

DESIGN AND IMPLEMENTATION OF AN ELECTRONIC ORDERING AND LIBRARY MANAGEMENT SYSTEM

CASE STUDY: KAMPALA INTERNATIONAL UNIVERSITY LIBRARY

*Final year report submitted to
Kampala International University in partial fulfillment
Of the requirement for the award of the degree
Of*

**Bachelor of Science
In Telecommunications Engineering**

By

ABDUL IDD AZIZ

BSTC/43822/143/DU

ODONGO HARUNA WANYIRAE

BSTC/43488/143/DU



**DEPARTMENT OF ELECTRICAL & TELECOMMUNICATIONS ENGINEERING
SCHOOL OF ENGINEERING AND APPLIED SCIENCES**

SEPTEMBER 2018

DECLARATION

We declare that this is our original copy of the project report and it is a reflection of the knowledge acquired from our research on the project about design and implementation of Electronic Ordering and library management system. We, therefore, declare that the information therein has not been submitted to any other institution for any award other than the Department of electrical and telecommunications engineering, School of Engineering and Applied Sciences, Kampala International University for our pursuit of Bachelor's degree in Telecommunications Engineering.

ABDUL IDD AZIZ

BSTC/43822/143/DU

ODONGO HARUNA WANYIRAE

BSTC/43488/143/DU

APPROVAL

I have read and at this moment recommend this project report titled “Design and Implementation of Electronic Ordering and library management system” for acceptance by Kampala international university in partial fulfillment of the requirement for the award of a degree in Bachelor of Science in Telecommunications Engineering of Kampala International University.

Signature Date

Mr. Adabara Ibrahim

Asst. Lecturer

Email. technologyvigilant@gmail.com

Web-site: **Technologyvigilant.wordpress.com**

Signature Date.....

Mr. Njubo Nelson

Asst. Lecturer

DEDICATION

We dedicate this project **to God Almighty** our creator, our strong pillar, the source of inspiration, wisdom, knowledge, and understanding. He has been the source of our strength throughout this

Project and on His wings only have we soared. Alhamdulillah.

We also dedicate this work to our **dear Parents** who have encouraged us all the way and whose inspiration has made sure that we give it all it takes to finish that which we started.

To our beloved best friends **Alfred Lyahinda, Mathew Derrick, Penelope, Patricia, Rose** and others who have been affected in every way possible by this quest.

Thank you. **Phic Wilson, Idd Shakira & Idd Omar**, for you all can never be quantified. God bless you.

ACKNOWLEDGMENT

We thank the Almighty God for giving us all the necessary strengths, knowledge, wisdom, financial and moral ability to complete this project report.

We sincerely wish to express our heartfelt gratitude to everyone who assisted us to complete this project report in one way or the other. Our primary obligation is to thank Kampala International University, our Supervisors Mr. Adabara Ibrahim and Mr. Njubo Nelson for their useful comments, criticisms, and suggestions on the original manuscript of this project report. Sincere thanks go to all the Lecturers of KIU especially from the department of electrical and telecommunications engineering for providing us with a friendly atmosphere of knowledge that enabled us to complete this report.

ABSTRACT

The main objective of this project is to design and Implement an affordable and reliable Electronic Ordering and library management system, taking Kampala International University library as a case study.

Specific objects include to design MySQL database that will be used as library management system, install the designed database on a laptop where students can easily view the catalog and identify books and their book short forms or book codes, To provide a keypad where students will type the preferred book short forms or book codes to place an order and To construct the transmitting section using RF transmitter, LCD (16 by 2), Arduino Uno Board, and +5V power supply. (Transmitting section is where the order is placed from. To construct the receiver section using RF receiver, LCD (16 by 2), Arduino Uno Board, buzzer, switch and +5V power supply.

The need to provide an easy way to view the available books in the library by the students and also to enable librarians to access the easiest means to keep track of the library records through designing an easy “to use and understand” database, makes the electronic ordering and library management system crucial in the modern world. To eliminate time wasted on making queues, writing chits about the books students want and using a lot of words to make a librarian understand, calls for the establishment of this system. The most crucial fact about the system is that it is cheap, reliable, easy to maintain and very effective in operation and hence can be afforded by the University.

This report consists of five chapters;

Chapter One-Introduction: It gives a brief introduction and background for this project.

Chapter two-Literature review: It gives an overview of the literature of all components used to build up the project.

Chapter three-Methodology: It explains the system design, i.e., architecture and interfacing of the devices used.

Chapter four-Results and discussion: Describes the results and output of the system.

Chapter five-Conclusions and Future Scope: It gives the conclusions drawn from this project and brief ideas about future development works that can be undertaken

TABLE OF CONTENTS

Contents

DECLARATION	i
APPROVAL	ii
DEDICATION	iii
ACKNOWLEDGMENT.....	iv
ABSTRACT.....	v
TABLE OF CONTENTS.....	vi
LIST OF FIGURES	xi
LIST OF TABLES	xii
ABBREVIATIONS	xiii
CHAPTER ONE	1
INTRODUCTION	1
1.0 Introduction.....	1
1.1 Project Background.....	1
1.2 Problem statement.....	2
1.3 Objectives of the study.....	2
1.3.1 Main Objective.....	2
1.3.2 Specific Objectives	2
1.4 Significance of the project	3
1.5 Project Scope	3
1.5.1 Technical/content scope.....	3
1.5.2 Geographical scope	3
1.5.3 Time scope	3

CHAPTER TWO	4
LITERATURE REVIEW	4
2.0 Introduction.....	4
2.1 History of library ordering and management systems	4
2.1.1 Pre-computerization.....	4
2.1.2 1960s: the influence of computer technologies	4
2.1.3 1970s–1980s: the early integrated library system.....	4
2.1.4 1990s–2000s: the growth of the Internet	5
2.1.5 2010s–present: the rise of cloud-based solutions.....	5
2.2 Existing systems.....	5
2.2.1. Manual ordering system.....	5
2.2.2 Online ordering system.	5
2.2.3 Computer wired network systems.....	5
2.2.4 Weaknesses of the existing systems	6
2.3 Design parameters.....	6
2.4 How RF wireless connectivity work.....	7
2.5 Data transmission.....	7
2.6 Database.....	8
2.6.1 Design and modeling	9
2.7 Sublime Text.....	9
2.8 Proteus Design Suite	9
2.8.1 Product Modules	9
2.9 RF fundamental.....	10
2.10 Instrumentation/ major components used	12

2.10.1 RF Transmitter	12
2.10.2 RF Receiver	12
2.10.3 Arduino	13
2.10.4 A microcontroller.....	14
2.10.5 LCD JHD162A	14
2.10.6 4*4 Keypad design.....	15
2.10.7 Buzzer	15
 CHAPTER THREE	 16
METHODOLOGY	16
3.0 Introduction.....	16
3.1 Data collection	16
3.2 System design	16
3.3 Conceptual design/framework	17
3.3.1 Transmitter section.....	17
3.3.2 Receiver section	18
3.4 Working Principal of the project. (Block diagram explanation).....	18
3.5 Overall transmitter circuit outline	20
3.7 Explanation of the functionality of the components (as seen in the circuit diagrams)	22
3.7.1 The DC Power Supply (+5v):	22
3.7.2 Arduino Uno Board.....	22
3.7.3 RF Transmitter and Receiver	22
3.7.4 LCD.....	22
3.7.5 Keypad	23
3.7.6 Buzzer	23

3.8 System flowchart (Transmitter section).....	24
3.9 System Flowchart (receiver section).....	25
3.10 System construction and Database design	26
 CHAPTER FOUR	 32
RESULTS AND DISCUSSION	32
4.0 Introduction.....	32
4.1 Breadboard components assembling.....	32
4.1.1 Breadboard results	33
4.2 software programming	34
4.2.1 Transmitter source code	34
4.2.2 Receiver source code	43
4.3 soldering on printed circuit board (PCB).....	45
4.3.1 Continuity testing.....	46
4.3.2 Results on PCB	46
4.4 project/device packaging	47
 CHAPTER FIVE	 48
RECOMMENDATIONS, CONCLUSION AND FUTURE SCOPE OF WORK	48
5.0 Conclusions.....	48
5.1 Recommendations.....	48
5.2 Future scope	49
REFERENCES	49
APPENDIX	51
APPENDIX A: Gantt chart showing the project timeline	51

Appendix B: Project Budget	52
Appendix C: assembling components on PCB	54
Appendix D: working circuit on PCB.....	54
Appendix E: showing the keypad design model.....	55
Appendix F: showing final devices after packaging and ready to be presented to the public	55

LIST OF FIGURES

Figure 1 showing a wireless link (Ken Ruppel, December 10, 2002)	10
Figure 2 showing carrier (Ken Ruppel, December 10, 2002).....	11
Figure 3 RF Receiver output & IF Receiver (Ken Ruppel, December 10, 2002).....	11
Figure 4 showing RF Transmitter (Posted by mybotic, 2016).....	12
Figure 5 showing RF Receiver (Posted by mybotic, 2016)	13
Figure 6 showing the Arduino Uno board (Smith, (c) 2018,).....	13
Figure 7 showing 16 by 2 LCD. (Bruno, et al, (2008))	14
Figure 8 4*4 keypad design (Instructables.com, retrieved 2018).....	15
Figure 9 showing buzzer (dhgate.com, retrieved 2018)	15
Figure 10 showing the conceptual design of the transmitter of the system	17
Figure 11 showing the conceptual design of the receiver section of the system	18
Figure 12 showing a transmitter circuit diagram	20
Figure 13 showing a receiver circuit diagram.....	21
Figure 14 transmitter flow chart	24
Figure 15 receiver flow chart.....	25
Figure 16 the homepage source code.....	26
Figure 17 server_access1.php file.....	27
Figure 18 insert11.html file.....	28
Figure 19 insert111.php file.....	29
Figure 20 default style.css file	30
Figure 21 gradientdesign.css file	31
Figure 22 shows a catalog of some available books in the library	31
Figure 23 showing breadboard assembling of components	33
Figure 24 showing results after breadboard connection in A and B.....	33
Figure 25 showing PCB circuit soldering.....	45
Figure 26 showing in A, LCD display results and B, the circuitry result after soldering.....	47
Figure 27 showing initial packaging stage.....	47
Figure 28 shows the transmitter & receiver devices after full packaging.....	48

LIST OF TABLES

Table 1 showing the project timeline.....	51
Table 2 showing project budget	52

ABBREVIATIONS

ASK	Amplitude Shift Keying
BER:	Bit Error Rate
CPCA:	Carrier Present, Carrier Absent
CPU:	Central Processing Unit
DFD:	Data flow diagrams
EEPROM:	Electrically-erasable programmable Read Only Memory
FCC:	Federal Communications Commission
GPS:	Global Positioning System
ICSP:	In-Circuit Serial Programming
KIU	Kampala International University
LCD	Liquid Crystal Display
LNA:	Low Noise Amplifier
NA:	Not Available/ No Answer
OOK:	On-Off Keying
PCB:	Printed Circuit Board
PIS:	Passenger Information System
RAM:	Random Access Memory
RF:	Radio Frequency
ROM:	Read Only Memory
V _{CC} :	Positive Power Supply

CHAPTER ONE

INTRODUCTION

1.0 Introduction

This chapter gives a brief introduction to the project, as well as discussing the problem statement in detail. Also, the main and specific objectives, significance and scope of the project are presented.

1.1 Project Background

Electronic ordering is worldwide adopted an effective way of placing orders via the internet or using specific structured ordering systems. In the current world, most people use online platforms to place orders if they want certain items from different business places including supermarkets, restaurants, and libraries among other. An increased number of clients/customers in various businesses has increased demand for items. This has called for evolving measures to match with demands of clients through ensuring better service deliveries. One of the major problems of developing countries today is the adaptation and adoption of new technologies that will enable them to utilize their information resources efficiently and effectively to propel them towards, modernizing service delivery, economic growth, and development. Governments must position themselves to ensure investment in and application of new technologies to harness the benefits of these technologies. (Hon. Aggrey Awori, 2010). With the Ugandan policy in recognizing technological developments that would enable fostering economic development to modernize service delivery, this project will be of great importance once adopted in other business fields. At Kampala International University library, students have to visit a website from the provided desktops or use their laptops to search for desired books from an online library catalog, then note the results down on a paper and hand them to the librarians in a reserved section to deliver their book order/request. The Electronic Ordering and library management system is the easiest way students will use to place their orders by simply typing their desired books utilizing a keypad provided and also the system will enable the library staff to control and manage library activities as designed in the database.

1.2 Problem statement

To control and manage the day-to-day library activities for example lending books to students, knowing which books are lacking in the library, and monitoring student's activities at among others is hard and requires the library staff's hard work and extra attention in ensuring proper book records and back and forth checking of the book records for certainty. Also, there's a lot of time wastage at the till of reserved section when students are placing their orders to borrow certain books. This is due to long queues, and sometimes difficulties on the side of the staff to understand student's requests. Therefore the electronic ordering and library management system aim at cubing down such issues through providing a platform where the librarians will easily monitor and manage library activities at KIU as per the database created and also ease and quicken the way of placing orders for books by students.

1.3 Objectives of the study

1.3.1 Main Objective

To design and Implement an affordable and reliable Electronic Ordering and library management system, taking Kampala International University library as a case study.

1.3.2 Specific Objectives

- (i) To design MySQL database that will be used as library management system.
- (ii) To install the designed database on a laptop where students can easily view the catalog and identify books and their book short forms or book codes.
- (iii) To construct the transmitting section using RF transmitter, LCD (16 by 2), Arduino Uno Board, and +5V power supply. (Transmitting section is where the order is placed from)
- (iv) And also Receiving Section using RF receiver, Arduino Uno Board, LCD (16 by 2) buzzer, switch and +5V power supply. (Receiving section is where a librarian receives an order) all are using Proteus Design Suit and implement it on PCB.

