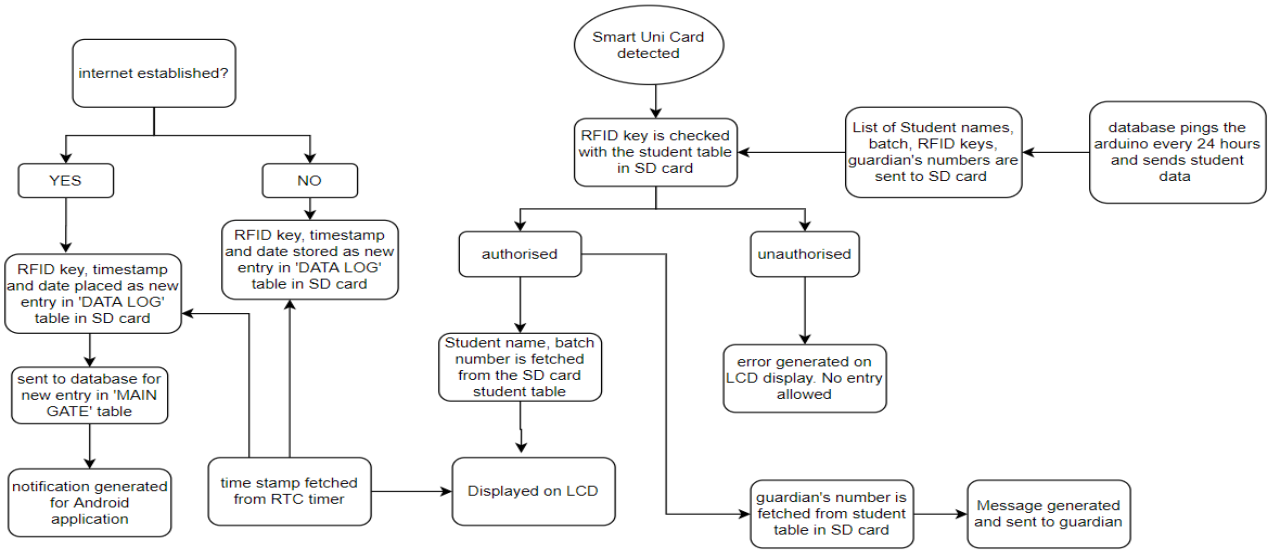


Figure 3.1: Functionality flow chart for the main gate entrance setup

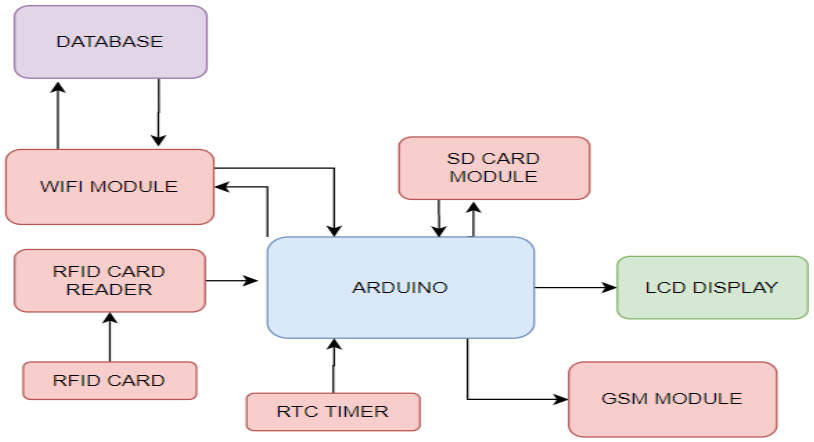


Figure 3.2 shows the block diagram of the main gate setup depicting the arrangements and connectivity of the components used.

Figure 3.2: Block diagram for the main gate entrance setup

3.1.2. Cafeteria setup

In the cafeteria setup, as shown in Figure 3.4, once the RFID tag is scanned, the key is tallied with the RFID key present in the "student table" present in the database. If the key is matched, an interface is opened from where the student can choose to add or subtract. The student can choose the "add" option if they wish to add credit to the Smart University Card. On the other hand, they can choose the "subtract" option if they wish to make a transaction and buy something from the

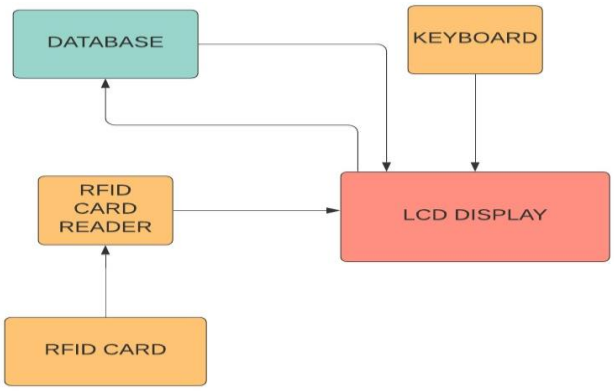


Figure 1.3: Block diagram for the cafeteria setup

cafeteria. After the amount is input into the system, the database is updated with the timestamp and transaction history and a notification is generated onto the Android application.

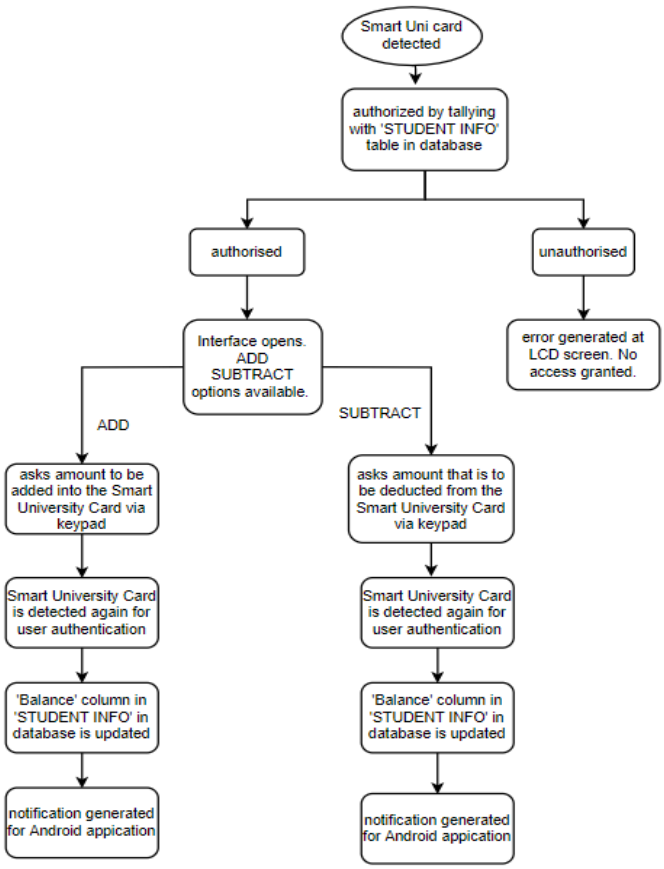


Figure 3.4 shows the flow diagram of the working of the cafeteria setup for a better understanding of the processes.

Figure 3.2: Functionality flow diagram for the cafeteria setup

3.1.3. Database

The working of the database is explained as follows:

- The student table in the database contains the student information structured as: RFID Key, name, batch, CMS ID, password, phone number, guardian number and balance.
- The table named main gate uses the foreign key named ‘RFID key’ and contains the date as well as time stamp of the entrance.

- The table named cafeteria uses the foreign key named ‘Registration Number’ and contains date, time stamp and transaction amount at the time of money transaction.
  If, for example, the RFID card is blocked and a new tag is issued, then only the 'RFID key’ field will be altered in the database manually. This prevents the amount already present in the account from being lost. Moreover, the previous RFID key will be over-written with the new issued RFID key in the database.

The block diagram for database entity relation as shown in Figure 3.5

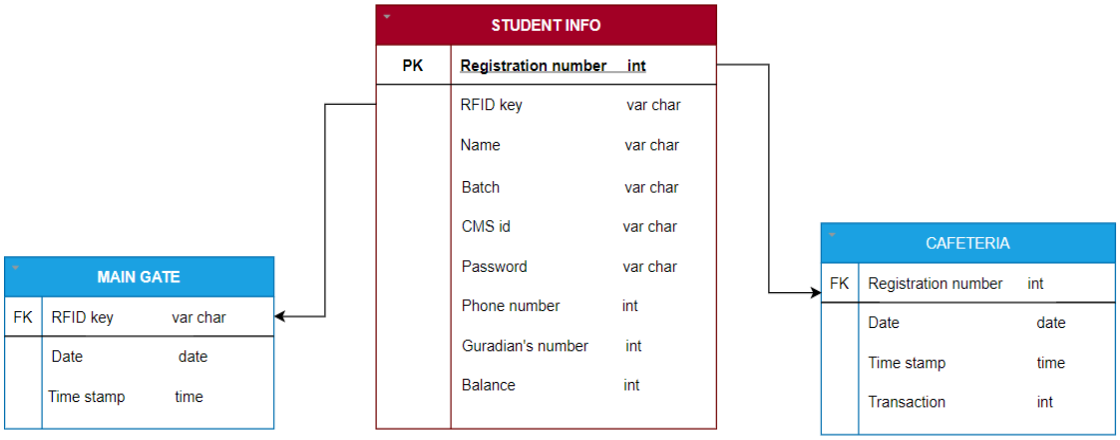


Figure 3.5: Entity relation of database

3.2. Hardware Specification

The following hardware has been used for the implementation of the design depicted in the previous figures (Figure 3.2 and Figure 3.3):

- RFID Readers and tags/cards
- ESP8266 NodeMCU
- LCD
- Arduino
- RTC Timer
- GSM Module
- SD Card

The description of each device is explained in the forthcoming sections.