1.4 Significance of the project

- i. The system helps students to identify their desired books from a library catalog displayed on the laptop and place their order which will be wirelessly sent to a receiving device placed in the reserved section for librarians. This is convenient and saves time.
- ii. The librarians in the reserved section can receive clear information on the required books by students as the information will be detailed on a display screen.
- iii. This system aims at delivering accurate information, reduce time wastage, reduce pollution by limiting the number of chits disposed of each day and enhance effectiveness in service delivery in the campus library.
- iv. Most importantly, the system is cheap, reliable, easy to maintain and very effective in operation and hence can be afforded by the University

1.5 Project Scope

1.5.1 Technical/content scope

The project uses RF technology to communicate between the transmitting section and the receiving section. The transmitter section is used for the ordering process. It includes catalog showing the available books in the library where the student selects books based on his preference. A microcontroller is fed with a code to control components being used in system build up. Here, the RF module transmits pin is connected to the transmitter pin of the microcontroller. The Receiving section is used to receive the order. Here the receiver pin of the module is interfaced with microcontroller all to ensure effective wireless communication between the two sections.

1.5.2 Geographical scope

The system is developed for Kampala International University, in Kampala City, Uganda, because the problem statement is defined from the campus library.

1.5.3 Time scope

The project took ten months for full completion including the time of problem statement to finally completing the report. For details (Refer to appendix).

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter will discuss more all of the information related to the project. It discusses the previous history and the present work about the project. We all look at existing systems, their weaknesses, and solutions. The literature review in this chapter is based on the Internet, journals, books, and articles.

2.1 History of library ordering and management systems

2.1.1 Pre-computerization

Before computerization, library tasks were performed manually and independently from one another. Selectors ordered materials with ordering slips, cataloguers manually cataloged sources and indexed them with the card catalog system (in which all bibliographic data was kept on a single index card) and users signed books out manually, indicating their name on cue cards which were then kept at the circulation desk. (Kochtanek, Thomas R. (2002))

2.1.2 1960s: the influence of computer technologies

The next big innovation came with the advent of MARC standards in the 1960s, which coincided with the growth of computer technologies – library automation was born. From this point onwards, libraries began experimenting with computers, and, starting in the late 1960s and continuing into the 1970s, bibliographic services utilizing new online technology and the shared MARC vocabulary entered the market. (Wallace, Patricia M. (1991))

2.1.3 1970s–1980s: the early integrated library system

The 1970s can be characterized by improvements in computer storage, as well as in telecommunications. As a result of these advances, ‘turnkey systems on microcomputers,’ known more commonly as integrated library systems (ILS) finally appeared. (Wallace, Patricia M. (1991)). These systems included necessary hardware and software which allowed the connection of major circulation tasks, including circulation control and overdue notices. As the technology

developed, other library tasks could be accomplished through ILS as well, including acquisition, cataloging, reservation of titles, and monitoring of serials. (Kochtanek, Thomas R. (2002))

2.1.4 1990s–2000s: the growth of the Internet

With the evolution of the Internet throughout the 1990s and into the 2000s, ILSs began allowing users to more actively engage with their libraries through OPACs and online web-based portals. Users could log into their library accounts to reserve or renew books, as well as authenticate themselves for access to library-subscribed online databases. (Kochtanek, Thomas R. (2002))

2.1.5 2010s–present: the rise of cloud-based solutions

The use of cloud-based library management systems has increased drastically since the rise of cloud technology started. Some common management systems include Insignia Software, Libramatic, OCLC World Share, Alma, Aura Software and Librarika. (Olson N, 2010).

2.2 Existing systems

2.2.1. Manual ordering system

This involves a student going to search for a particular book he or she needs physically from library shelves or from a website designated in the library to search for available books. Sometimes this calls for adopting a piece of paper to record the contents before submitting your request at the reserve section desk. Then an attendant looks for that particular book from the different shelves. With manual systems, the level of service is dependent on individuals, and this puts a requirement on management to run training continuously for staff to keep them motivated.

2.2.2 Online ordering system.

This involves ordering for a book (s) through the internet. This is used more for public libraries where individuals order for books from their different places through the library website. The library then delivers the book(s) to the particular individual's destination. This involves using the internet which is expensive.

2.2.3 Computer wired network systems.

These include computer networks set in the libraries which use wired networking methodology to communicate from one computer to another. These systems are used in libraries by students to send particular requests about available books to the librarian

2.2.4 Weaknesses of the existing systems

- It is much time to consume and slow (especially the manual system). This happens in times of a large number of students at the ordering desk with different requests. With the device in place, students can easily place their order one at a time instead of crowding the ordering desk where in most cases a lot of time is consumed waiting to be served.
- Lots of manual labor is required. This is simply because it requires different individuals to handle different tasks, such as getting the students information, cross-checking availability of the books and other individuals to go and look for the books.
- Manual operating systems are vulnerable to human error. For instance, a librarian who misfiles a borrower's records or indexes a book incorrectly slows down the process and wastes employees' time.
- The computer wired networks are expensive to install and maintain whereas this system uses wireless communication devices which are cheap and reliable.
- Online systems are expensive because they involve purchasing data packages to use the internet to place an order. This electronic system is cheap and offers free ordering.

2.3 Design parameters

- The wireless RF link consists of a transmitter with antenna, a transmission path and the receiver with antenna. Parameters of interest are the output power of the transmitter and the sensitivity of the receiver
- It includes two antennas in two different places with one at the point of transmitting and the other point for receiving the signal. The modulated radio signal (electrical current) will pass through the antenna inducing a magnetic field, which oscillates at the given frequency. The variations in the current create slight variations in the radio frequency.
- The gotten signal depends on terrain, obstructions, and height of the antenna. Buildings can reflect RF energy is making it difficult or impossible to receive the desired signal. Hence, the ideal conditions for the best transmission and reception signal are a line of sight and outside with no obstructions
- The system is designed in a portable, an accessible and easy way for all the students to understand and use easily.

2.4 How RF wireless connectivity work

RF is commonly used in the wireless communications industry to describe certain types of equipment which use radio frequency waves to transmit sounds and data from one point to another. In computer networking, RF is used to describe network devices such as hubs or bridge that transmits data signals using radio waves instead of data cables or telephone lines. Even though the phrase "RF wireless networking" might seem mysterious, the underlying technology is very common. It uses radio waves, the same type of energy used to transmit radio and television broadcasting. Two-way radios and walkie-talkies also use this kind of technology. In the middle of the radio transmission and receiving process sit two antennas in two different places which is one located at the point for transmitting the signal, and the other point is for receiving the signal. To transmit the modulated radio signal, an electrical current will pass through the antenna inducing a magnetic field, which oscillates at the given frequency. The variations in the current create slight variations in the radio frequency (S. Keizimier et al., 1998).

2.5 Data transmission

Data transmission is the conveyance of any information from one space to another. Historically this could be done by courier, a chain of bonfires or semaphores, and later by Morse code over copper wires. In recent computer terms, it means sending a stream of bits or bytes from one location to another using any number of technologies, such as copper wire, optical fiber, laser, radio, or infrared light. RF modules transmit data wirelessly, some usual RF devices are those digital modules where a button or command generates a digital output on the receptor, and this limits the amount of control that can be generated on the receptor to a few "channels." In most cases, some "complex" custom communication is required, where the RF modules need to handle any type and size of information the process require. In this case, an Arduino board connected to an RF transmitter that sends the strings it receives via serial communication, it sends it to a receiver RF module with another Arduino Board which interprets it to recreate the message on its serial interface. (Sabastian R. 2014)

2.6 Database

A database is an organized collection of data. A relational database, more restrictively, is a collection of schemas, tables, queries, reports, views, and other elements. Database designers typically organize the data to model aspects of reality in a way that supports processes requiring information, such as (for example) modeling the availability of rooms in hotels in a way that supports finding a hotel with vacancies. A database management system (DBMS) is a computer software application that interacts with end-users, other applications, and the database itself to capture and analyze data. A general-purpose DBMS allows the definition, creation, querying, update, and administration of databases. (Merriam Webster, retrieved 2018)

Existing DBMSs provide various functions that allow management of a database and its data which can be classified into four main functional groups:

- **Data definition** – Creation, modification, and removal of definitions that define the organization of the data.
- **Update** – Insertion, modification, and deletion of the actual data. (Wallace, Patricia M. 1991).
- **Retrieval** – Providing information in a form directly usable or for further processing by other applications. The retrieved data may be made available in a form the same as it is stored in the database or in a new form obtained by altering or combining existing data from the database. (Wallace, Patricia M. 1991).
- **Administration** – Registering and monitoring users, enforcing data security, monitoring performance, maintaining data integrity, dealing with concurrency control, and recovering information that has been corrupted by some event such as an unexpected system failure. (Kochtanek, Thomas R. 2002)
- Databases and DBMSs can be categorized according to the database model(s) that they support (such as relational or XML), the type(s) of computer they run on (from a server cluster to a mobile phone), the query language(s) used to access the database (such as MySQL or XQuery), and their internal engineering, which affects performance, scalability, resilience, and security.

2.6.1 Design and modeling

- The first task of a database designer is to produce a conceptual data model that reflects the structure of the information to be held in the database. A successful data model will accurately reflect the possible state of the external world being modeled: such as if people can have more than one phone number, it will allow this information to be captured.
- The next stage is to translate this into a schema that implements the relevant data structures within the database. This process is often called logical database design, and the output is a logical data model expressed in the form of a schema. Whereas the conceptual data model is (in theory at least) independent of the choice of database technology, the logical data model will be expressed regarding a particular database model supported by the chosen DBMS.
- The final stage of database design is to make the decisions that affect performance, scalability, recovery, security, and the like, which depend on the Particular DBMS. (Wallace, Patricia M. 1991).

2.7 Sublime Text

Sublime Text is a proprietary cross-platform source code editor with a Python application programming interface (API). It natively supports many programming languages and markup languages, and functions can be added by users with plugins, typically community-built and maintained under free-software licenses. (Peleg Dan, 2013)

2.8 Proteus Design Suite

The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards. (Wikipedia, retrieved 2018)

2.8.1 Product Modules

The Proteus Design Suite is a Windows application for schematic capture, simulation, and PCB layout design. It can be purchased in many configurations, depending on the size of designs being produced and the requirements for microcontroller simulation. All PCB Design products

include an auto-router and basic mixed mode SPICE simulation capabilities. (Wikipedia, retrieved 2018)

2.9 RF fundamental

The wireless link consists of a transmitter with antenna, a transmission path and the receiver with antenna. Parameters of interest are the output power of the transmitter and the sensitivity of the receiver. Figure 1 illustrates the linking principle

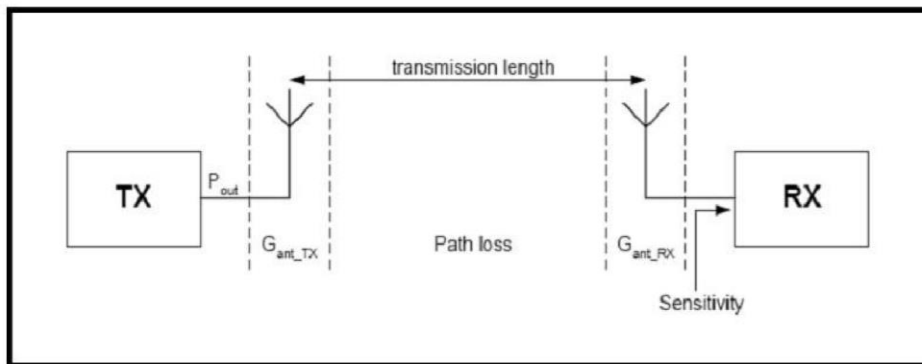


Figure 1 showing a wireless link (Ken Ruppel, December 10, 2002)

Sensitivity is the minimum received power that results in a satisfactory Bit Error Rate (BER, usually 1×10^{-3}) at the received data output (i.e., correct demodulation). The difference between received signal power and sensitivity is the transmission link margin also known as “headroom.” Headroom is reduced by some factors such as transmission path length, antenna efficiency, carrier frequency and physical characteristics of obstructions in the transmission path. Sensitivity and output power given in the RF circuit datasheets are given for the load impedance which is optimal for the input LNA and the output power amplifier. This means that the impedance of the antenna used must be equal to the load stated in the datasheet; otherwise, mismatch and loss of headroom occur. A typical matching network introduces in the order of 13 dB of attenuation. Radio Frequency (RF) waves are lower in frequency and longer in wavelength than Infrared. At 300 MHz the wavelength is 1m (39.37") while Consumer IR wavelengths are just under 1 millionth of a meter. Most RF remotes use a carrier in the 300-1000 MHz range. RF receiver only needs to be tuned to the carrier frequency used by the remote. RF remotes

and their receivers are tuned to a fixed frequency. The FCC allows unlicensed, low power use of 300MHz-1000MHz as well as some higher frequency bands as a general rule; the codes are comprised of pulses and spaces with durations of 0.31.5ms which is an audible signal in the 500-2000 Hz range as shown in Figure 2. The IR and RF receivers output the demodulated code waveform. The only difference is that IR receivers output an active low or inverted signal while RF receivers output an active high signal as shown in Figure 3.