3.2.1. RFID Readers and tags/cards

MFRC522 RFID Reader module communicates with the RFID tags by creating a 13.56MHz electromagnetic field. With a frequency range of 13.56 MHz, 2.5V-3.3V operating supply voltage, 13mA-26mA maximum and 10µA minimum operating current, and a reading range of 5 cm, the RFID readers can have a communication with any compatible microcontroller.

3.2.2. ESP8266 NodeMCU

The NodeMCU is a free development board for software as well as hardware and is built on System-on-a-Chip (SoC) commonly known as ESP8266, used specially for IOT applications. It is programed in low level machine language. Having 16 digital I/O pins (DIO), 4 MB flash memory, 64 KB SRAM, and 80 MHz clock speed, it can operate on 3.3 V voltage with an input voltage of 7-12V. It can be easily programmed with Arduino Integrated Development Environment (IDE), making it fit perfectly into Internet of Things (IoT) applications.

3.2.3. 16x4 LCD

16x4 LCD has 16 columns and 4 rows alphanumeric display based on the HD44780 display controller. Working on 5V with green backlight which can be switched on and off to adjust the brightness as required or desired. Moreover, it can be interfaced with a vast majority of microcontrollers.

3.2.4. Arduino

Arduino Uno, has a microcontroller with ceramic resonator operating at a frequency of 16 MHz, an In-Circuit Serial Programming header, reset button and 14 digital input/output pins, is based on the ATmega328P, 5V operating voltage, 7-20V input voltage, 32 KB (ATmega328P) flash memory, 2 KB (ATmega328P) SRAM, 1 KB (ATmega328P)

EEPROM, clock speed of 16 MHz, Arduino serves many purposes in many different fields such as robotics, motor control, Unmanned Aerial Vehicles (UAVs), sensor networks, e.t.c..

3.2.5. RTC Timer

RTC modules have batteries to keep them working in the absence of external power. RTC keeps and update track of current day, month, and year of date and seconds, minutes, and hours of the time with full accuracy. They have low power consumption, are portable and can operate on -45°C to +80°C.They are used in robotics, gaming, GPS, embedded systems, e.t.c..

3.2.6. GSM Module

A GSM modem/GSM module, usually part of an embedded system, uses Global System for Mobile Communications technology for the purpose of providing a data link to a remote network. They require a subscriber identification module (SIM) for identifying themselves to the network. The SIM900A is an easily available GSM/GPRS module that is used in many mobile phones for the purpose of developing Embedded system applications or IOT. It works on frequencies EGSM 900MHz and DCS 1800MHz [11].

A GSM module is technically a chip which is used in order to establish a communication link between a mobile device or a computer and a GSM/GPRS system and is normally used for automated Multimedia Messaging Service (MMS) and SMS message generation employing the 2G/ 3G cellular networks. The GSM modems require a registered SIM and an International Mobile Equipment Identity (IMEI) number in order to operate and generate messages. The GSM modem utilizes AT commands in order to carry out its functionalities. Using the ATtention (AT) commands, the user can write, send, read or delete the SMS messages. Along with this, they can also monitor the network's signal strength, and battery levels. Another function that can carried out is searching, reading and writing the phone book entries.

3.2.7. SD Card

SD card, a non-volatile and removable memory card used for inexpensive reading and writing large quantities of data (in gigabytes) at 12.5 MB/s in a wide variety of mobile electronics, video game consoles, cameras, smart devices, and IoT applications due to their small size, portability and cheap/affordable costs.

3.3. Software Specification

The following software has been used for the implementation of the design depicted in previous figures.

- Arduino IDE
- Flutter
- Android Studio
- Visual Studio Code
- Eclipse IDE

The description of the software is provided in the forthcoming sections.

3.3.1. Arduino Integrated Development Environment (IDE)

It is a simple and an open-source programming software used for writing and uploading the code to any Arduino board easily due to its community-driven system and simple interface. The code can be written in C and C++ languages using code structuring rules. It can be used for Windows, macOS, Linux.

3.3.2. Flutter

It is a platform, i.e., a User Interface (UI) kit used for Cross platform android & IoS application development from the same Codebase using the programming language Dart.

Flutter is Google's mobile UI tool for making traditional, amazing and wonderful mobile, web, and desktop applications from a single code. Flutter is a free and open source that works with existing

code. It is used by developers and organizations all around the world. The main purpose of using Flutter is creating an advanced Android and iOS application where payment notifications, transaction details, e.t.c., are displayed on the screen in the cafeteria.

3.3.3. Android Studio

Android Studio (Figure 3.6) offers a cohesive environment to create Android phone, tablet, and Android Auto apps. Structured code modules enable us to break down our project into functional units that we can test and customize independently. The official language of Android development is Java; large parts of Android are written in Java and its Application Programming Interfaces (APIs) are designed to be based on Java. The Flutter Android application can be used anywhere where Dart Programming is done. It also makes use of the Flutter Android application development tool.

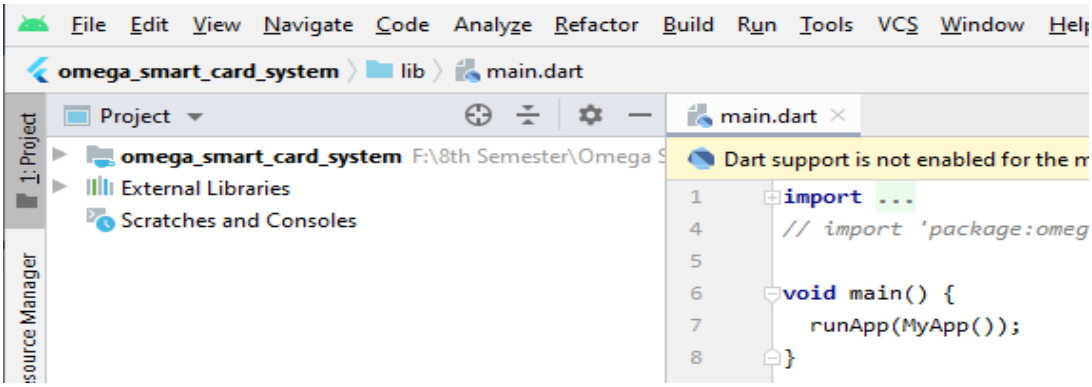


Figure 3.6: Android Studio interface

3.3.4. Visual Studio code

Visual Studio Code is a state-of-the-art code editor that supports development tasks such as debugging, task performance, and version control. It aims to provide the necessary tools that a developer needs in a fast-paced code-build-error cycle and leave complex workflows in embedded IDEs, such as Visual Studio IDE.

Moreover, Visual Studio takes less download data than Android Studio. We have largely selected this Visual Studio in our application development project.

3.3.5. Eclipse IDE

The Eclipse concept is best for our integrated Java Development (IDE) site. We can easily integrate multilingual support and other features in any of our default packages. The Eclipse market allows for customization and unlimited expansion. Our desktop application is built on this Eclipse IDE which will be running on the cafeteria setup, as shown in Figure 3.7.

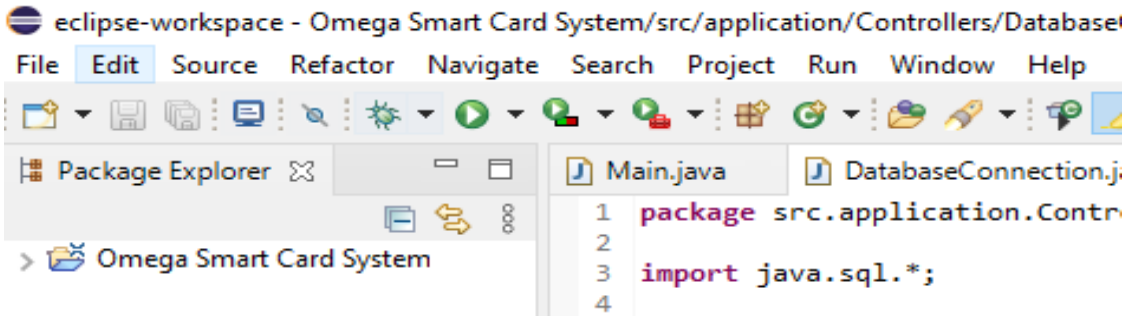


Figure3.7: Eclipse IDE

3.4. Programming Language

3.4.1. Main gate setup programming

The programming for the main gate is done in the efficient, powerful, effective and most widely used general-purpose language which has a quality to extend itself i.e., C language. C language is a structured programming language that utilizes a static type of system. It has been widely used in the coding for operating systems, application softwares and the like.

3.4.2. Cafeteria setup programming

In Cafeteria Desktop Application we used Java programming language, where JavaFX Platform is used, JavaFX is a Java library used to build Internet Applications. Apps written using this library can work seamlessly across multiple platforms. Apps developed using JavaFX can work on a variety of devices such as desktop computers, mobile phones, TVs, tablets, e.t.c..

3.4.3. Website

In database management we used the online hosting database, i.e., MySQL. MySQL is an open-source software which is written in C and C++. It works on the client-server model and is free of cost. It is a technical programming language that is used to create and modify relational databases which can be linked to one another. It is also used to give access rights and/or limit them such that everyone does not have access to them. MySQL has the capabilities to integrate and work along with other softwares and applications which require relational databases. Different statements can be utilized in order to perform different operations such as:

- Data query: for sorting and retrieving specific information from the database.
- Data identity: for changing the data types of the present data and is also used to modify the relations of the tables.
- Data manipulation: can be used to add, change, sort, delete and perform other manipulative actions.
- Data access control is practiced to give access rights and/ or limit the rights in order to protect the data present in the database.

First, we integrated it locally on localhost and kept our PC as a Server. The web hosting was then done to get its live access.

3.4.4. Android Application

In the Android application, we used Dart System Language. Dart is an object-oriented, classroom-based language, which collects garbage with C-style syntax made by Google and can be used to build server and desktop applications. It is designed for the building of desktop applications and servers. Dart is a sound type system which means that it checks for data type validation at run time which helps in identifying bugs at the compilation stage.

CHAPTER 4: PROJECT ANALYSIS AND EVALUATION

In this chapter, we will be discussing how the project was evaluated and analyzed. Also, the key components used and the various programs which were utilized will be explored. This section will be dealing with the performance and objectives of the project, and the objectives that were met will be further explained. Also, the forthcoming chapter will discuss the already existing similar projects (if any) and state how the Smart University Card is different and novel in its being.

4.1. Database

This section discusses the databases which were created in order to cater to the project.

The main gate has the firebase database which contains the student information such as:

- RFID Key
- Name
- Batch
- CMS ID
- phone no.
- guardian’s no

Figure 4.1 displays the database structure shows the above-mentioned fields.

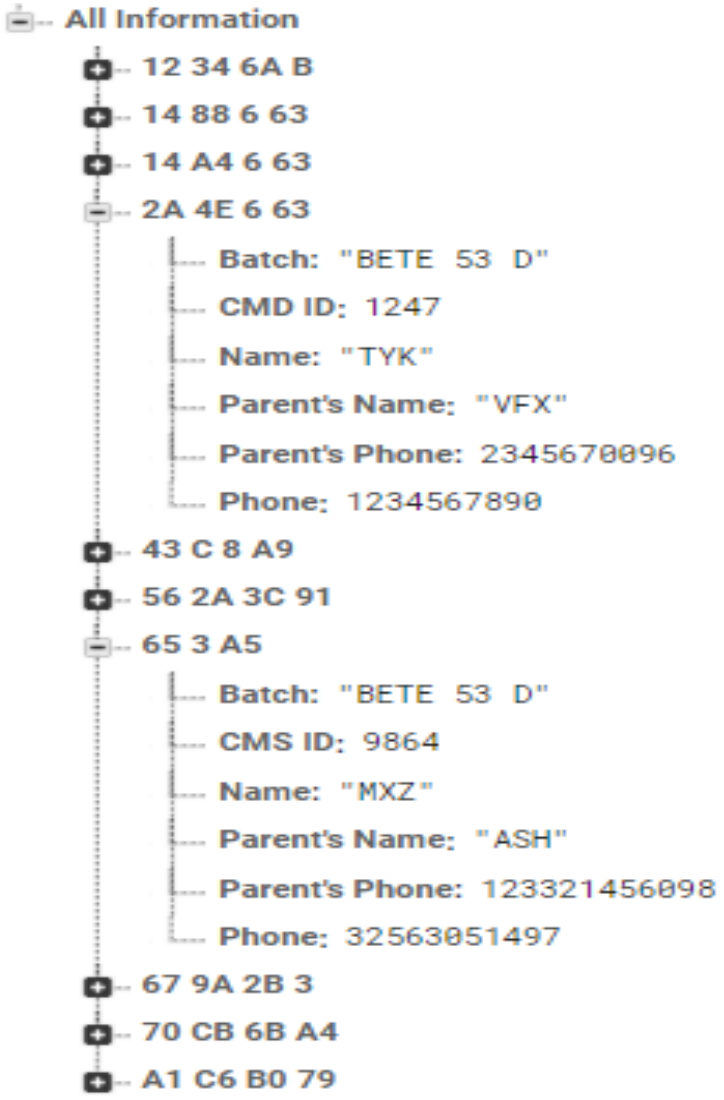


Figure 4.1: Firebase database showing student's information

Figure 4.2 shown below displays the date as well as time stamp of the entrance when the card is detected and access is allowed.

Figure 4.2: Date and timestamp displayed after access allowed

The cafeteria has the MySQL database which contains student information and stores the date, time stamp and transaction amount at the time of money transaction. Figure 4.3 shows the cafeteria database.

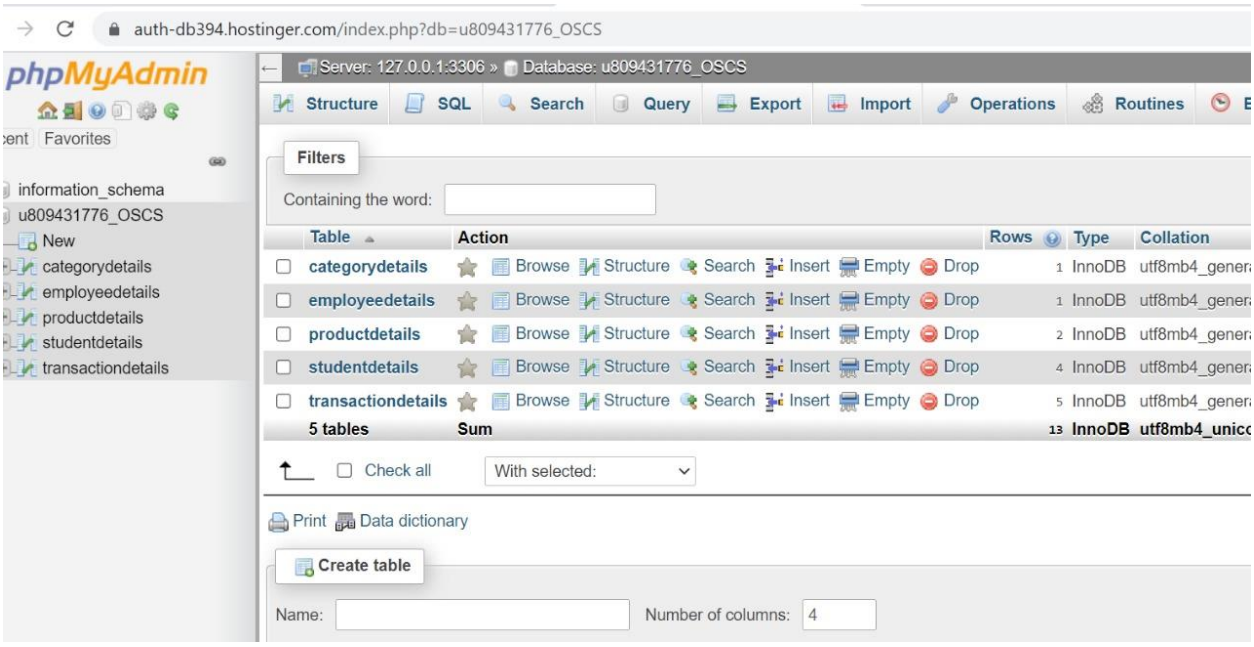


Figure 4.3: Cafeteria Database

4.2. Testing the main gate setup

The RFID tags that were already registered with the database were given immediate access and the tags which had no registration were denied access. The rejected RFID tags were later registered with the database to check the addition of a new entry into the system and that worked seamlessly as well giving access when the tags were detected. Figures 4.4 and 4.5 show the two scenarios when the RFID tags were accepted and rejected by the system, respectively.

Figure 4.4: Display when access is allowed

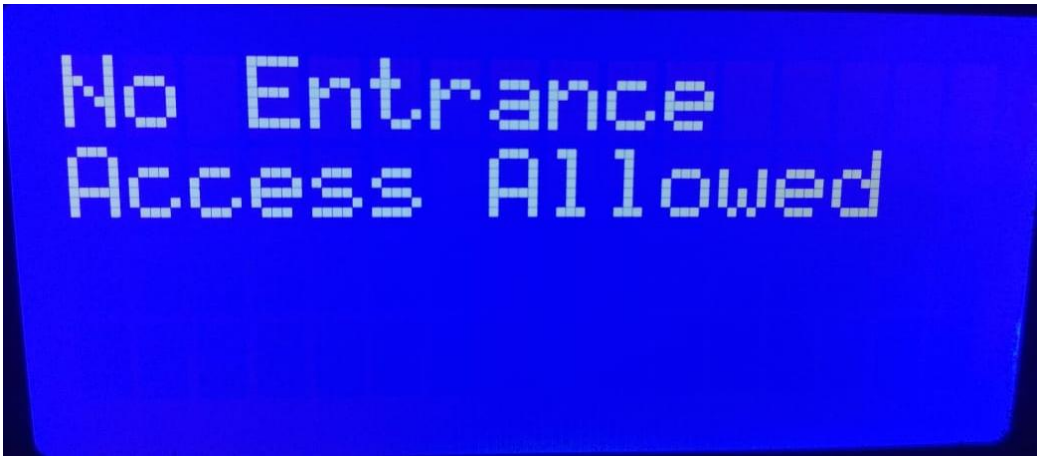


Figure 4.5: LCD display when access is denied

The GSM module was also tested to see if the message was sent to the correct number stored in the database after scanning. It was found that the message was successfully sent to the related SIM numbers whenever the card was scanned. Card time stamp is successfully restored to the site where access is granted and from when the application can display that time stamp notification. Figure 4.6 shows the auto generated phone message that was received after access was granted.