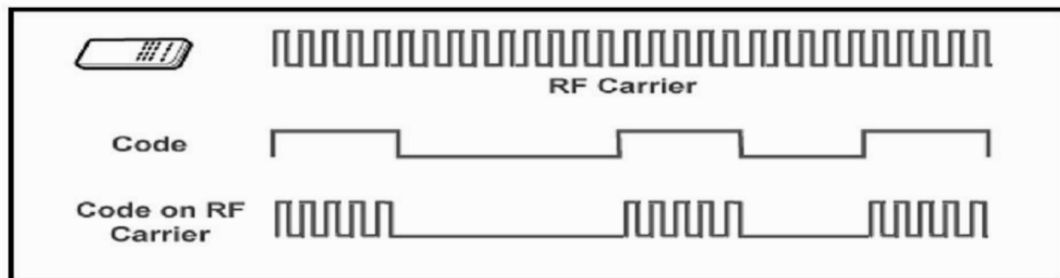


Figure 2 showing carrier (Ken Ruppel, December 10, 2002)

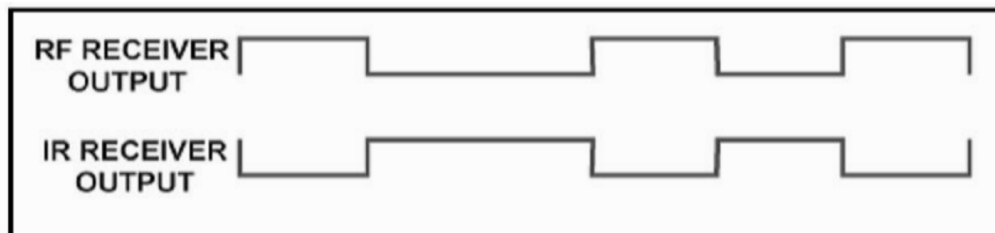


Figure 3 RF Receiver output & IF Receiver (Ken Ruppel, December 10, 2002)

Other than the range, it makes no difference whether the data signal is used to modulate an RF carrier, an IR carrier, an ultrasonic carrier, a laser beam, or smoke. At the receiving end, the demodulated signal carries the same information. For RF control, both the transmitter and receiver need to be tuned to the same carrier frequency and need to use the same type of modulation. Most RF remotes use ASK (Amplitude Shift Keying) or OOK (On-Off Keying). OOK is just a special case of ASK. OOK is also called CPCA (Carrier Present, Carrier

Absent). All of the illustrations above represent ASK. FSK (Frequency Shift Keying) uses two different carrier frequencies to denote two different states. (Ken Ruppel, December 10, 2002)

2.10 Instrumentation/ major components used

2.10.1 RF Transmitter

The function of a radio frequency (RF) transmitter is to modulate, upconvert, and amplify signals for transmission into free space. An RF transmitter generally includes a modulator that modulates an input signal and a radio frequency power amplifier that is coupled to the modulator to amplify the modulated input signal. The radio frequency power amplifier is coupled to an antenna that transmits the amplified modulated input signal. (P.LEACH, A. P. MALVINO and &. DONALD, 2011)

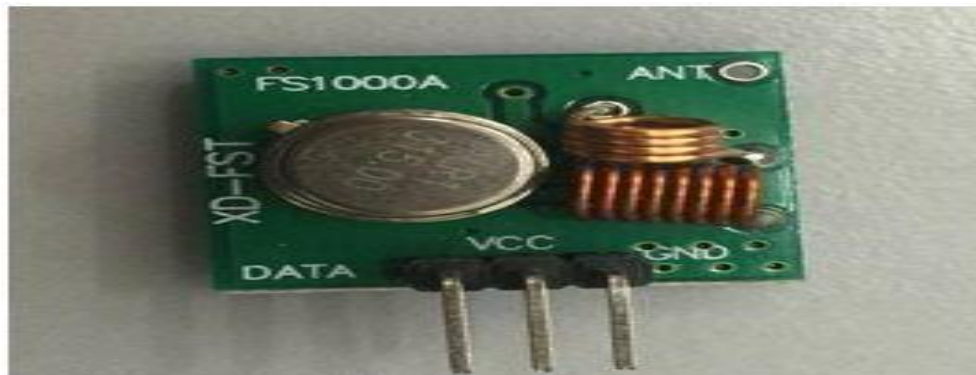


Figure 4 showing RF Transmitter (Posted by mybotic, 2016)

2.10.2 RF Receiver

The RF receiver receives an RF signal, converts the RF signal to an IF signal, and then converts the IF signal to a baseband signal, which it then provides to the baseband processor.

The RF receiver is coupled to the antenna and includes a low noise amplifier, one or more intermediate frequency stages, a filtering stage, and a data recovery stage. The low noise amplifier receives an inbound RF signal via the antenna and amplifies it. (P.LEACH, A. P. MALVINO and &. DONALD, 2011)

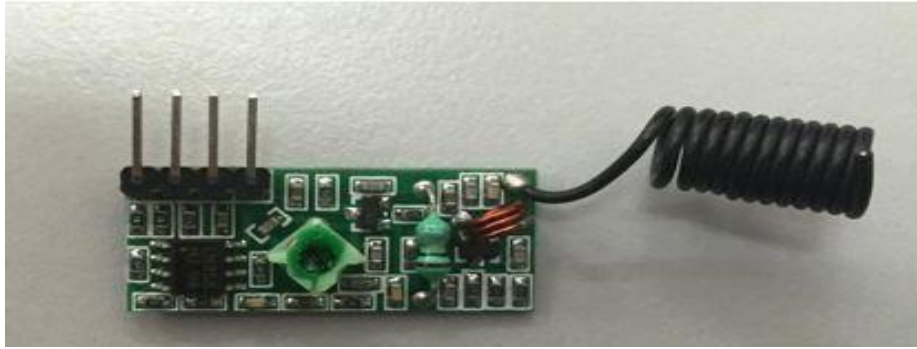


Figure 5 showing RF Receiver (Posted by mybotic, 2016)

2.10.3 Arduino

Arduino is an open source computer hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical and digital world. Arduino board designs use a variety of microprocessors and controllers. ("Arduino - Introduction". www.arduino.cc.) The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards or Breadboards (shields) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project. (David Kushner, (2011-10-26)).

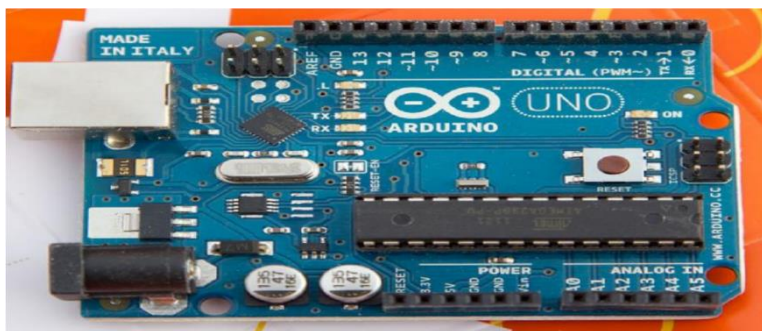


Figure 6 showing the Arduino Uno board (Smith, (c) 2018,)

2.10.4 A microcontroller

A microcontroller is a computer-on-a-chip used to control electronic devices. It is a type of microprocessor emphasizing self-sufficiency and cost-effectiveness, in contrast to a general-purpose microprocessor. A typical microcontroller contains all the memory and interfaces needed for a simple application. A microcontroller is a single integrated circuit with the following key features: Central processing unit - ranging from small and simple 8-bit processors to sophisticated 32- or 64-bit processors, input/output interfaces such as serial ports, peripherals such as timers, RAM for data storage, ROM, EEPROM or Flash memory for program storage, clock generator often an oscillator for a quartz timing crystal and resonator or RC circuit. This integration drastically reduces the number of chips and the amount of wiring and Printed Circuit Board (PCB) space that would be needed to produce equivalent systems using separate chips. (S. Heath et al., 2003).

2.10.5 LCD JHD162A

A liquid crystal display is a flat panel, an electronic visual display that uses the light modulating properties of liquid crystals. Liquid crystal does not emit light directly. The working of LCD depends on two sheets of polarizing material with a liquid crystal solution in between them. When an electric current is passed through the liquid, it causes the crystals to align so that it blocks out light and does not allow it to pass. Each crystal behaves like a shutter; it either allows light to pass through or blocks the light.

It can function properly in the temperature range of -10°C to 60°C and has an operating lifetime of longer than 50000 hours (at room temperature without direct irradiation of sunlight). (Eds. Siciliano, Bruno, et al., (2008))

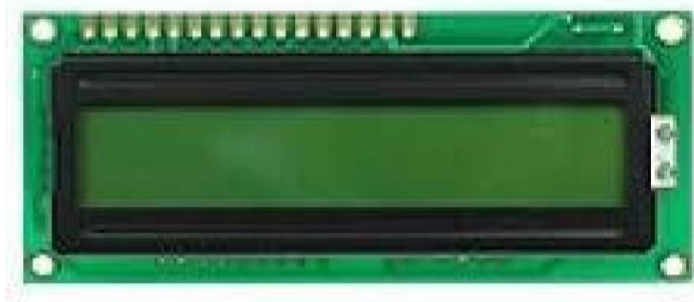


Figure 7 showing 16 by 2 LCD. (Bruno, et al, (2008))

2.10.6 4*4 Keypad design

Matrix keypad consists of a set of Pushbuttons, which are interconnected. Like in our case we are using 4X4 matrix keypad, in which there are 4 push buttons in each of four rows. And the terminals of the push buttons are connected according to the diagram. In the first row, one terminal of all the 4 push buttons are connected together, and another terminal of 4 push buttons are representing each of 4 columns, the same goes for each row. So we are getting 8 terminals to connect with a microcontroller.

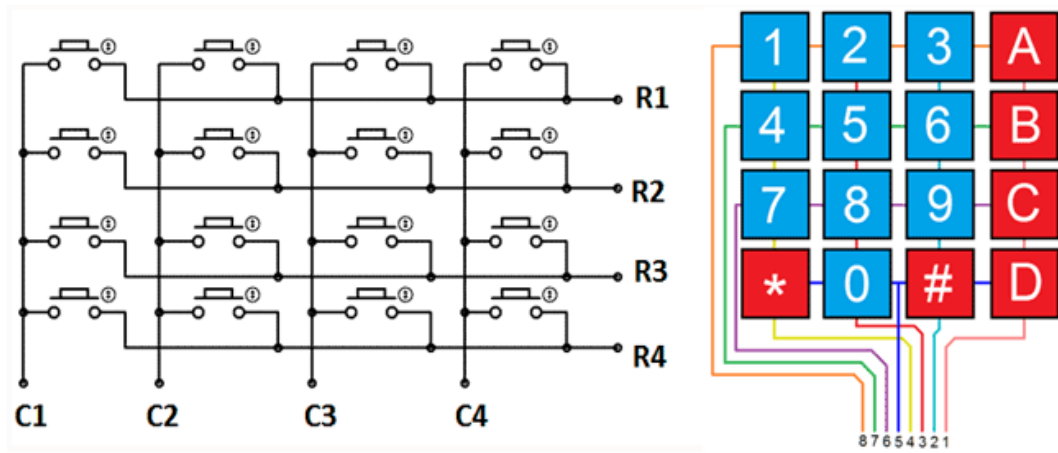


Figure 8 4*4 keypad design (Instructables.com, retrieved 2018)

2.10.7 Buzzer

This gives a beeping sound on the receiver section to alert the librarian about a new order being placed by students. A piezoelectric buzzer/beeper is used in this project because of its portability and low power consumption.



Figure 9 showing buzzer (dhgate.com, retrieved 2018)

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter explains in detail the methodology and components that were used in the project. In this chapter also, the technical plan, analysis and also the specifications will be explained.

3.1 Data collection

Experimental data collection method was used in this project. It is data produced by a measurement, test method, experimental design or quasi-experimental design. Also, it is data produced as a result of a clinical trial. Experimental data may be qualitative or quantitative, each being appropriate for different investigations. The data therein used in this project is both qualitative and quantitative where qualitative data is considered more descriptive and can be subjective in comparison to having a continuous measurement scale that produces numbers normally experimentally repeatable. Qualitative information is usually more closely related to phenomenal meaning and is, therefore, subject to interpretation by our observations as it will be shown in the experiments and block diagrams in this and the next chapters.

3.2 System design

The system is designed with the use of a combination of tools. These tools are categorized as hardware tools and software tools as elaborated forth.

HARDWARE SYSTEM COMPONENTS

- RF transmitter TWS-434 A
- Voltage Regulator LM7805
- RF Receiver RWS-434
- Microcontrollers
- LCD
- Power supply section which contains a transformer, rectifier, filter, regulator which ensures a constant +5V.
- Keypad (4*4)

- Capacitors
- Prototyping board (breadboard)
- Implementation circuit board (copper board)

SOFTWARE

- Proteus
- Arduino IDE

SYSTEM SPECIFICATIONS

- Arduino IDE 1.8.6 (hourly build)
- Windows 7 professional, 64-bit operating system.

3.3 Conceptual design/framework

The block diagram consists of the transmitter and receiver section. They can be represented as the following block diagrams.

3.3.1 Transmitter section

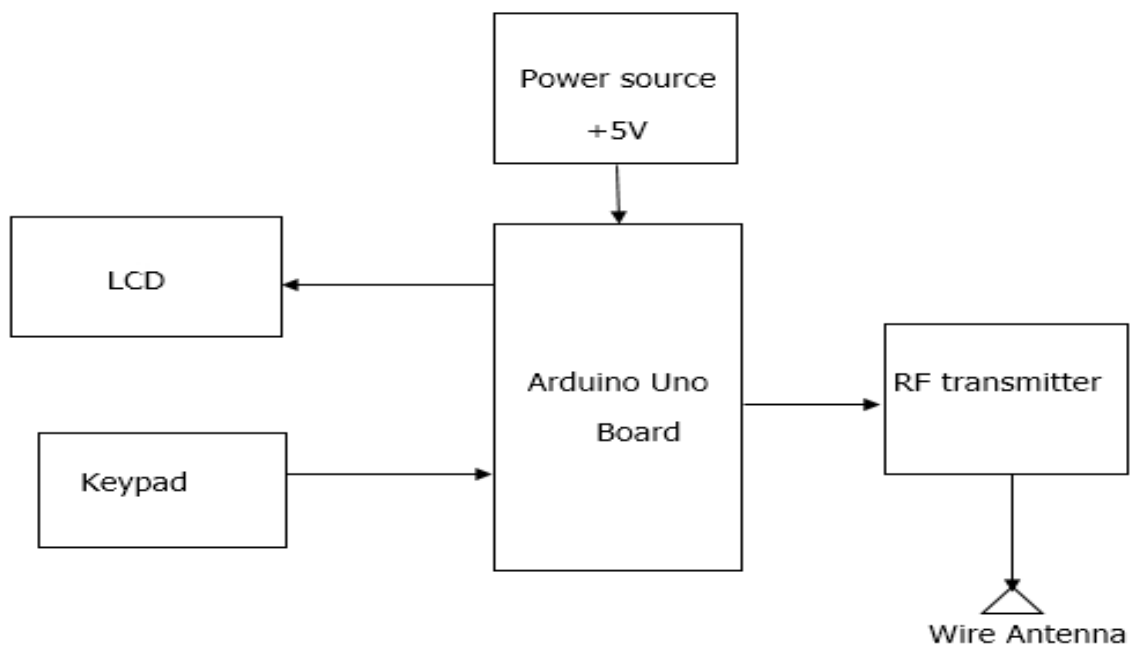


Figure 10 showing the conceptual design of the transmitter of the system

3.3.2 Receiver section

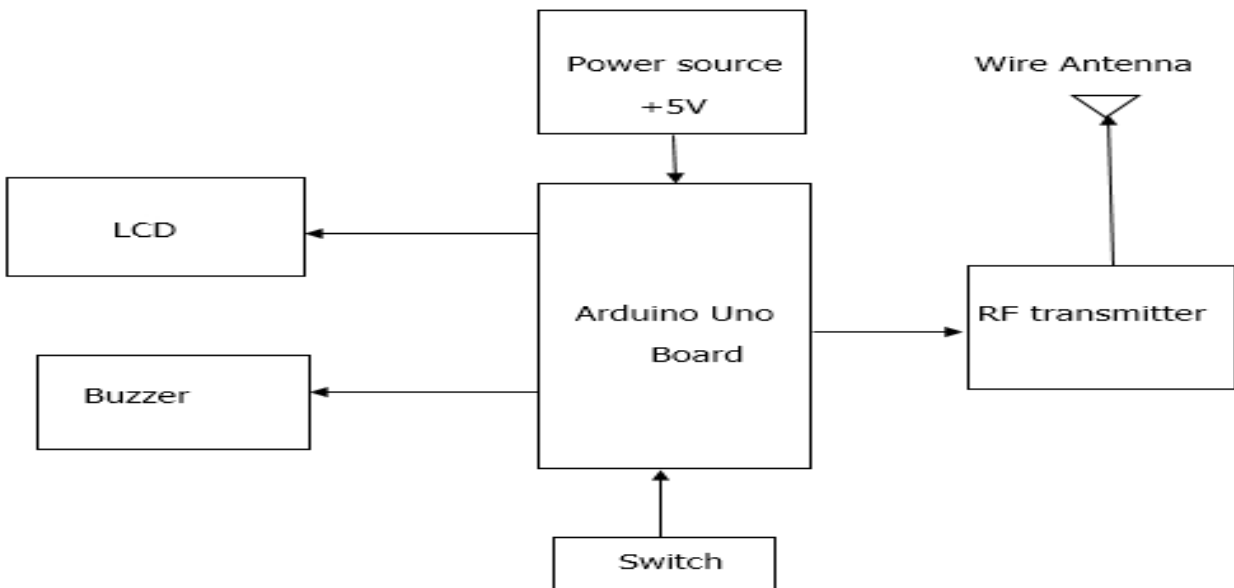


Figure 11 showing the conceptual design of the receiver section of the system

3.4 Working Principal of the project. (Block diagram explanation)

- The project uses RF technology to communicate between the transmitting section and the receiving section. The transmitter section is used for the ordering process. A microcontroller is fed with a code to control components being used in system build up. Here, the RF module transmits pin is connected to the transmitter pin of the microcontroller.
- The Receiving section is used to receive the order. Here the receiver pin of the module is interfaced with microcontroller all to ensure effective wireless communication between the two sections.
- At the transmitter side, a keypad (4*4) is provided to enable input by the user, which is in the form of characters and digits, which are displayed on LCD. Both the keypad and LCD are interfaced with Arduino Uno board so that the input from keypad and output results on LCD. An RF transmitter sends contents of the input from the keypad to the receiver side. A power source of +5V is essential in running this component (keypad, LCD, RF Tx, and Arduino Uno)

- At the receiving section, LCD (16*2), switch, buzzer, and RF receiver are the main components being used. All of them are interfaced with the Arduino Uno which contains an ATmega328 microcontroller. The input is the content being transmitted from the transmission side. The LCD prints or displays these contents whereas the buzzer makes (outputs) a beeping sound to signal reception of these contents. The switch clears current contents on LCD and drives back to a command that notifies a user to wait for “next contents” from the transmission side.

3.5 Overall transmitter circuit outline

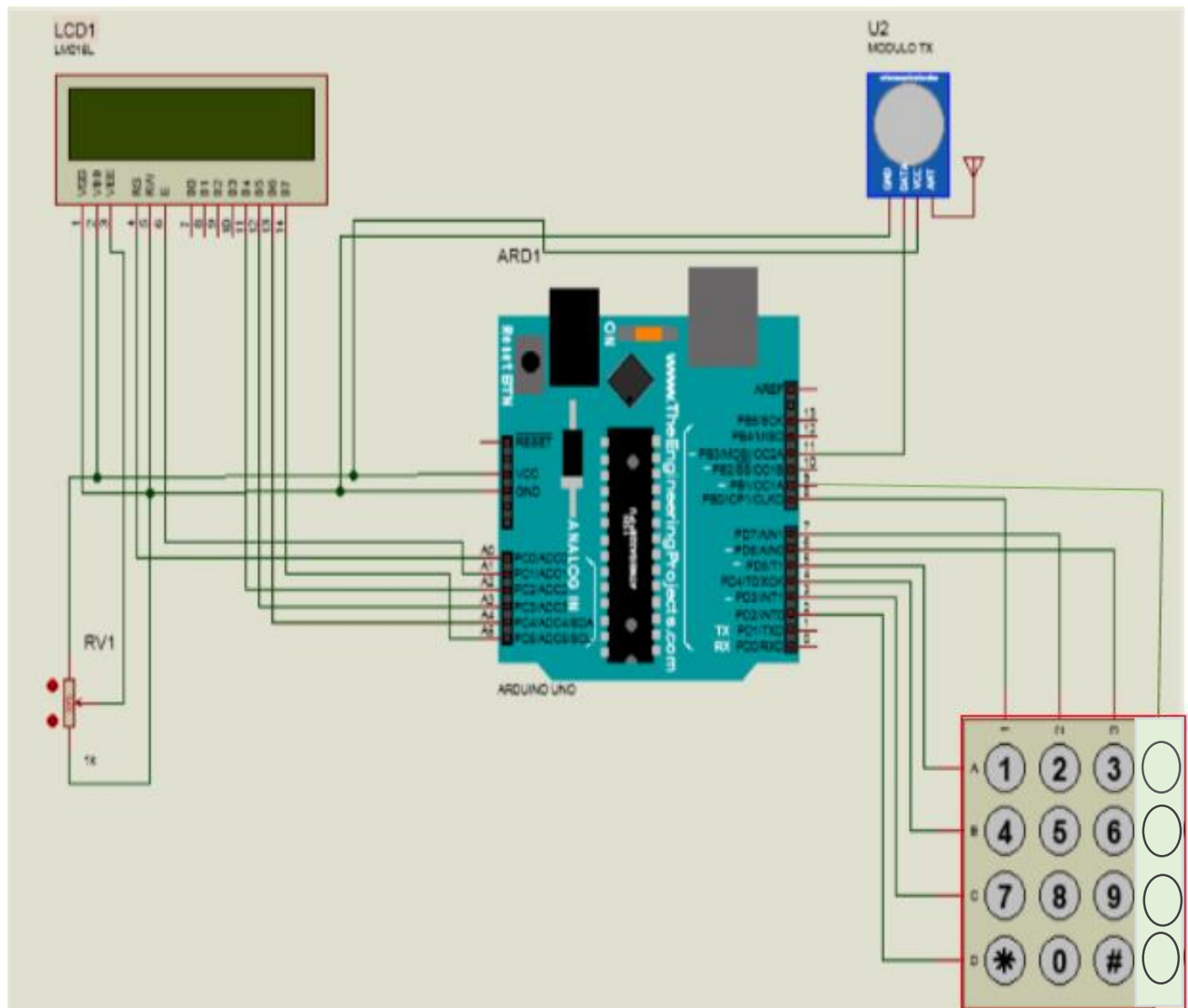


Figure 12 showing a transmitter circuit diagram

3.6 Overall Receiver circuit outline

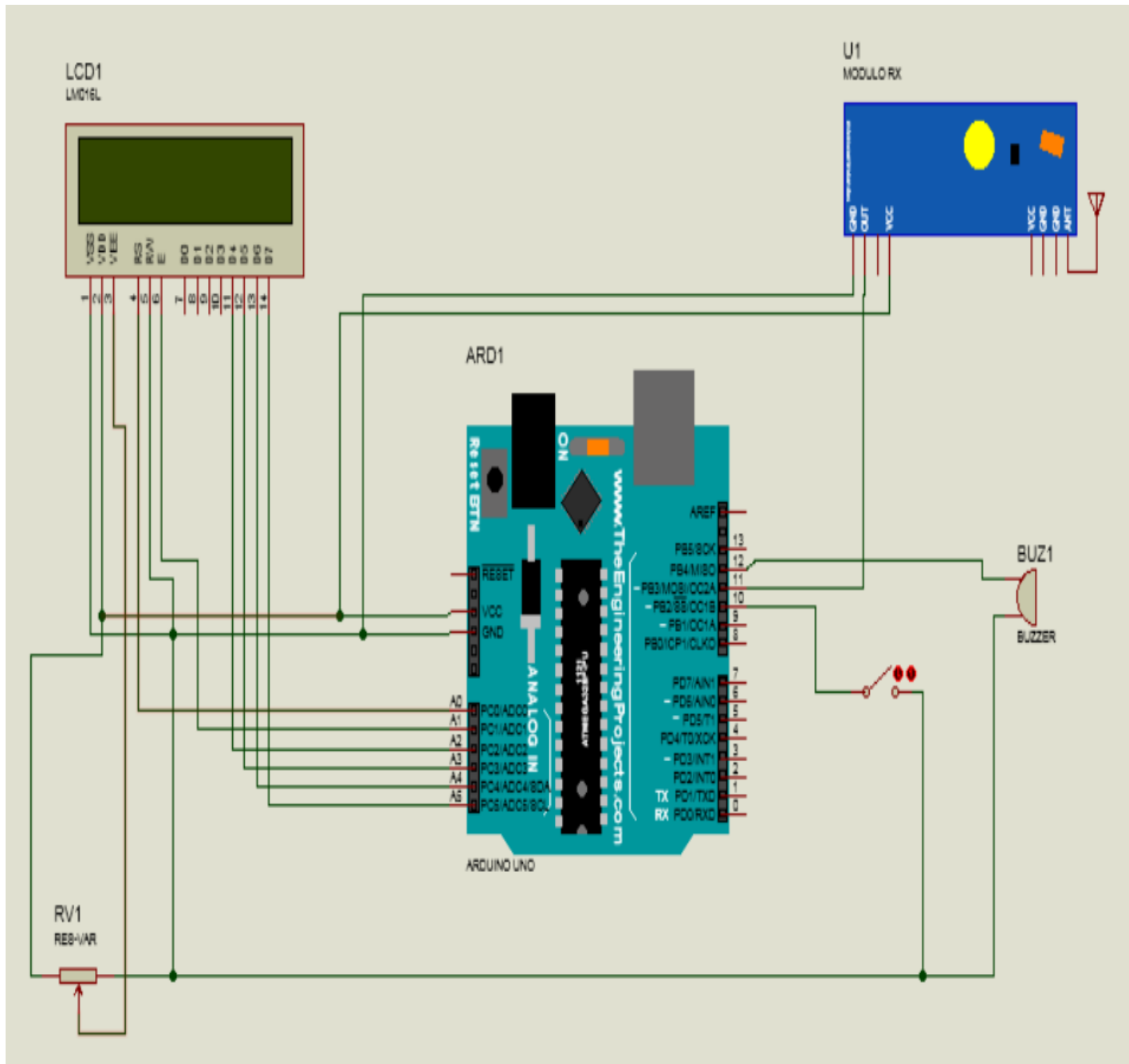


Figure 13 showing a receiver circuit diagram

3.7 Explanation of the functionality of the components (as seen in the circuit diagrams)

3.7.1 The DC Power Supply (+5v):

DC power supply is a traditional electronic device which takes AC power from AC mains and converts it into DC power to operate various electronic DC appliances. In the electronic laboratory, the DC power supply is a common instrumental device which is used as a DC voltage source. Other DC sources like dynamo can be more costly than DC power supply. DC power supply also has long-lasting and adjustable voltage facility which is suitable for experimental work in the laboratory. Here, a regulated DC power supply of +5V has essentially used to power the complete circuit.

3.7.2 Arduino Uno Board

Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with AC-to-DC adapter or battery to get started. In this case, the Arduino Uno is the heart of the project. All the programming in Arduino IDE to link with other units in system implementation is done.

3.7.3 RF Transmitter and Receiver

The transmitter/receiver (Tx/Rx) pair operates at a frequency of 434 MHz. An RF transmitter receives serial data and transmits it wirelessly through RF through its antenna connected at a given pin (pin 11 of the microcontroller). The transmission occurs at the rate of 1Kbps - 10Kbps. The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter.