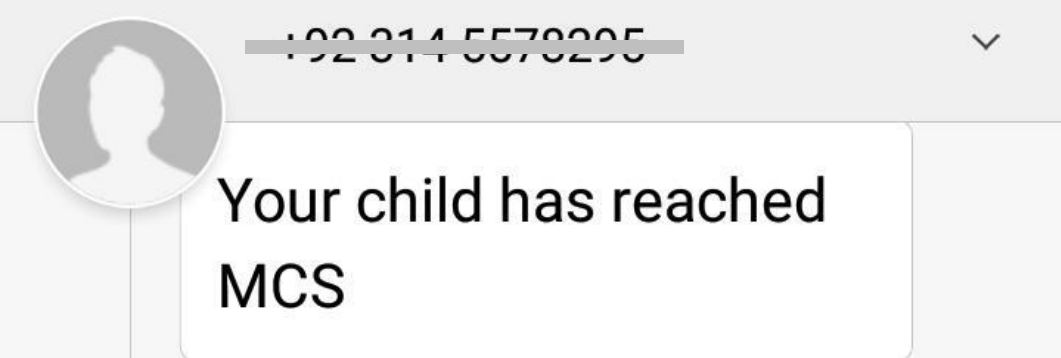


Figure 4.6: Auto generated message upon entry grant

4.3. Testing the cafeteria setup

The cafeteria desktop application is made on Eclipse using JavaFX. Eclipse IDE is used mainly for developing applications in Java, but applications can also be written in other programming languages such as C, C++, JavaScript, etc. via plug-ins.

After the dataset was complete, the cafeteria setup was tested by adding a new student record, deleting some old records, adding some money, making some transactions, issuing a new card, another old card blocked, e.t.c.. All changes were successful in all programs and everything performance was working well.

4.3.1. Authentication Screen

The screen below is attached to the Cashier System Login Panel. By installing cashier login credentials, the cashier can log into the software after his entered data is matched with the data from the database. Figure 4.7 depicts the software interface of the login screen.

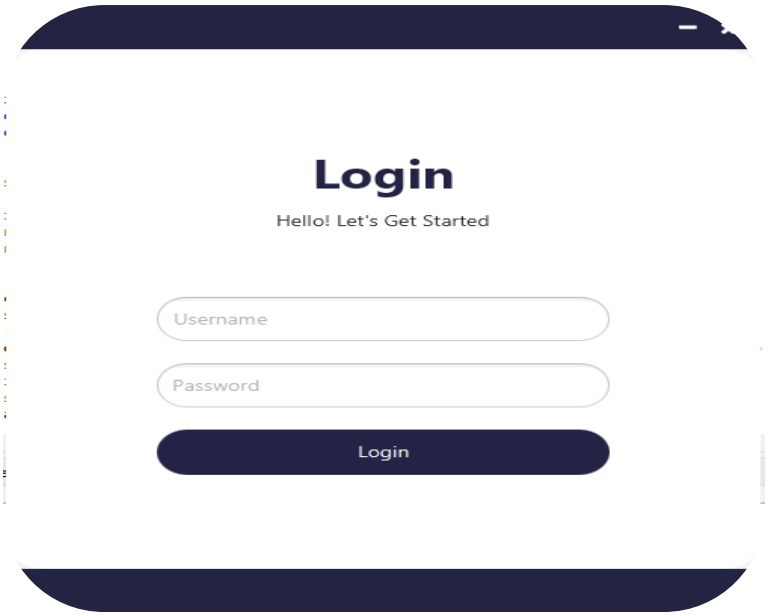


Figure 4.7: Login interface for cafeteria setup

4.3.2. Dashboard Panel

On the dashboard page where the RFID card is scanned, the data will be downloaded from the card issuer details and displayed on the dashboard page, i.e., registration number, name, department, phone number and balance on the card. All details will be downloaded from the connected website. We can say that the portal of student will be unlocked after access is granted to the student.

After selecting the product category and filling in the remaining fields at the top of the dashboard panel, an order can be placed, and the purchased items can be seen in the purchased items list. Total amount of the purchases, remaining credit along with other information can be seen on the right of the page. Figure 4.8 shows a display of the dashboard panel.

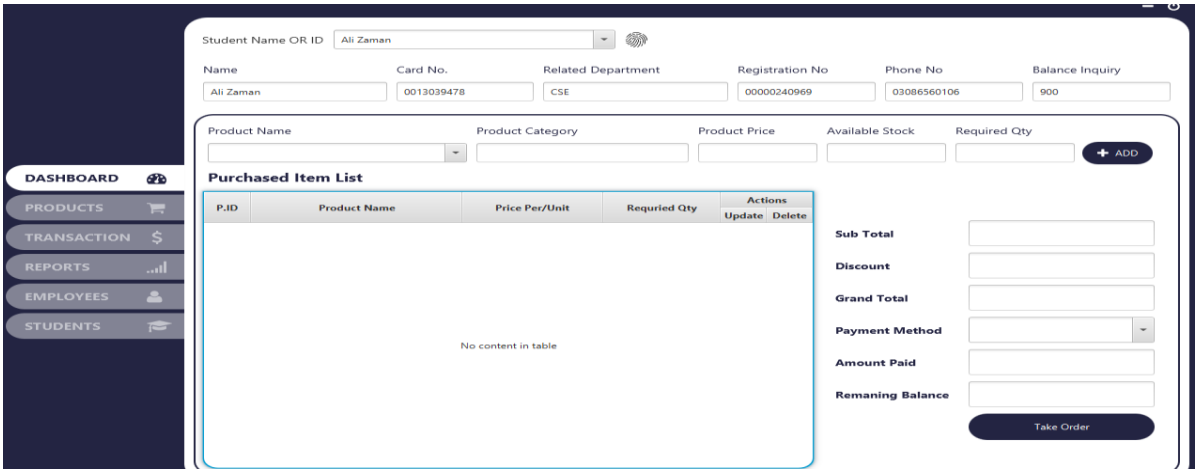


Figure 4.8: Dashboard Panel

4.3.3. Product Panel

A list of all stock and details for each item can be viewed in the products panel. Here we can add other products to the list as well. We only need to fill in the required fields namely:

- Product name
- Bar code number (if applicable)
- Product category
- Purchase price
- Set sale price
- Quantity

Figure 4.9 shows the product panel interface.

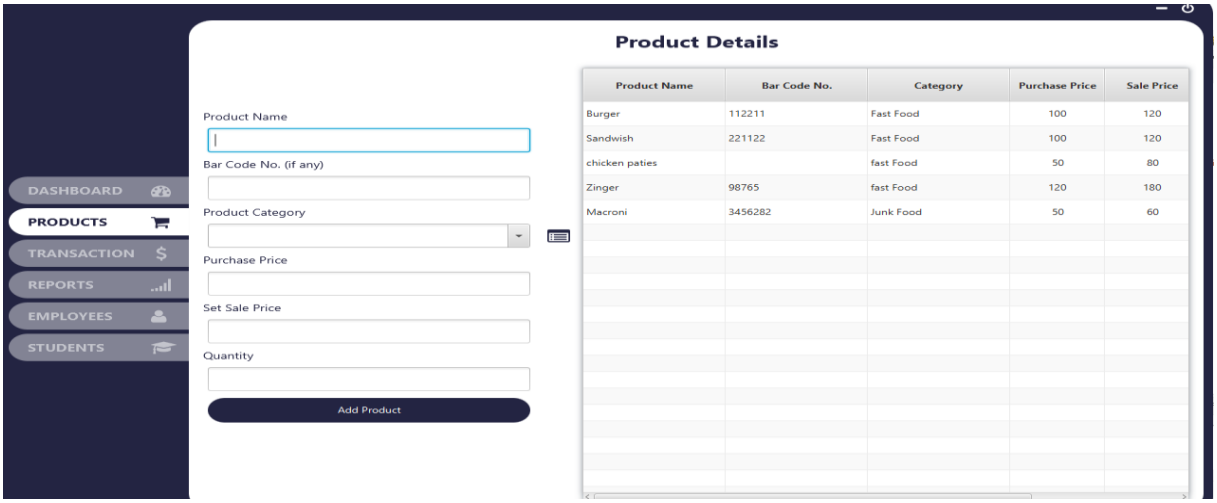


Figure 4.9: Product details panel

4.3.4. Transactions panel

The record of all transactions made by the students can be viewed in the transaction details panel. Each record of the transaction contains the following fields:

- Student's name
- Card number
- Registration number
- Purchased item details
- Product cost

Figure 4.10 depicts the transaction details panel as displayed in figure 17.

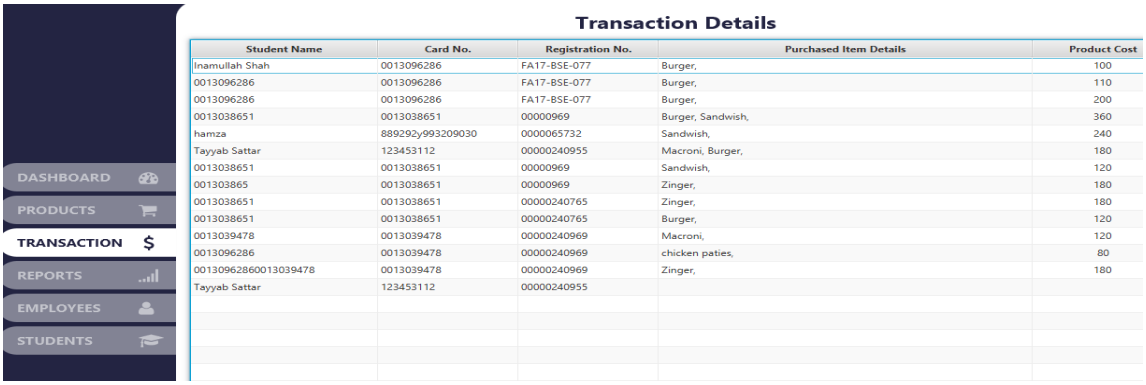


Figure 4.10: Transaction details panel

4.3.5. Reports

Each line chart has data-linked points to indicate the trend (continuous change) between the purchases (sales) and date (time). The X-axis represents dates of the month (time), and the Y-axis represents the total amount of sales. These line graphs can be utilized for the analysis of sales and producing a sales report. An exemplary sales report is shown in Figure 4.11.