3.7.4 LCD

The LCD will display the selected books both at the transmitter section and a Receiver section. A 16 by 2 LCD is used in this project.

Interfacing LCD with Atmega 328P

16x2 LCD has 16 pins connected to the microcontroller as follows.

- R/W pin is always grounded so we require only 6 pins in 4-bit mode, thus saving a number of pins.
- RS (Read-Select) pin to pin A0 of microcontroller
- En (Enable) pin to A1 of microcontroller
- D4 pin to A2 of microcontroller
- D5 pin to A3 of microcontroller
- D6 pin to A5 of microcontroller
- D7 pin to A5 of microcontroller

Note: LCD pins above are connected to the Analog points of the Atmega 328P

3.7.5 Keypad

The keypad is the most widely used input device to provide input from the outside world to the microcontroller. The keypad makes an application more user interactive. It is from here where the students will enter the preferred book names or acronyms. A 4 by 4 keypad is used in this project since it's cost-effective and easy to use and interface with Arduino.

Interfacing Keypad with Atmega 328P

The keypad is a 4*4, which means it has four rows and four columns.

Row pins are connected as {8, 9, 2, 3} which are pins from Atmega 328P.

Column pins are connected as: {4, 5, 6, 7}, pins from Atmega 328P.

3.7.6 Buzzer

It gives a beeping sound on the receiver section to alert the librarian about a new order being placed by students. A piezoelectric buzzer/beeper is used in this project because of its portability and low power consumption.

3.8 System flowchart (Transmitter section)

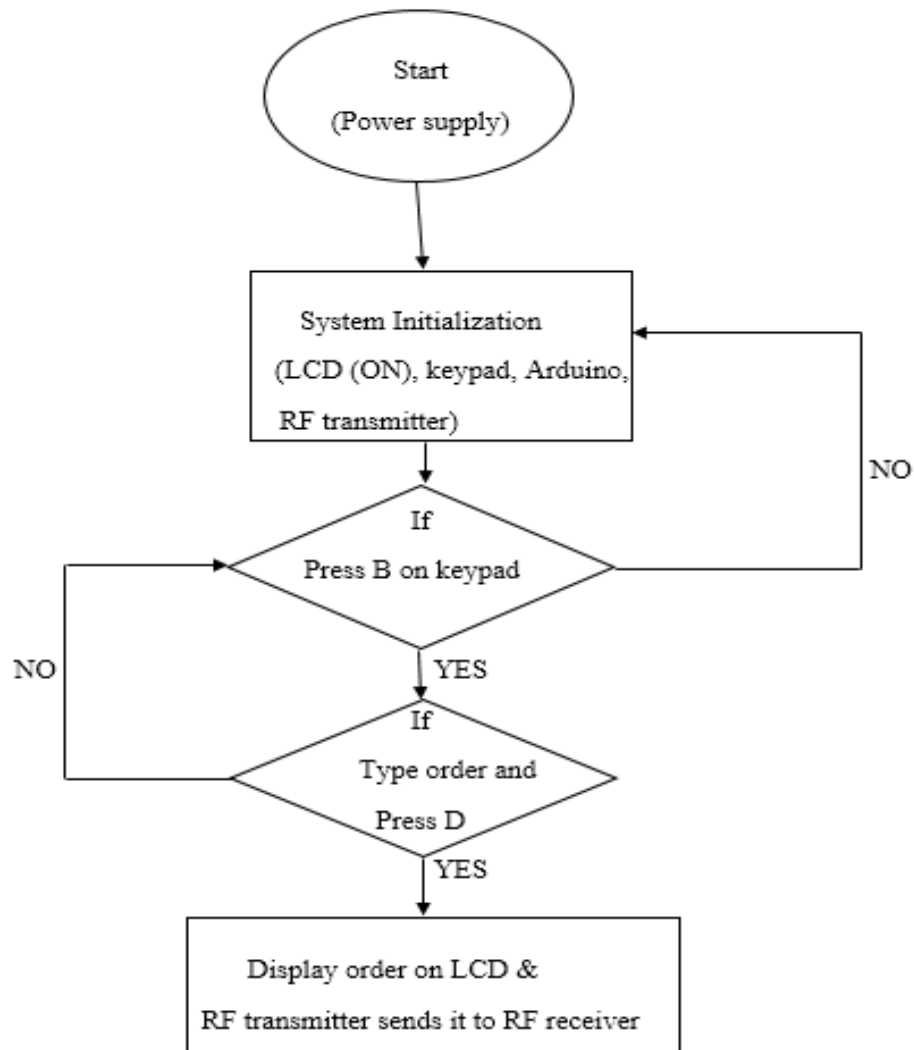


Figure 14 transmitter flow chart

- Once the power supply is ON, the components connected to the transmitter side will be powered hence system initialization. If a user/student presses key “B” on the keypad, he/she will be prompted to type order and press “D” to send the order to the receiver. If “B” is not pressed, no order will be made or sent.

3.9 System Flowchart (receiver section)

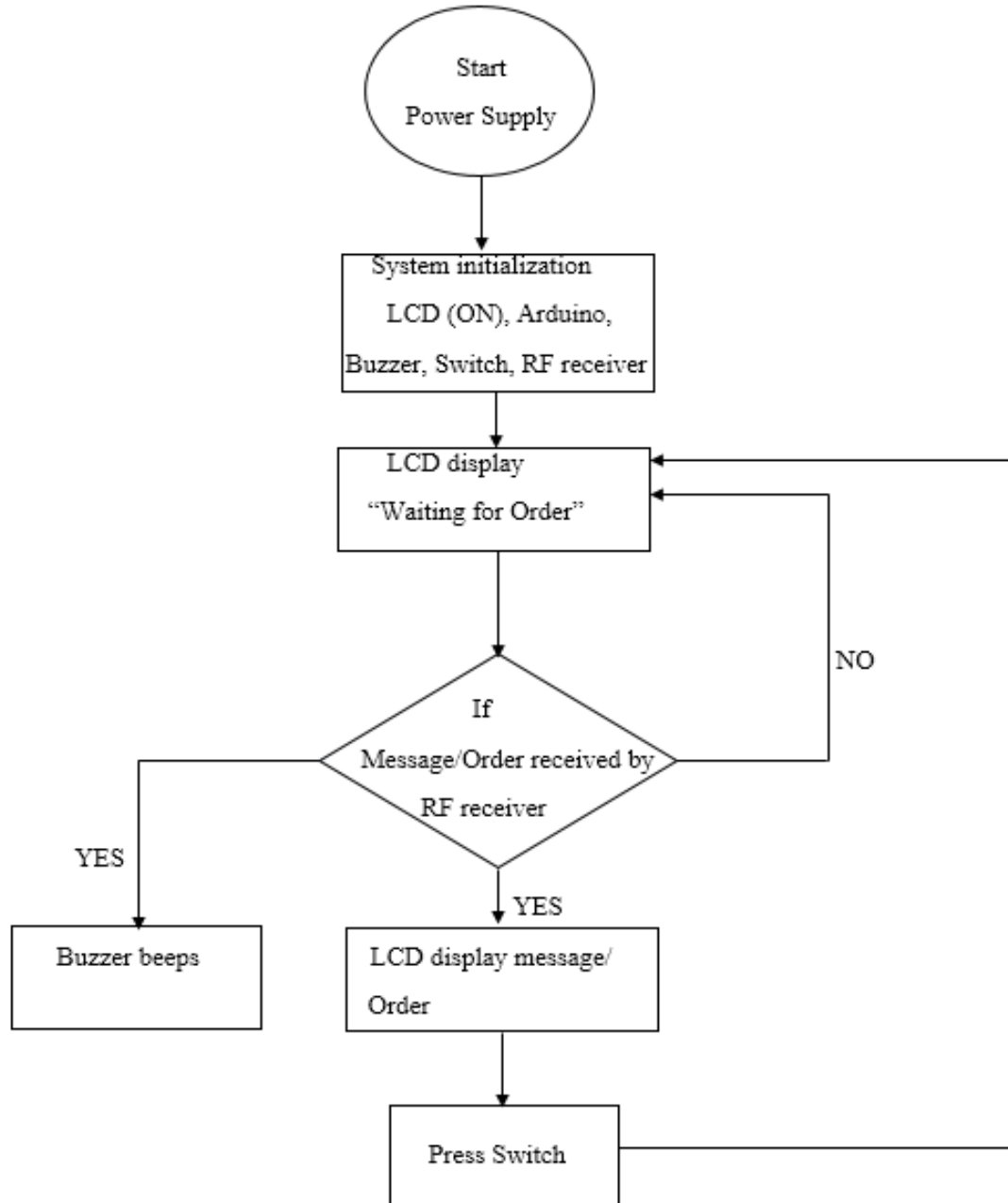


Figure 15 receiver flow chart

- When the power supply is ON, the components are powered, and the system initializes. The LCD will display “waiting for Order.” If the order is received, the LCD will display the order, and the buzzer will make a beeping sound. If a switch is pressed after reading the message/order, the LCD will again display “waiting for order.”

3.10 System construction and Database design

The database design takes the following steps;

- creating and managing MySQL database, i.e., creating a database and be able to update and view its contents

Procedure:

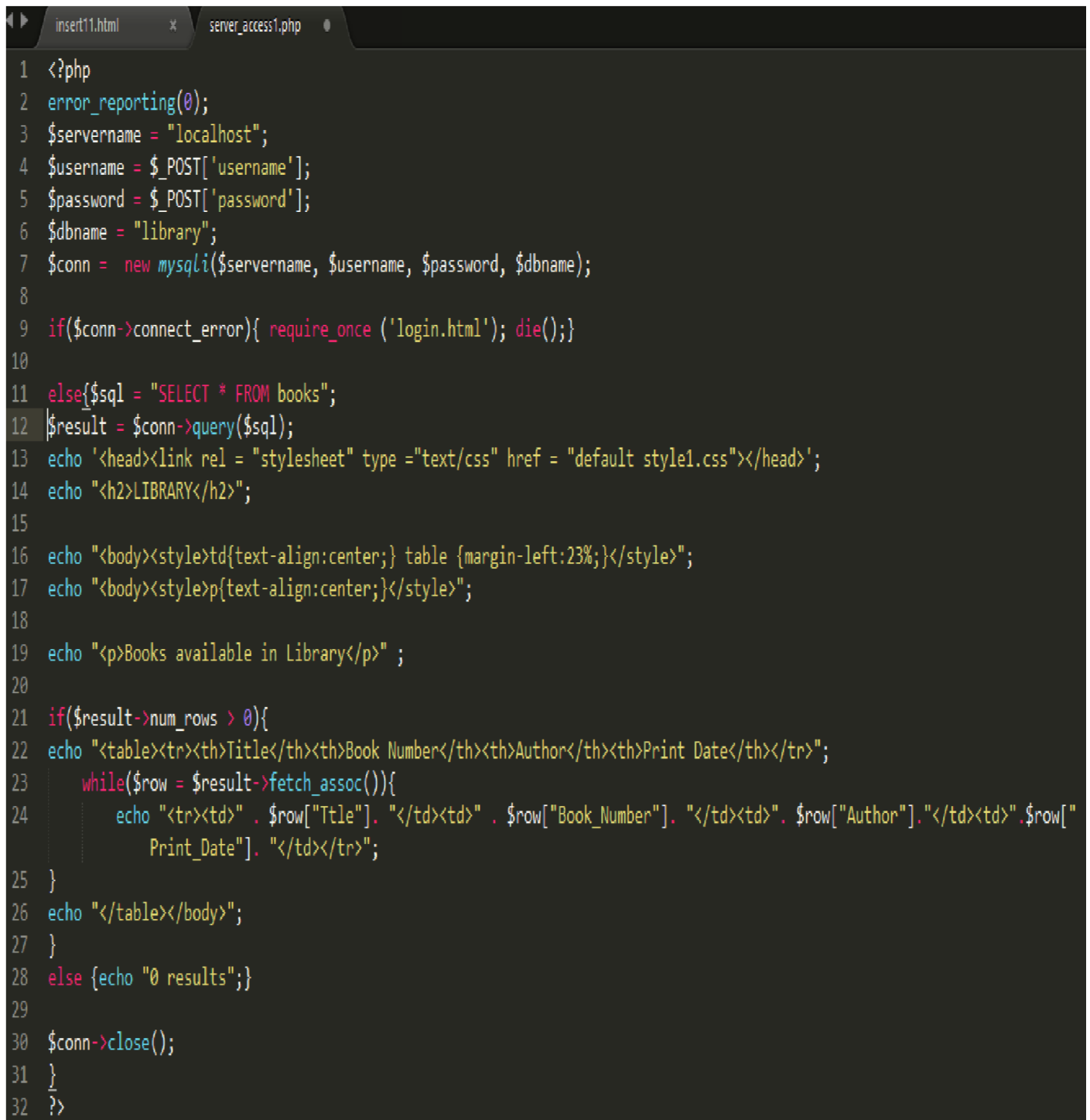
- The process started by creating a single HTML page to access the database and the source code is shown below.

```
1  <html>
2    <head>
3      <link rel="stylesheet" type="text/css" href="design/default
4        style.css">
5      <link rel="stylesheet" type="text/css" href="design/
6        gradientdesign.css">
7    </head>
8    <body>
9      <h2>ELECTRONIC ORDERING & LIB MGT SYSTEM - GUIDE</h2>
10     <ul id="grad">
11       <li><a class="active" href="#home">HOME</a></li>
12       <li><a class="active" href="server_access1.php" target="frame1
13         ">VIEW BOOKS</a></li>
14       <li><a class="active" href="insert11.html" target="frame1">
15         ADD RECORD</a></li>
16       <li class="right"><a class="blk" id="lastt" href="#about">ABOUT
17         </a></li>
18     </ul>
19     <br>
20     <iframe src = "design/frames/targetframe.html" name = "frame1"
21       style = "height: 700px; background-color: rgba(50,255,50,0.5);
22       border: 0.5px solid black"></iframe>
```