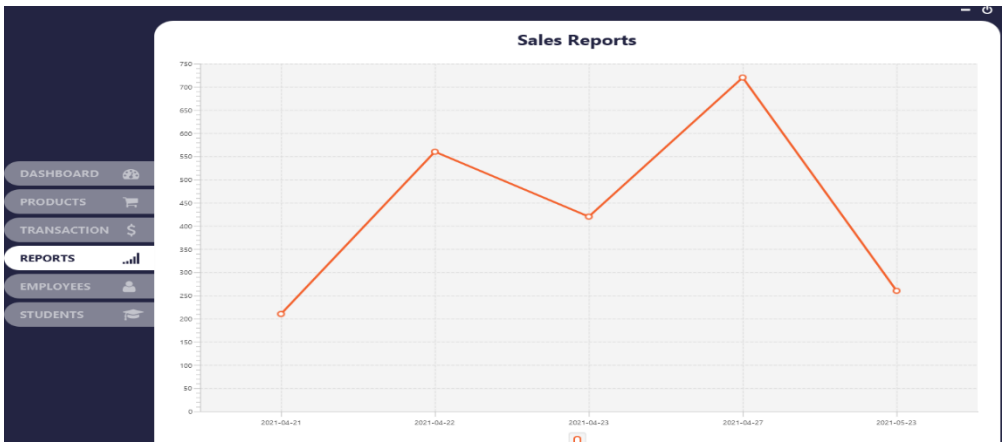


Figure 4.11: Sales report

4.3.6. Staff panel

The corresponding data recorded of each employee is shown in Figure 4.12. Record of staff can also be deleted in case they are terminated or quit the job using the delete button. Moreover, the record can be updated using the update button. Each record consist of information about the employees and the following fields can be seen:

- Employee name
- phone number
- CNIC number
- Description
- Address

Employee Name	Phone No.	CNIC No.	Designation	Postal Address	Action	
					Update	Delete
Inayat Hussain Shah	0305-5053171	37406-1621843-9	Manager	HIT Taxila		
nasir	03107219536	7271166272	Waiter	Mcs Rawalpindi		
tayyab	0903203123	544000329912122	Manager	Sialkot		

Figure 4.12: Employees information in staff panel

Job details can be updated at any time. Also, newly employed staff's information can also be recorded by filling in the fields on the left-hand side of the employees panel. Figure 4.13 shows the fields on the employees panel which are required to be filled to add a new cafeteria staff member.

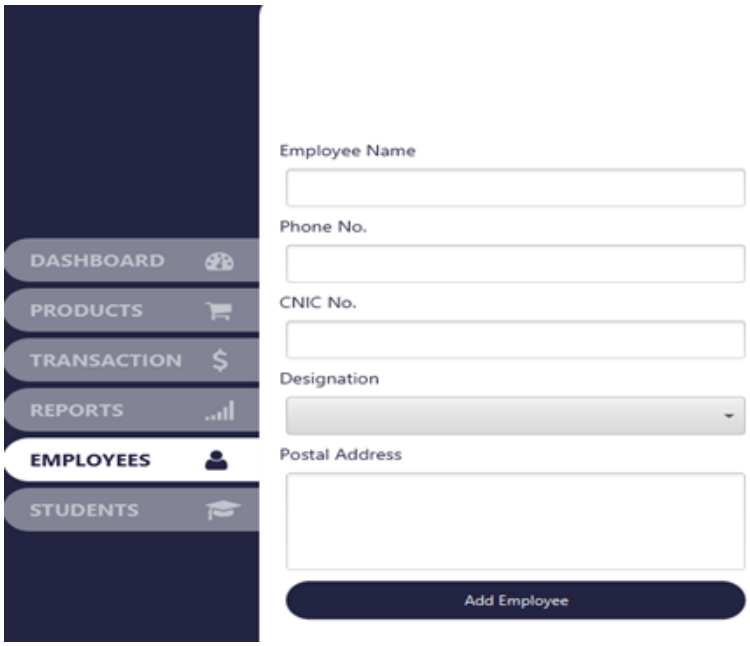


Figure 4.13: Addition of a new employee

4.3.7. Student Details Panel

The student panel show, detail of students that are registered with the system. Each record contains information about the student such as their name, registration number, phone number, email address, CNIC number, etc. Also, a new record can be made for a new student who needs to register with the database to use their card in the cafeteria. It can be done by filling the fields on the left-hand side of the students panel. The Figure 4.14 below displays the student panel.

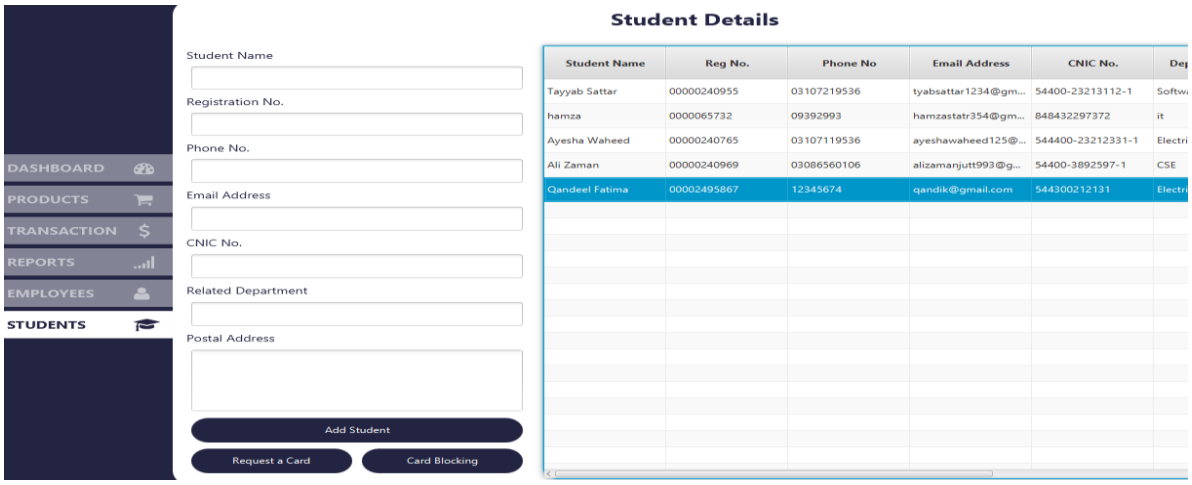


Figure 4.14: Student panel display

4.3.8. Request a Card

Figure 4.15 displays the “request a card display”. Students can add credit to their Smart University Cards with the help of “request a card” panel. Information about the student is filled in the following fields and credit is added into their corresponding account:

- Students name
- Registration number
- Phone number
- Card number
- Current balance
- New amount

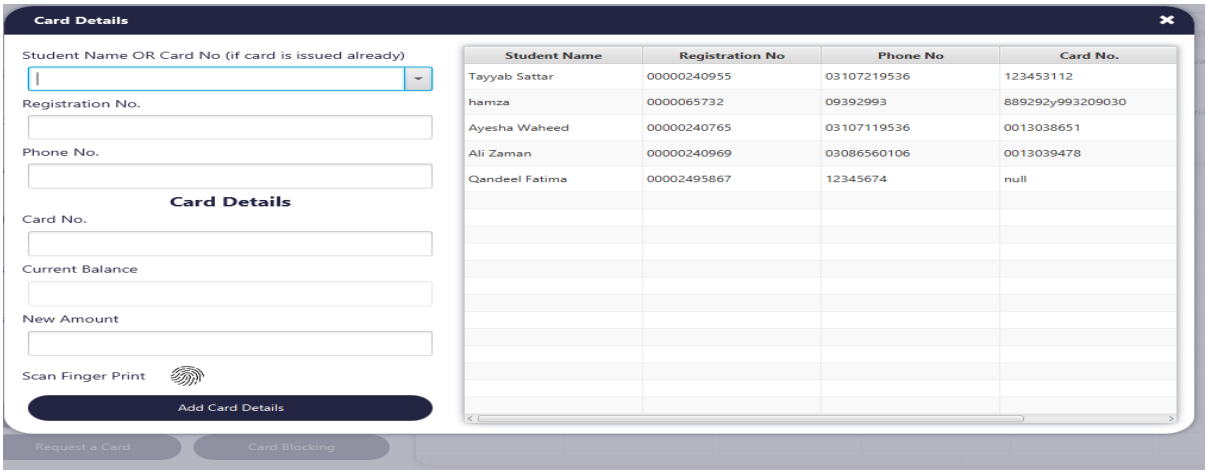


Figure 4.15: Addition of credit through request a card option

4.3.9. Card Blocking

In the event of a lost or stolen card, the Smart University Card may be blocked in order to avoid transactions. The card may be blocked temporarily and permanently. In case of temporary blocking, the student's account is suspended and therefore, they are unable to carry out any transaction at the cafeteria, however, their information is still present in the database. While in case of permanent blocking, the student's data will be permanently deleted from the dashboard. After permanently blocking the card, the student will need to re-register for the program. An exemplary card blocking panel is shown in Figure 4.16.