Figure 16 the homepage source code

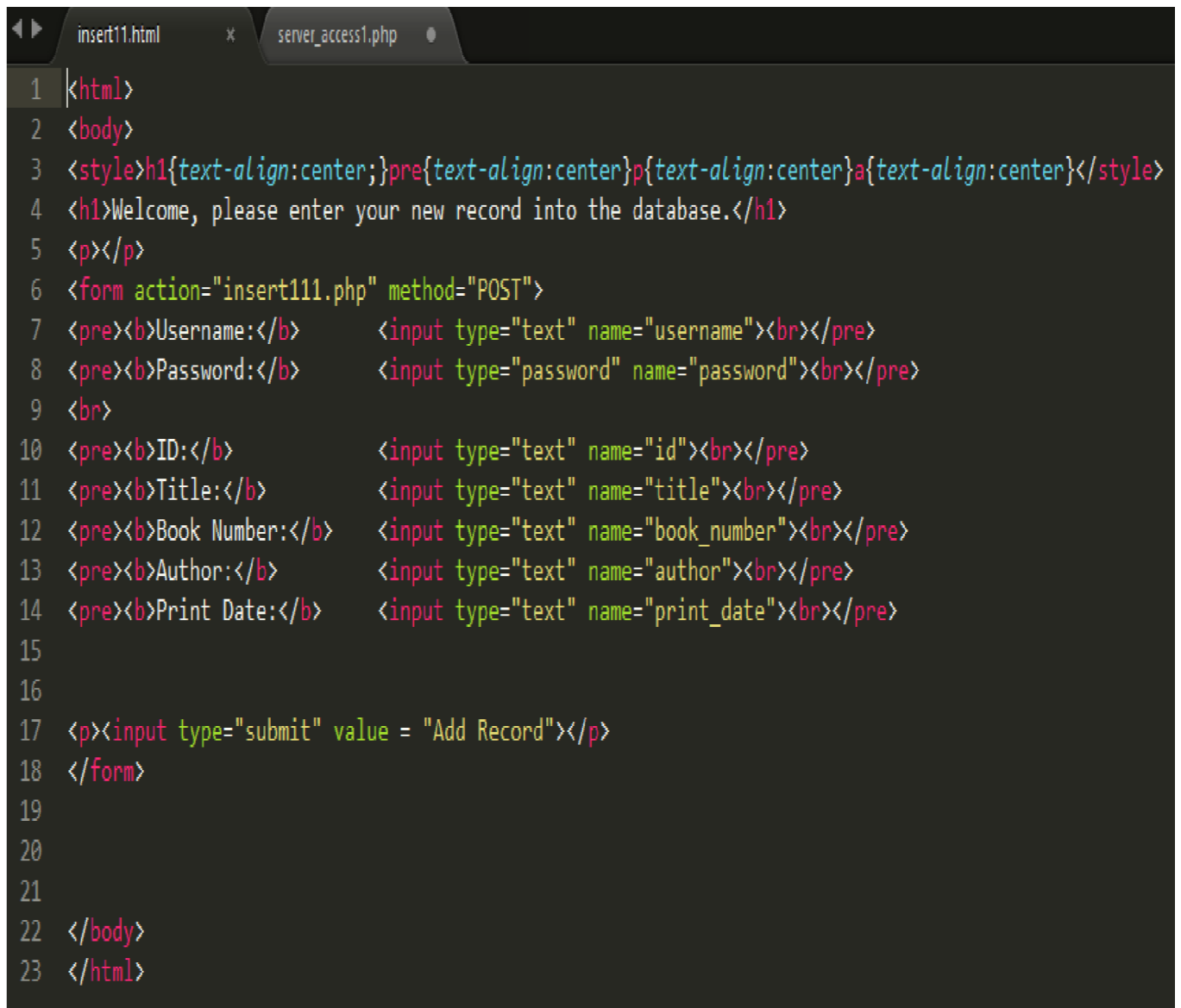
- Line 11 and 12 shows references to two files; the “server_access1.php” for viewing the table and the “insert11.html” for entering new records into the

database. The codes for the “server_access1.php” and “insert11.html” are shown below.



```
1 <?php
2 error_reporting(0);
3 $servername = "localhost";
4 $username = $_POST['username'];
5 $password = $_POST['password'];
6 $dbname = "library";
7 $conn = new mysqli($servername, $username, $password, $dbname);
8
9 if($conn->connect_error){ require_once ('login.html'); die();}
10
11 else{$sql = "SELECT * FROM books";
12 $result = $conn->query($sql);
13 echo '<head><link rel = "stylesheet" type = "text/css" href = "default style1.css"></head>';
14 echo "<h2>LIBRARY</h2>";
15
16 echo "<body><style>td{text-align:center;} table {margin-left:23%;}</style>";
17 echo "<body><style>p{text-align:center;}</style>";
18
19 echo "<p>Books available in Library</p>";
20
21 if($result->num_rows > 0){
22 echo "<table><tr><th>Title</th><th>Book Number</th><th>Author</th><th>Print Date</th></tr>";
23 while($row = $result->fetch_assoc()){
24 echo "<tr><td>" . $row["Title"]. "</td><td>" . $row["Book_Number"]. "</td><td>" . $row["Author"]. "</td><td>" . $row["
    Print_Date"]. "</td></tr>";
25 }
26 echo "</table></body>";
27 }
28 else {echo "0 results";}
29
30 $conn->close();
31 }
32 ?>
```

Figure 17 server_access1.php file



```
1 <html>
2 <body>
3 <style>h1{text-align:center;}pre{text-align:center}p{text-align:center}a{text-align:center}</style>
4 <h1>Welcome, please enter your new record into the database.</h1>
5 <p></p>
6 <form action="insert111.php" method="POST">
7 <pre><b>Username:</b>      <input type="text" name="username"><br></pre>
8 <pre><b>Password:</b>      <input type="password" name="password"><br></pre>
9 <br>
10 <pre><b>ID:</b>              <input type="text" name="id"><br></pre>
11 <pre><b>Title:</b>          <input type="text" name="title"><br></pre>
12 <pre><b>Book Number:</b>    <input type="text" name="book_number"><br></pre>
13 <pre><b>Author:</b>         <input type="text" name="author"><br></pre>
14 <pre><b>Print Date:</b>     <input type="text" name="print_date"><br></pre>
15
16
17 <p><input type="submit" value = "Add Record"></p>
18 </form>
19
20
21
22 </body>
23 </html>
```

Figure 18 insert11.html file

- The “server_access1.php” creates a connection to the database and returns table while the “insert11.html” contains a form for entering records into another file “insert111.php” whose codes are shown below.

```

1 <?php
2 error_reporting(0);
3 $servername = "localhost";
4 $username = $_POST['username'];
5 $password = $_POST['password'];
6 $dbname = "library";
7
8     $id = $_POST['id'];
9     $title = $_POST['title'];
10    $book_number = $_POST['book_number'];
11    $author = $_POST['author'];
12    $print_date = $_POST['print_date'];
13
14    $conn = new mysqli($servername, $username, $password, $dbname);
15
16    if($conn->connect_error){require_once ('insert11.html'); die();}
17
18    $sql = "INSERT INTO books (Id, Title, Book_Number, Author, Print_Date) VALUES ('$id', '$title', '$book_number', '$author', '$
        print_date')";
19
20    if ($conn->query($sql) === TRUE) { echo "New record created successfully";}
21
22
23    else { echo "Error: " . $sql . "<br>" . $conn->error;}
24
25
26    header ("refresh:3 ; url = insert11.html");
27
28    $conn->close();
29
30    ?>
31

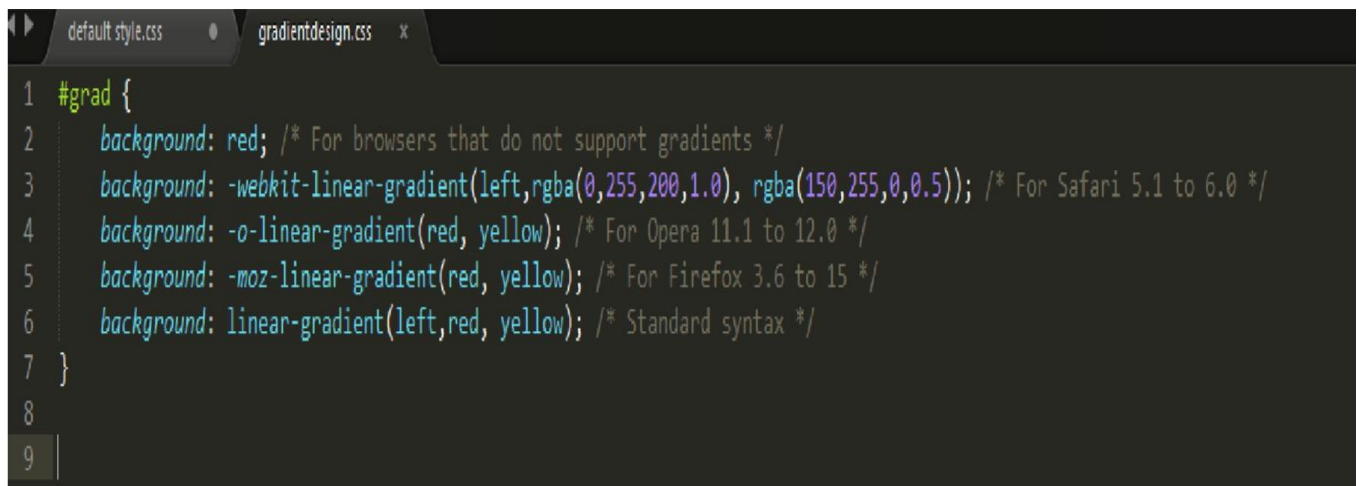
```

Figure 19 insert11.php file

- The code above receives the data entered in the HTML form “insert11.html”, creates a connection to the database and inserts the new record into the database. Line 26 of the code refreshes the page after three seconds to return the HTML form for another record to be entered.
- The homepage is linked to two CSS files (default style and gradient design) shown below responsible for the appearance of the page

```
default.style.css  gradientdesign.css  x
1 #image12{width:100%;height:400px;float:left;}
2 a{text-decoration:none;}
3 ul {list-style-type:none; margin:0;padding:0;overflow:hidden;}
4 li {float: left;border-right:1px solid grey;}
5 li:last-child {border-right: none;}
6 li a {display: block;color: white;text-align: center;padding: 14px 16px;text-decoration: none;}
7 li a:hover:not(.active) {background-color: #111;}
8 #lastt:hover:not(.active) {background-color: white;}
9 .active l{background-color: #4CAF50;}
10
11 li.rght{float:right;}
12 a.blk{color:black;}
13
14 body {background-color:rgb(255,255,255);}
15 h2,td{text-align:center;}
16 p{text-align:center; font-style:italic;}
17 table,th,td{border:1px solid black;border-collapse:collapse; font-style:italic;}
18 iframe{width:100%;height:500px;}
19 pre{text-decoration:none;color:#0000ff;text-align:center;}
20
21 table,td,th{border:1px solid green;padding: 10px}
22 th{background-color:green;}
23 tr.bc{background-color:rgb(200,200,200);}
24 img.gallery{width:110px;height:90px; opacity:0.5;}
25
26 pre.clr {clear:left;}
27 div.img {margin: 5px; padding: 5px; border: 1px solid #ffffff; height: auto; width: auto; float:left; text-align: center; }
28 div.tr11 {background-color:red; width:auto; height:auto;}
29 div.desc { text-align: center; font-weight: normal; width: 120px; margin: 5px;}
30
31 img:hover{opacity: 1.0;}
32 div:hover {background-color:rgb(230,230,230);}
33
```

Figure 20 default style.css file



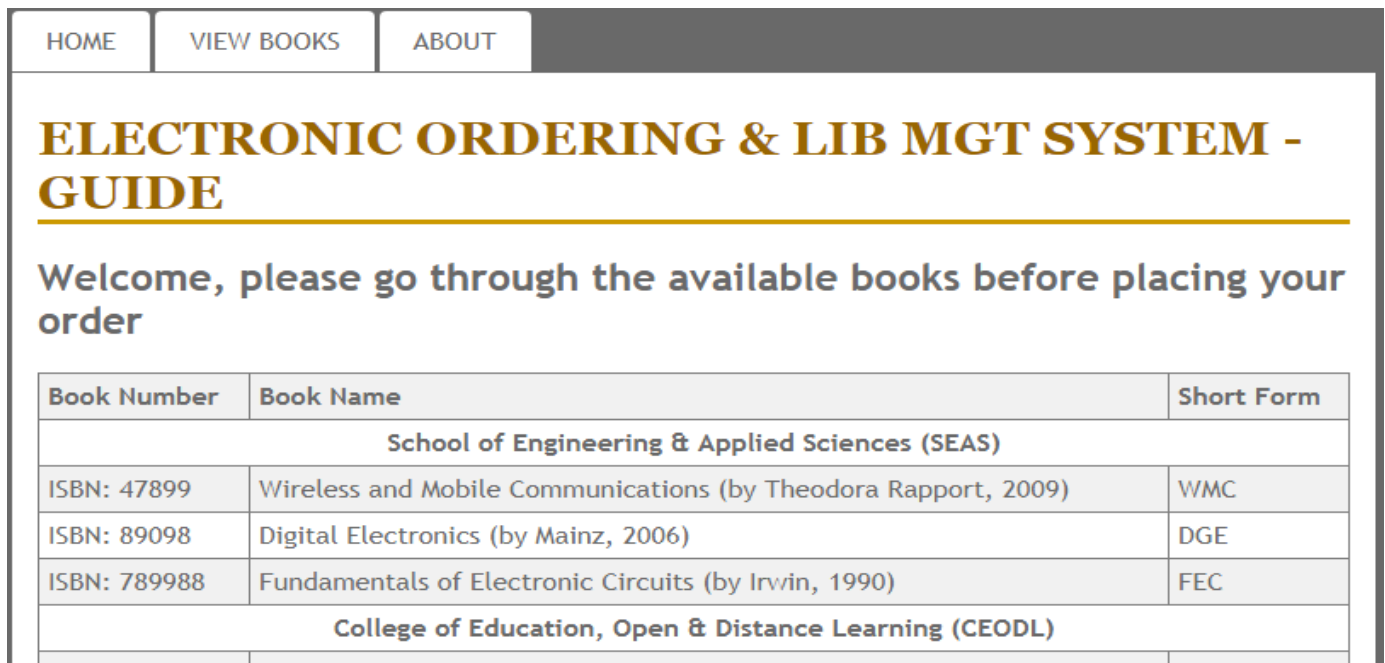
```

1 #grad {
2   background: red; /* For browsers that do not support gradients */
3   background: -webkit-linear-gradient(left, rgba(0,255,200,1.0), rgba(150,255,0,0.5)); /* For Safari 5.1 to 6.0 */
4   background: -o-linear-gradient(left, red, yellow); /* For Opera 11.1 to 12.0 */
5   background: -moz-linear-gradient(left, red, yellow); /* For Firefox 3.6 to 15 */
6   background: linear-gradient(left, red, yellow); /* Standard syntax */
7 }
8
9

```

Figure 21 gradientdesign.css file

Below is a review of available books in the library. This can be web viewed after coding from the sublime text.