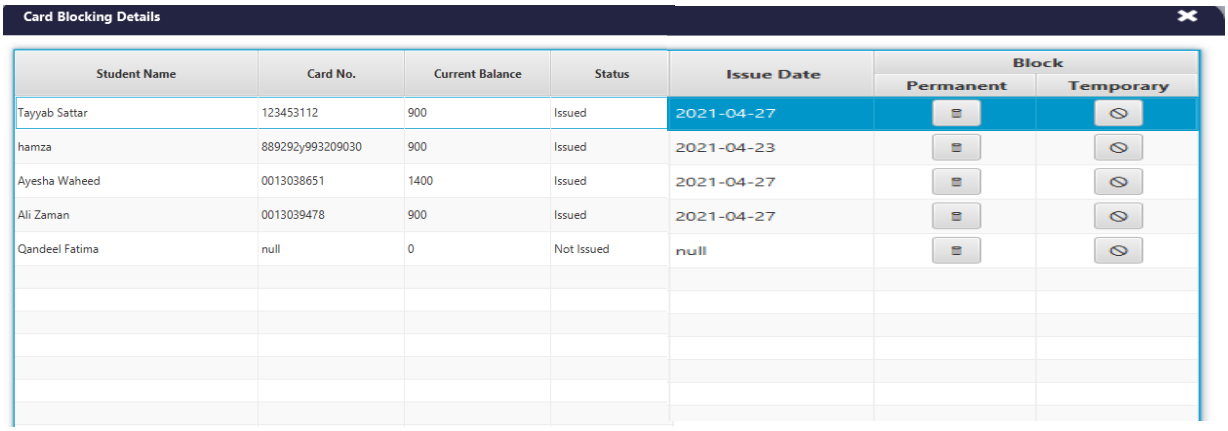


Figure 4.16: Card Blocking Panel

4.4. Android Application Development

We built the Android system with a Flutter frame in the Visual Studio code. Like setting up a restaurant, the Android application code was imported into all the applications and was applied to the Visual Studio codes. The resultant Android application worked well on both applications.

The Android APK is installed on our Android devices and whenever the RFID card is used at the main gate or cafeteria, a notification is successfully executed on the Android application. In addition, to test the generation of electronic receipts in the Android application, we made a transaction at the cafeteria, and it resulted in the successful display of the receipt in the application.

C-panel hosting was purchased to test the application's performance and information on Smart University Card usage and transaction details are fully available in the application. Currently, the application is hosted on it.

4.4.1. Home Screen

Figure 4.17 show the display of the home screen containing the MCS logo. This screen first appears when the application is run. As we are looking forward to hopefully be given a chance to implement this project in the campus, hence the MCS logo is used for this project.

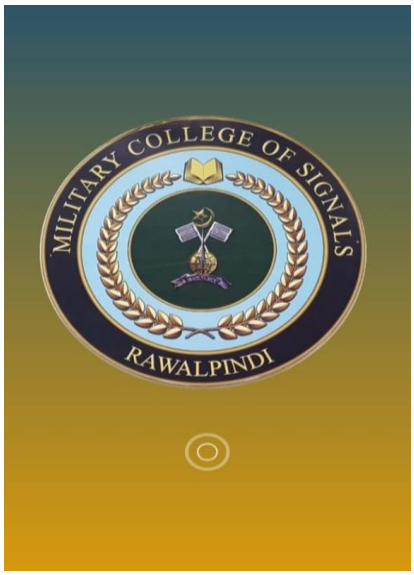


Figure 4.17: Application start up display

4.4.2. Login Screen

The login page that appears after the home screen is shown in Figure 4.18. The log in credentials need to be filled in by the student in order to log in to the Android application. If the user submits the appropriate credentials access is granted, otherwise an error is displayed. In case the student forgets his password, an option of “forgot password” is available where the student can retrieve his password or create a new.

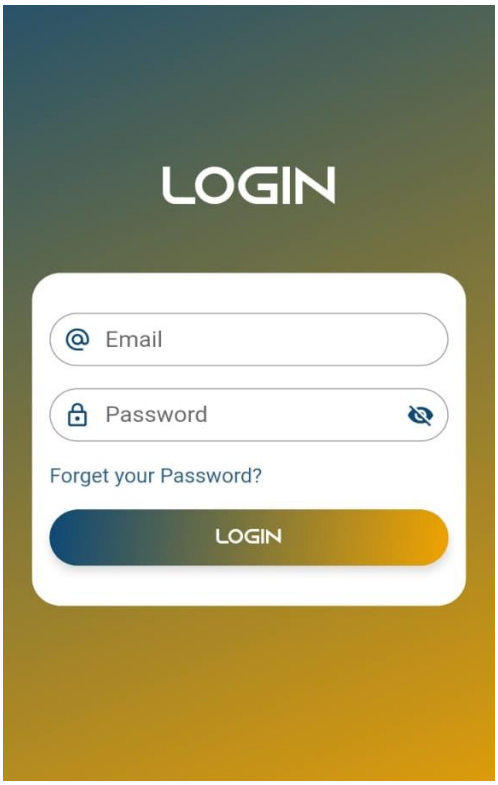


Figure 4.18: Android application log in page

4.4.3. Dashboard

Figure 4.19 shows the dashboard after the log in is successful and it shows two options on the dashboard i.e., account and block. The account option displays the user's key details whereas card blocking option gives user the opportunity to block the card. Also, a log-out option is available at the bottom where the user can sign out of the Android application. At the top of the dashboard, user number and email address with a profile picture are displayed.

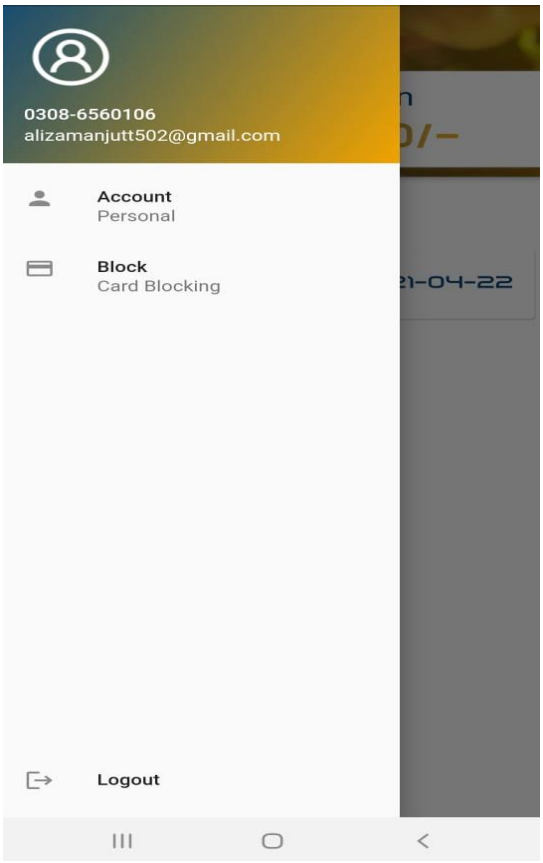


Figure 4.19: Android application dashboard

4.4.4. User Profile Screen

When the account option is selected from the dashboard, user profile with more information appears on the screen. This screen contains information that is visible only to the user, as shown in Figure 4.20.

At the top is the user's profile picture, below follows the student's name in capital letters, followed by CNIC number, card number, email ID, phone number, department and registration number.

Finally, there is a button that says the change password. The user can click it and they will be taken to another interface where they will be able to change or update their password.

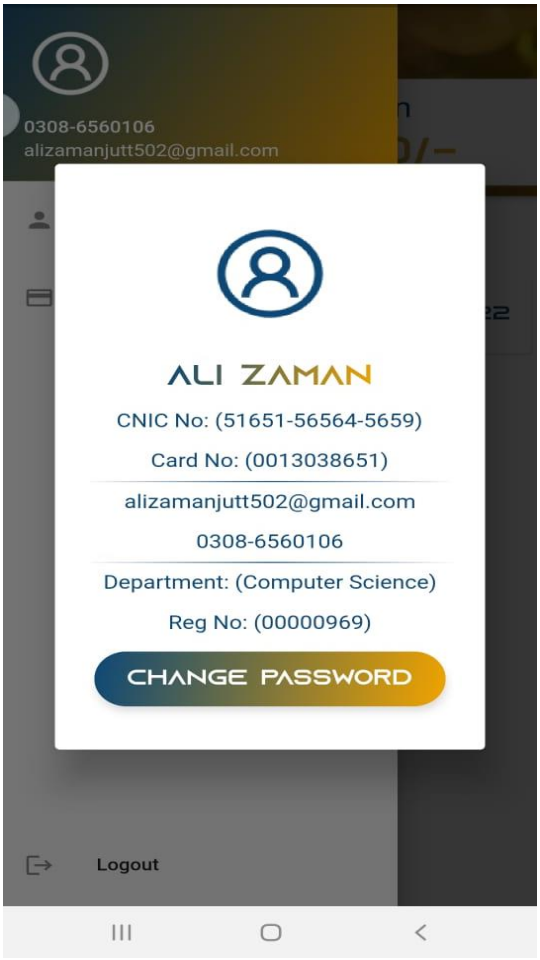


Figure 4.20: User profile screen

4.4.5. Card Blocking Screen

From the dashboard, when the Block option is utilized, a screen appears asking the user to confirm whether they want to block their card or not. If they want to block the card in case of theft, the user confirms it by clicking “Yes” and the card will be blocked immediately. Therefore, if the card is stolen or lost, no one will be able to use it. Figure 4.21 displays the card blocking screen.