Book Number	Book Name	Short Form
School of Engineering & Applied Sciences (SEAS)		
ISBN: 47899	Wireless and Mobile Communications (by Theodora Rapport, 2009)	WMC
ISBN: 89098	Digital Electronics (by Mainz, 2006)	DGE
ISBN: 789988	Fundamentals of Electronic Circuits (by Irwin, 1990)	FEC
College of Education, Open & Distance Learning (CEODL)		

Figure 22 shows a catalog of some available books in the library

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Introduction

As stated previously in the initial chapters, this project uses RF technology to communicate between the transmitting section and the receiving section. The transmitter section is used for placing an order to borrow a book. A microcontroller is fed with a code to control components being used in system build up. The Receiving section is used to receive the order. In this chapter, we shall discuss the process of the project buildup and the results. In this chapter, the results and discussion of the project are discussed.

4.1 Breadboard components assembling

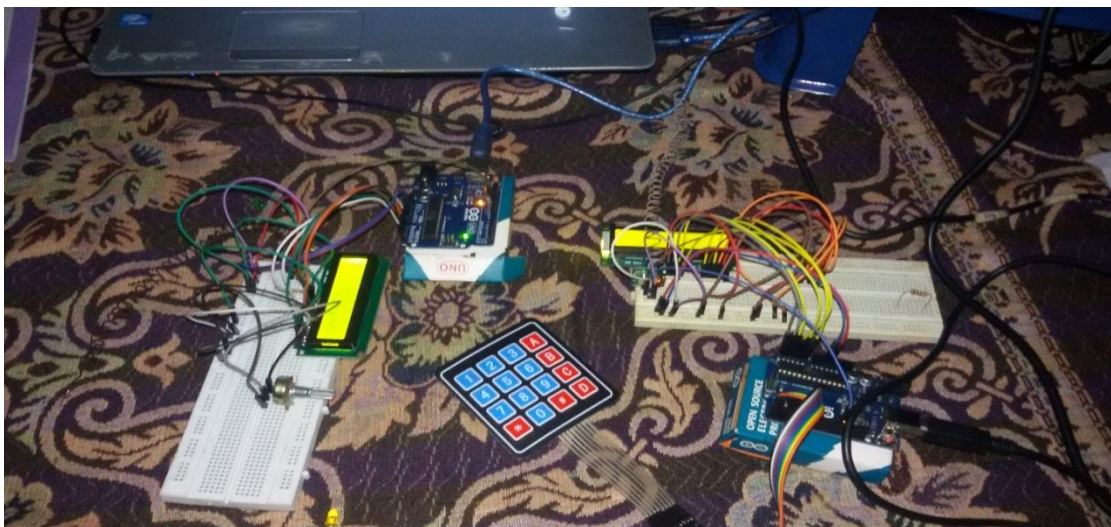
Here, all components are first assembled on the breadboard, and the concept of the project operation tested before finally transferring the components to a printed circuit board (PCB).



Figure 23 showing breadboard assembling of components

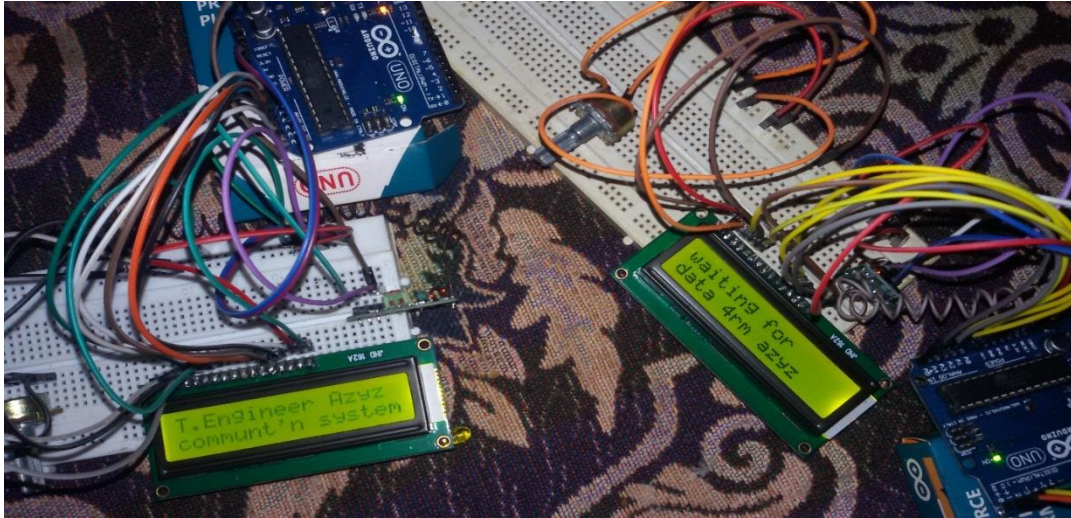
4.1.1 Breadboard results

The results were positive as all components performed their tasks as expected, right from the +5v power source tapped from the laptop with the aid of Arduino Uno power cable (USB), through the board to all other components (RF modules, Potentiometer, LCD, Keypad)



A

Figure 24 showing results after breadboard connection in A and B



B

4.2 software programming

Here, after the having positive feedback from breadboard circuit outline, it is important to come up with a suitable source code as per the project specific goals, hence the transmitter and receiver source codes are as seen below

4.2.1 Transmitter source code

```
#include <Keypad.h>
//simple Tx on pin D12
#include <VirtualWire.h>
#include <EEPROM.h>
#include <LiquidCrystal.h>
const byte ROWS = 4; //four rows
const byte COLS = 4; //four columns
String text_out = "";
boolean typing = false;
int k=0;
char keys[ROWS][COLS] =
{
  {'1', '2', '3', ' '},
  {'4', '5', '6', 'B'},
```



```

    {'7', '8', '9', 'C'},
    {'<', '0', '#', 'S'}
};
char chr[][5] =
{
    {'+', '-', '/', '0', 'x'},
    {':', '!', '?', '1', '!'},
    {'A', 'B', 'C', '2', '@'},
    {'D', 'E', 'F', '3', '#'},
    {'G', 'H', 'I', '4', '$'},
    {'J', 'K', 'L', '5', '%'},
    {'M', 'N', 'O', '6', '&'},
    {'P', 'Q', 'R', 'S', '7'},
    {'T', 'U', 'V', '8', '*'},
    {'W', 'X', 'Y', 'Z', '9'}
};
byte rowPins[ROWS] = {8,9,2,3}; //connect to the row pinouts of the keypad
byte colPins[COLS] = {4,5,6,7}; //connect to the column pinouts of the keypad
// initialize the library with the numbers of the interface pins
LiquidCrystal disp(A0,A1,A2,A3,A4,A5);
Keypad keypad = Keypad( makeKeymap(keys), rowPins, colPins, ROWS, COLS );
const int len=40;
const int startAdd=0;

void saveData(int index,String data)
{
    {
        EEPROM.write( startA+k,data.charAt(k));
    }
    EEPROM.write( startA+k,0);
}

```

```

String readData(int index)
{
    int startA = startAdd+(index*len);
    String dat = "";
    for(k=0;k<len;k++)
    {
        char ch = (char)EEPROM.read( startA+k );
        if(ch!=0){ dat = dat + ch; }
        else{ break; }
    }
    return dat;
}

String readCode()
{
    int k=1;
    String temp = "";
    char key = keypad.getKey();

    disp.clear(); disp.print("press any number");
    disp.setCursor(1,1); disp.print("then press 'D'");
    while( k!=0 )
    {
        if(key&&key!='A')
        {
            if(key=='B' || key=='C' || key=='#'){ }//keys reserved for other functions
            else if(key=='S'){ k=0; }
            else if(key=='<')//backspace key
            {
                //////////back space
                temp = temp.substring(0, temp.length()-1);
                //////////end of back space
            }
        }
    }
}

```

```

    }
    else
    {
        temp = temp+key;
    }
    delay(400);
    // lcdClearBottom();
    disp.clear(); disp.print(temp);
    }key = keypad.getKey();
}return temp;
}
void dispTitle(String title)
{
    title.toUpperCase();
    disp.setCursor(0, 0);
    disp.print( "          " );
    disp.setCursor(0, 0);
    disp.print( title );
    disp.setCursor(0, 1);
    disp.blink();
}
void initRF()
{
    vw_set_ptt_inverted(true); //
    vw_set_tx_pin(11); //pin where transmitter is connected
    vw_setup(2000); // speed of data transfer Kbps
}
void setup()
{
    initRF();
    disp.begin(16,2);

```

```

    delay(3000);
    disp.print("Aziz & Haruna's");

    disp.setCursor(0,1);
    disp.print("E.O.S TRANSMITER");
    delay(4000);
    disp.clear();
    disp.setCursor(5,0);
    disp.print("System");
    disp.setCursor(1,1);
    disp.print("initializing...");
    delay(4000);
    disp.clear();
    disp.setCursor(2,0);
    disp.print("System Ready");
    delay(5000);
    dispStart();
    //Serial.begin(19200);
}

void decodeButton(char code)
{
    short val = code - 48;
    if( val<10 and val>-1 )
    {
        short ind = 0, k = 5;
        while( k-- )
        {
            long crnt = millis();
            char key = keypad.getKey();
            while( (millis()-crnt)<400 && !key ) //while no key is pressed in 400ms
            {

```

```

        key = keypad.getKey();
    }
    //checkInput();
    if( key )
    {
        if(key!=code){ break; }
        else
        {
            ind++; if(ind==5){ ind=0; }
            //disp.print( chr[val][ind] );
        }
    }
    else{ break; }
}
code = chr[val][ind];
}
text_out = text_out + (char)code;
disp.clear(); disp.print(text_out);
}
void dispClearBottom()
{
    disp.setCursor(0, 2);
    disp.print( "          " );
    disp.setCursor(0, 2);
}
void dispStart()
{
    disp.begin(20, 4);
    disp.print("Book Order Menu");
    disp.setCursor(0,1);
    disp.print("*-CLEAR, A-SPACE");

```

```

delay(5000);
disp.clear();
disp.begin(20, 4);
disp.print("Book Order Menu");
disp.setCursor(0,1);
disp.print("B-ORDER, D-SEND");

delay(5000);
}
void instr()
{
dispClearBottom();
if(text_out=="")
{
disp.print("Type Msg, S");
}
else disp.print(text_out);
}
String readMSG()
{
String ret = "";
while( Serial.available() )
{
char ccc =Serial.read();

ret = ret + ccc;
}
ret.trim();

return ret;
}

```

```

void checkInput()
{
    String request = readMSG();
    if(request != "")
    {
        disp.clear(); disp.print("unknow request");
        int rqst = request.toInt();
        if( rqst< 25)
        {
            String response = readData(rqst);
            Serial.print(response);
        }
    }
}

void myLoop(int indd)
{
    while(true)
    {
        char key = keypad.getKey();
        while(!key)
        {
            key = keypad.getKey(); checkInput();
        } //wait for key to be pressed

        if(key=='S')
        {
            vw_send((uint8_t *)char_array, strlen(char_array));
            vw_wait_tx();    // We wait to finish sending the message
            delay(1000);    // We wait to send the message again
            //Serial.print(text_out);
            saveData(indd, text_out);
        }
    }
}

```

```

        //String temp = readData(indd);
        //Serial.print(temp);
        //dispClearBottom();
        disp.clear(); disp.print( "Order sent " );
        disp.setCursor(1,1); disp.print("successfully..."); delay(4000);
        text_out = "";
        break;//typing = false;
    }
    else if(key=='<')
    {
        text_out = text_out.substring(0, text_out.length()-1);
        disp.clear(); disp.print(text_out);
    }
    else if(key!='B' && key!='C' )
    {
        //typing = true;
        decodeButton(key);
        disp.clear(); disp.print(text_out);
    }
}
dispStart();
}

void loop()
{
    checkInput();
    char key = keypad.getKey();
    if(key=='B')
    {
        disp.clear(); disp.print( "type index" );
        int val = readCode().toInt();
        disp.clear(); disp.print("type Order then");
    }
}