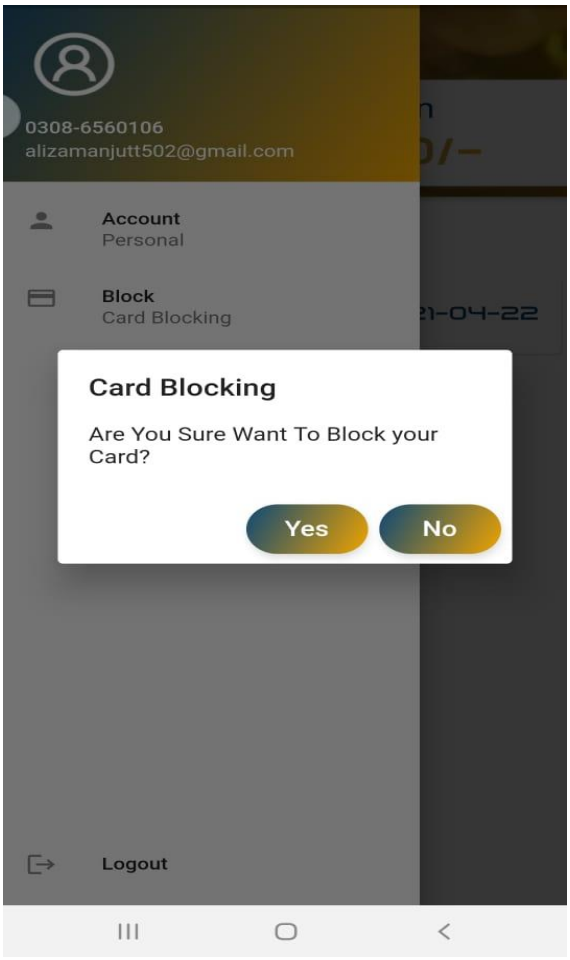


Figure 4.21: Card blocking interface

4.4.6. Update password Screen

On the profile screen, there is an option to update password, as shown in Figure 4.13. When the option is clicked, a screen appears where the user can update their password. The user can change or update their Android application password using this screen.

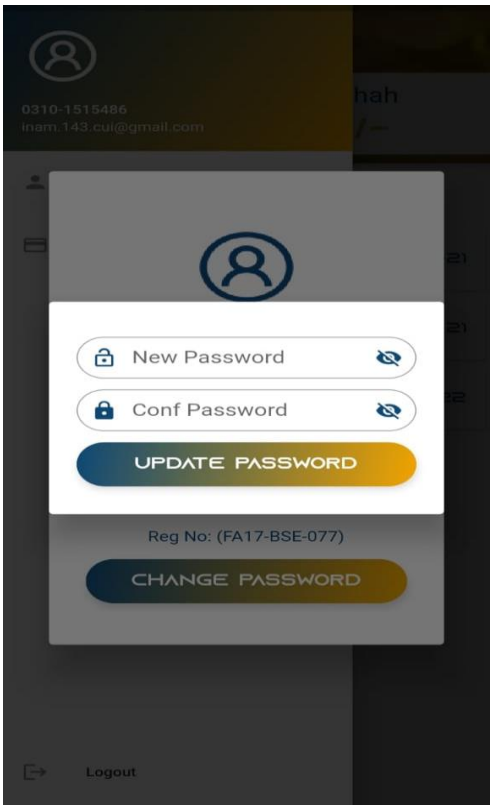


Figure 4.22: Update password interface

4.4.7. Transaction Details

On the main screen when the user logs in, they can see the details of the student's transactions at the cafeteria. The receipts are received and displayed on the Android application. Every time the student makes a transaction at the cafeteria, the receipt is generated and returned to the database from where the Android application returns the receipt and shows it on the transaction screen. Therefore, the student can view the transaction details from the Android application. Figure 4.23 displays an exemplary electronic receipt.

Figure 4.23: Receipt generated by the Android application

4.5. Comparison with existing systems (if any):

Nowadays smart cards are issued by the bank to its customers which have a microprocessor chip integrated into them. These kinds of cards are called smart cards because they are not ordinary cards, rather they contain a large amount of confidential information and data associated with a particular user: the cardholder.

These cards have a microprocessor memory attached to store information about its users. The users, with the use of technology, can perform online financial transactions such as cash purchases, payments such as electronic bills, and transferring funds to a second party.

However, these kinds of smart cards are only used in supermarkets and shops, especially in Pakistan. If we talk about the use of smart cards in companies, schools, colleges or universities, where many activities can be combined into one card such as entrance, restaurant billing, implementation in library, and other remarkable operations, e.t.c., such systems are scarce to find. We call it Smart University Card because we can add all the detailed access to one card and apply it everywhere. We currently only include university entrance data logs and cafeteria billing; but many other features can be added in the future as it is a flexible embedded system.

At the moment, the students of MCS possess a simple student identity card which is displayed at the entrance gate. It cannot be used for any other purposes as it is not a smart card. But with the Smart University Card, it can be used for many purposes including entrance at the gate and cafeteria billing.

CHAPTER 5: CONCLUSION AND FUTURE WORK

5.1. Future Work

RFID technology is becoming more and more accessible and widespread with each passing day. Its use is not only restricted to using it for educational purposes, but it has proved to be an amazing tool that can be used successfully in tourism, hospitals, healthcare, libraries, museums, waste management, marketing, recruitment and training, sports, etc. The scope of the proposed project was limited to the educational institutions. However, by venturing deeper into the project and exploring the depth of the process we can achieve some additional objectives which are discussed below.

5.2. Teaching Objectives

The smart University Card has many uses for educational purposes. It aids in keeping the parents and guardians informed with a notification on their phones that is generated as soon as the student enters the premises.

It is not uncommon for students to forget to bring their money along with them to buy food from the cafeteria. The Smart University Card eliminates this mishap as the smart card holds the credit for cafeteria transactions making it easier to make payments. Along with this, the cafeteria staff may also misplace the written loans taken by students. This may seem like a little amount lost, by when accumulated, it can add up to a large sum of money. The University Smart Card not only eliminates the usage of paper bills making it an environmentally friendly project, but it also eliminates the losses that the cafeteria may face as it excludes any kind of loans.

5.3. Transportation

University Smart Card can extend its usage worldwide for travel plans as well. There are millions of smart cards used to pay for each travel and parking fee etc. It can be extended for fast ticket systems, wash services, etc. This RFID Smart Card Technology will narrow down the line system while collecting tickets. We can say that it works as an electronic wallet that can be used for small purchases.

5.4. Health care

RFID Smart cards in the healthcare sector can allow hospitals to securely store patient medical records securely and reliably.

It helps the authorities to access data faster. It may make refunds and insurance process faster and more transparent. One of the benefits of this is often the interaction of government officials with physical donations.

5.5. Libraries

Use of RFID smart card reduces the time required to perform extracurricular activities. This technology helps librarians save valuable time spent scanning barcodes while viewing and evaluating borrowed items. For users, RFID technology speeds up borrowing and payment processes. Customer can properly view records of ordered books in the Android application with their relevant policies etc. It can be utilized as an asset management system.

5.6. Conclusion

In conclusion, the performance of Smart University Card has been evaluated and tested. The objectives of the project were successfully fulfilled.

RFID continues to demonstrate that this concept can significantly improve productivity and efficiency, especially in educational institutions, supply chains, asset tracking, and access control systems as all described above briefly. RFID provides important information and assists our organizations and customers all the way though. Every kind of business requires the collection of data in some or the other form. The funds that are utilized and the transactions that are made are also kept record of. In such systems, projects like Smart University Card hold a great amount of potential to satisfy the needs of the said customers.

APPENDICES

APPENDIX A: Code for Transaction details for Android application

```
import 'dart:convert';
List<TransactionDetails> transactionDetailsFromJson(String str) =>
    List<TransactionDetails>.from(
        json.decode(str).map((x) => TransactionDetails.fromJson(x)));
String transactionDetailsToJson(List<TransactionDetails> data) =>
    json.encode(List<dynamic>.from(data.map((x) => x.toJson())));

class TransactionDetails {
  TransactionDetails({
    this.id,
    this.studentName,
    this.cardNo,
    this.registrationNo,
    this.productsPurchased,
    this.totalCost,
    this.balanceRemains,
    this.transactionDate,
  });

  String id;
  String studentName;
  String cardNo;
  String registrationNo;
  String productsPurchased;
  String totalCost;
  String balanceRemains;
  String transactionDate;
```

```
 factory TransactionDetails.fromJson(Map<String, dynamic> json) =>
      TransactionDetails(
        id: json["ID"],
        studentName: json["StudentName"],
        cardNo: json["CardNo"],
        registrationNo: json["RegistrationNo"],
        productsPurchased: json["ProductsPurchased"],
        totalCost: json["TotalCost"],
        balanceRemains: json["BalanceRemains"],
        transactionDate: json["TransactionDate"],
      );
```

APENDIX B: Code for Log in & its Authentication

```
  void studentLogin() async {
    setState(() {
      _processing = true;
    });
    var data = {"email": email.text, "password": password.text};
    var response = await http.post(
        Uri.parse(
            'http://www.anasweb.net/Omega Smart Card System/Login.php'),
        body: data);
    final record = jsonDecode(response.body);
    if (jsonDecode(response.body) == "Invalid Account Details") {
      setState(() {
        _processing = false;
      });
      Fluttertoast.showToast(
          msg: "Invalid Account Details",
          toastLength: Toast.LENGTH_SHORT,
```

```
        gravity: ToastGravity.BOTTOM,
        timeInSecForIosWeb: 1,
        backgroundColor: Color.fromRGBO(13, 72, 119, 1),
        textColor: Colors.white,
        fontSize: 16.0);
    } else {
     if (jsonDecode(response.body) == "false") {
      setState(() {
       _processing = false;
      });
      Fluttertoast.showToast(
          msg: "Invalid Password",
          toastLength: Toast.LENGTH_SHORT,
          gravity: ToastGravity.BOTTOM,
          timeInSecForIosWeb: 1,
          backgroundColor: Color.fromRGBO(13, 72, 119, 1),
          textColor: Colors.white,
          fontSize: 16.0);
     } else {
      await FlutterSession().set("token", email.text);
      // print(record['StudentName']);
      Fluttertoast.showToast(
          msg: "Welcome",
          toastLength: Toast.LENGTH_SHORT,
          gravity: ToastGravity.BOTTOM,
          timeInSecForIosWeb: 1,
          backgroundColor: Color.fromRGBO(13, 72, 119, 1),
          textColor: Colors.white,
          fontSize: 16.0);
      Navigator.pop(context);
      Navigator.of(context).push(
```

```
        MaterialPageRoute(
          builder: (context) => Dashboard(
            studentName: record['StudentName'],
            phoneNo: record['PhoneNo'],
            registrationNo: record['RegistrationNo'],
            cardNo: record['CardNo'],
            emailAddress: record['EmailAddress'],
            currentBalance: record['CurrentBalance'],
            departmentalInformation: record['DepartmentalInformation'],
            cnicNo: record['CNICNo'],
          ),
        ),
      );
      setState(() {
        _processing = false;
      });
    }
    setState(() {
      _processing = false;
    });
  }
 }
}
```

APPENDIX C: Code for Dashboard Page

```
class _DashboardState extends State<Dashboard> {
  bool _passwordVisible = false;
  bool _processing = false;
  TextEditingController newPassword, confrimPassword;
  @override
  void initState() {
    _processing = false;
    newPassword = new TextEditingController();
    confrimPassword = new TextEditingController();
    super.initState();
  }

  @override
  Widget build(BuildContext context) {
    return Scaffold(
      drawer: Drawer(
        child: Container(
          child: Column(
            children: [
              UserAccountsDrawerHeader(
                decoration: BoxDecoration(
                  gradient: LinearGradient(
                    begin: Alignment.topLeft,
                    end: Alignment.bottomRight,
                    colors: [
                      Color.fromRGBO(13, 72, 119, 1),
                      Color.fromRGBO(241, 164, 0, 1)
                    ],
                  ),
```

```
),
accountName: Text(widget.phoneNo),
accountEmail: FutureBuilder(
   future: FlutterSession().get('token'),
   builder: (context, snapshot) {
     return Text(
       snapshot.hasData ? snapshot.data : "Loading...",
     );
   }),
```

APPENDIX D: Code for splash screen

```
import 'dart:async';
import 'package:flutter/material.dart';
import 'package:flutter_session/flutter_session.dart';
import 'package:flutter_spinkit/flutter_spinkit.dart';
import 'package:omega_smart_card_system/dashboard.dart';
import 'login.dart';
class SplashScreen extends StatefulWidget {
  @override
  _SplashScreenState createState() => _SplashScreenState();
}
class _SplashScreenState extends State<SplashScreen> {
  @override
  void initState() {
    WidgetsFlutterBinding.ensureInitialized();
    dynamic token = FlutterSession().get('token');
    super.initState();
    Timer(
      Duration(seconds: 3),
      () => Navigator.of(context).pushReplacement(
        MaterialPageRoute(
          builder: (BuildContext context) =>
              token == null ? Dashboard() : Login(),
        ),
      ),
    );
  }

  @override
  Widget build(BuildContext context) {
```

```
  return Scaffold(
    body: Container(
      decoration: BoxDecoration(
        gradient: LinearGradient(
          begin: Alignment.topCenter,
          end: Alignment.bottomCenter,
          colors: [
            Color.fromRGBO(13, 72, 119, 1),
            Color.fromRGBO(241, 164, 0, 1)
          ],
        ),
      ),
      child: Column(
        mainAxisAlignment: MainAxisAlignment.center,
        crossAxisAlignment: CrossAxisAlignment.center,
        children: [
          Padding(
            padding: const EdgeInsets.all(25.0),
            child: Center(
              child: Image.asset('images/MCS.png'),
            ),
          ),
          SpinKitRipple(
            color: Colors.white,
            size: 75.0,
          ),
        ],
      ),
    ),
  );
}
```

APPENDIX E: Cafeteria Desktop Application Coding Files

```
package src.application;
import javafx.application.Application;
public class Main extends Application {
        private double xoffset= 0;
        private double yoffset= 0;
        @Override
        public void start(Stage primaryStage) {
        try {
         primaryStage.initstyle(StageStyle.TRANSPARENT);
         BorderPane root=(BorderPane)FXMLLoader.Load(getClass().getResource("FrontEnd");
         Scene scene= new Scene(root,500,550);
         scene.getstylesheets().add(getClass().getResource("application.css".).toExternal
         primaryStage.setScene(scene);
         primaryStage.show();
         primaryStage.centreOnScreen();
         primaryStage.setTitle("Omega Smart Card System");
         scene.setFill(Color.TRANSPARENT);
         root.setOnMousePressed(new EventHandler<MouseEvent>(){
         @Override
         Public void handle(MouseEvent event){
                xoffset= event.getScene();
                yoffset= event.getScene();
```

BIBLIOGRAPHY

[1] Landt, J. (2005). The history of RFID. *IEEE potentials*, *24*(4), 8-11.

[2] Singh, G., and Sharma, M. (2015). Barcode technology and its application in libraries and Information centers. *International Journal of Next Generation Library and Technologies*, *1*(1), 1-8.

[3] Hyster, A. (2012). RFID VS Barcodes: Advantages and disadvantages comparison. *Retrieved May*, *11*, 2012.

[4] Campbell, A. (2011). QR Codes, Barcodes and RFID: What's the Difference. *Small Business Trends*.

[5] Sivakami, N. (2018). Comparative Study of Barcode, Qr-Code and RFID System in Library Environment. *International Journal of Academic Research in Library & Information Science*, *1*(1).

[6] Lotlikar, T., Kankapurkar, R., Parekar, A., and Mohite, A. (2013). Comparative study of Barcode, QR-code and RFID System. *International Journal of Computer Technology and Applications*, *4*(5), 817.

[7] Farashbandi, F. Z., and Najafi, N. S. S. (2013). Quick response code applications in library and information centers. *Jentashapir Journal Health Resource*, *5*(2), 73-78.

[8] Farashbandi, F. Z., and Najafi, N. S. S. (2013). Quick response code applications in library and information centers. *Jentashapir Journal Health Resource*, *5*(2), 73-78.

[9] Ma, Y. C., and Huang, Y. H. (2012). General Application Research on GSM Module. In *Applied Mechanics and Materials* (Vol. 151, pp. 96-100). Trans Tech Publications Ltd.

[10] Shahid, S. M. (2005). Use of RFID technology in libraries: A new approach to circulation, tracking, inventorying, and security of library materials. *Library Philosophy and Practice*, *8*(1), 1-9.

[11] https://www.electronicsforu.com/resources/gsm-module

[12]https://en.wikipedia.org/wiki/C_(programming_language)#:~:text=C%20(%2Fsi%CB%90%2F%2C,efficiently%20to%20typical%20machine%20instructions.

[13] https://www.hostinger.com/tutorials/what-is-mysql

[14] https://en.wikipedia.org/wiki/MySQL

[15] https://dart.dev/guides/language/type-system

[16]https://en.wikipedia.org/wiki/Dart_(programming_language)#:~:text=Dart%20is%20an%20object%2Doriented,reified%20generics%2C%20and%20type%20inference.

[17] https://www.abr.com/advantages-of-rfid-vs-barcodes/

[18] https://en.wikipedia.org/wiki/Radio-frequency_identification

[19] https://www.brooks.com/applications-by-industry/semiconductor/rfid/rfid-basics/rfid-components/transponder

[20] https://en.wikipedia.org/wiki/Eclipse_(software)

PLAGIARISM_REPORT

ORIGINALITY REPORT

4%	2%	1%	2%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to University of Hong Kong Student Paper	<1%
2	ddd.uab.cat Internet Source	<1%
3	Submitted to Higher Education Commission Pakistan Student Paper	<1%
4	Submitted to University of Bedfordshire Student Paper	<1%
5	www.zipcodewilmington.com Internet Source	<1%
6	Submitted to City University College of Science and Technology Student Paper	<1%
7	docplayer.net Internet Source	<1%
8	www.slideshare.net Internet Source	<1%

9	Submitted to Rochester Institute of Technology Student Paper	<1%
10	kodytechnolab.com Internet Source	<1%
11	Submitted to South Bank University Student Paper	<1%
12	scisweb.ulster.ac.uk Internet Source	<1%
13	Submitted to University of Cape Town Student Paper	<1%
14	Submitted to College of Technology London Student Paper	<1%
15	iris.lib.neu.edu Internet Source	<1%
16	J. Landt. "The history of RFID", IEEE Potentials, 2005 Publication	<1%
17	core.ac.uk Internet Source	<1%
18	iabmglossary.com Internet Source	<1%
19	ks.utc.sk Internet Source	<1%

20	www.mdpi.com Internet Source	<1%
21	Submitted to Kuala Lumpur Infrastructure University College Student Paper	<1%
22	Submitted to Northern Caribbean University Student Paper	<1%
23	dk.um.si Internet Source	<1%
24	ir.uiowa.edu Internet Source	<1%

Exclude quotes	Off	Exclude matches	Off
Exclude bibliography	Off		