```



```
disp.setCursor(1,1); disp.print("press'D'to send");  
  myLoop( val );  
}  
}
```

4.2.2 Receiver source code

```
#include <VirtualWire.h>  
#include <LiquidCrystal.h>  
LiquidCrystal lcd(A0,A1,A2,A3,A4,A5);  
int i;  
const int buzzer=12;  
const int sw=10;  
void setup()  
{  
  lcd.begin(16,2);  
  delay(3000);  
  lcd.print("Aziz & Haruna's");  
  lcd.setCursor(1,1);  
  lcd.print("E.O.S RECEIVER");  
  delay(4000);  
  lcd.clear();  
  lcd.setCursor(5,0);  
  lcd.print("System");  
  lcd.setCursor(1,1);  
  lcd.print("initializing...");  
}
```

```

    delay(4000);
    lcd.clear();
    lcd.setCursor(2,0);
    lcd.print("System Ready");
    delay(5000);
    inT();
    //vw_set_ptt_inverted(true); // Required by the RF module
    vw_setup(2000);           // bps connection speed
    vw_rx_start();           // Start the receiver
    vw_set_rx_pin(11);        // Arduino pin to connect the receiver data pin
    pinMode(12,OUTPUT);
    pinMode(10,INPUT);
}
void loop()
{
    int swVal;
    swVal=digitalRead(sw);
    uint8_t buf[VW_MAX_MESSAGE_LEN];
    uint8_t buflen = VW_MAX_MESSAGE_LEN;
    if (vw_get_message(buf, &buflen))    // We check if we have received data
    {
        lcd.clear();
        lcd.setCursor(0, 0);
        for (i = 0; i < buflen; i++)
        {
            lcd.write(buf[i]);
        }
        digitalWrite(12,HIGH);
        delay(2000);
        digitalWrite(12,LOW);
        delay(2000);
    }
}

```

```
}  
else if(swVal==HIGH){  
    inT();  
}  
else{  
}  
}  
void inT(){  
    lcd.clear();  
    lcd.print("WaitingForOrder:");  
}
```

4.3 soldering on printed circuit board (PCB)

This involves, placing components on a PCB and soldering them on with the aid of a soldering gun and lead. This makes a strong continuous outline of the circuit whereby all components are connected from point to point, from Vcc to ground and microcontroller connections.

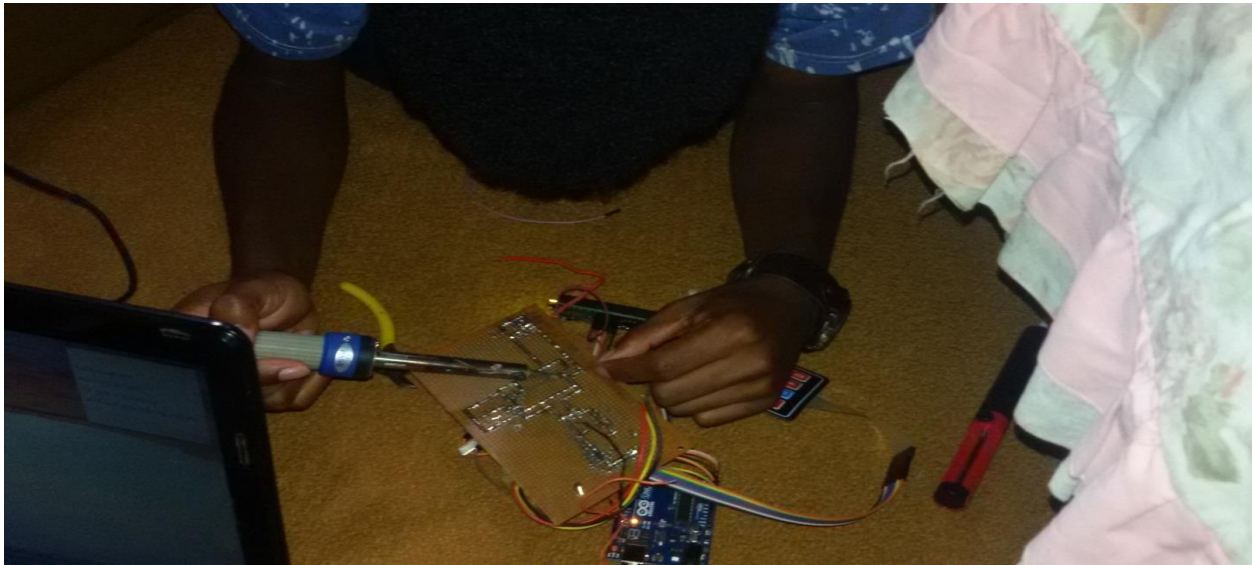


Figure 25 showing PCB circuit soldering

Precautions were taken while soldering

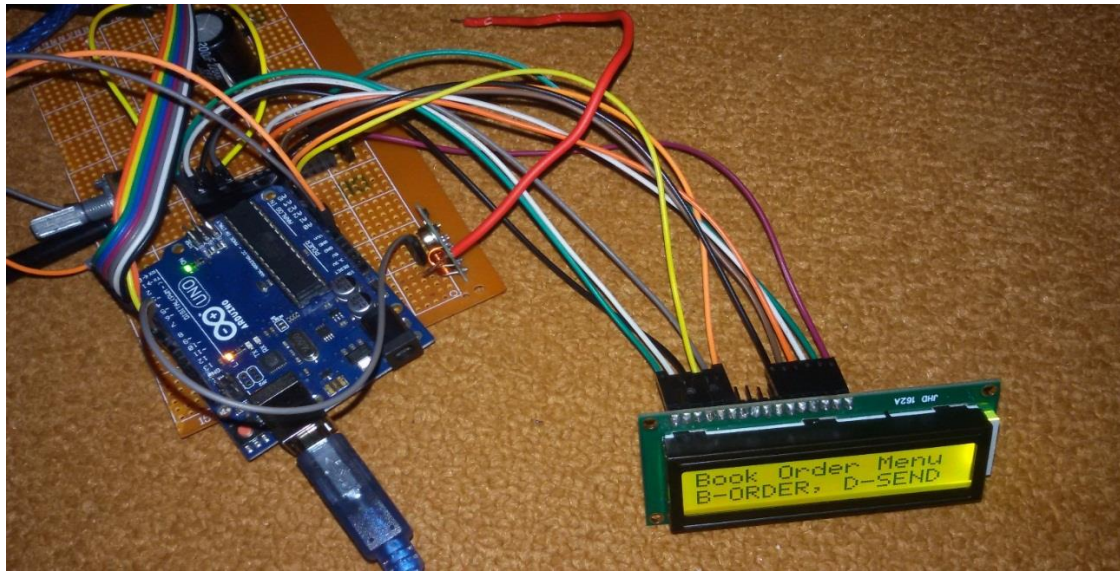
- Keeping the heated/hot soldering gun tip away from body contact.
- Placing the hot soldering gun on a stand to prevent it from burning surrounding stuff.
- Ensuring the gun doesn't burn the components as a result of overheating

4.3.1 Continuity testing

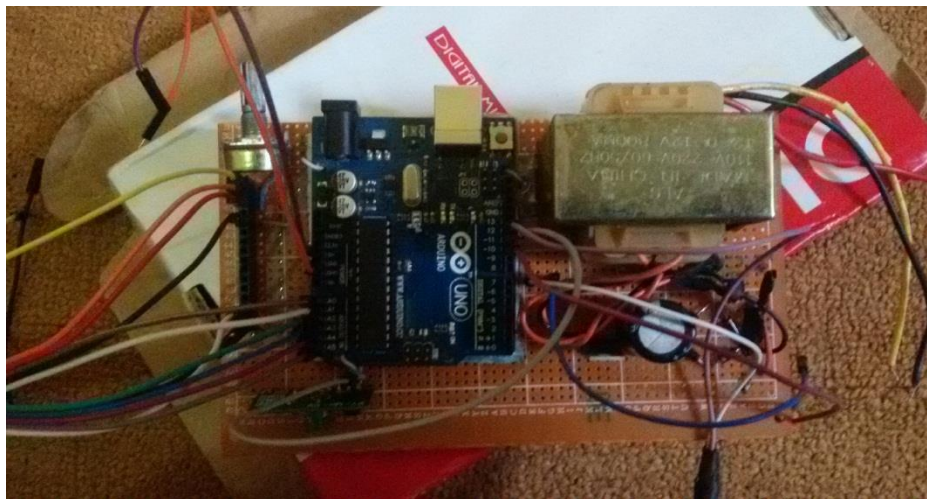
After soldering is done, the continuity test is crucial for testing whether a line is continuous from one point to another and also to ensure there are no short circuits as a result of continuity between Vcc and ground.

4.3.2 Results on PCB

A successful continuity test gives a go forward to power the circuit and hence all components successfully performed as anticipated and the figures A and B show the results after soldering on PCB and powering the device.



A



B

Figure 26 showing in A, LCD display results and B, the circuitry result after soldering

4.4 project/device packaging

This is the final stage, and it involves finding the best outlook of the device. It involves covering the circuitry part of the device and only exposing the crucial components that will be used by the user.



Figure 27 showing initial packaging stage



Figure 28 shows the transmitter & receiver devices after full packaging

CHAPTER FIVE

RECOMMENDATIONS, CONCLUSION AND FUTURE SCOPE OF WORK

5.0 Conclusions

In this project, a system which will help students to wirelessly send an order from the transmitter side to the receiver has been successfully made. The database guides students on what to order how to place the order. On the receiver side, the librarians read the contents from LCD and act accordingly, as well as using the database to maintain proper record keeping and management easily. This chapter includes the recommendations, future prospects, and conclusions deducted from the project. It also includes the references and Appendixes at the end of the report.

5.1 Recommendations

We recommend a more portable packaging method which will be easy to disassemble in case of any future device troubleshooting works or component replacement. Also, better antenna options should be considered for better wireless communication coverage.

5.2 Future scope

The following features can be added to this project design in the future.

- Transceiver modules for two way wireless communication
- Also, mouthpiece and speakers can be integrated to allow voice communication
- Enhancements so that the device is adopted across all other business entities.
- An inbuilt battery to offer more power supply options

REFERENCES

Circuits Gallery (October 2014). "Arduino and Proteus VSM"

David Kushner (2011-10-26). "The Making of Arduino." IEEE Spectrum

Eds. Siciliano, Bruno and Khatib, Oussama. Springer, (2008), "Handbook of robotics."

Edward, L. Bosworth, Ph.D. TSYS School of Computer Science Columbus State University Columbus, "Encoders and Decoders Details and Design Issues," August 13, 2010.

Hon. Aggrey Awori, National Electronic Government (e-Government) Framework, 2010 draft. <http://library.health.go.ug/publications/leadership-and-governance/policydocuments/national-electronic-government-e>.

IEEEExplore White Paper (May 2011) "Application of Proteus VSM in modeling brushless DC motor drives."

Ken Ruppel; Director Systems; Engineering; Proxim Corporation; "Radio Frequency (RF) and Radio Technology Fundamentals," December 10, 2002.

Leonardo Barboni, "low power CMOS RF amplifiers for Short Range wireless links" December 2005. Retrieved 2018- http://ie.fing.edu.uy/investigacion/grupos/microele/papers/tesis_lb.pdf

Kochtanek, Thomas R. (2002). "1 - The Evolution of LIS and Enabling Technologies". Library Information Systems: From Library Automation to Distributed Information Access Solutions. Westport, CT: Libraries Unlimited. p. 4. ISBN 1-59158-018-8

L. S. Corporation, 1553 Encoder/Decoder, April 2005.

Merriam-webster.com, "Database – Definition of the database by Merriam-Webster" Mybotic, <https://www.instructables.com/id/How-to-Interface-With-RF-Transmitter-andReceiver/> posted, 2016. Retrieved 2018.

Olson, N. (2010). Taken for Granted - The Construction of Order in the Process of Library Management System Decision Making (Vol. 45). Göteborg / Borås: Valfrid publishing.

Peleg Dan (2013), Mastering Sublime Text. Birmingham, UK: Packt Publishing. ISBN 978- 1-84969-842-9

P.LEACH, A. P. MALVINO and &. DONALD, Digital Principles, and Applications, 2011 edition.

P. Surekha, "Data Transmission concepts"

<https://www.globalspec.com/reference/67241/203279/chapter-8-data-transmissionconcepts>.

Sebastian R on Mon, 04/28/2014 - 00:08 <http://www.libremechanics.com/?q=node/31>
http://www.cytron.com.my/datasheet/WirelessDevice/RF_TX_User's_Manual.pdf

Smith, (c) 2018, W.A. "Differences between the Arduino Uno Revision 2 and Revision 3". Startingelectronics.org. Retrieved 20 February 2018.

S. Heath, Embedded systems design Newness (EDN series for design engineers (2 nd edition), 2003.

Wallace, Patricia M. (1991). Gary M. Pitkin, ed. Library Systems Migration: An Introduction. Westport, CT: Meckler. Pp. 1–7 [3]. ISBN 0-88736-738-0

<https://es.dhgate.com/product/new-3-24v-12v-95db-electronic-buzzer-beep/230545415.html>.

Retrieved 2018.

https://en.wikipedia.org/wiki/Proteus_Design_Suite

<https://www.arduino.cc> "Arduino - Introduction"

<https://www.instructables.com/id/Connecting-a-4-x-4-Membrane-Keypad-to-an-Arduino>

APPENDIX

APPENDIX A: Gantt chart showing the project timeline

Table 1 showing the project timeline

NO.	Activity/task	Period					
		2017	2018				
		Dec	Jan	Feb	Mar	Apr-Aug	Sept
1.	Title identification						
2.	Problem statement identification						

3.	Proposal writing						
4.	Proposal presentation and Gathering requirements						
5.	System design System implementation						
6.	Testing and validation						
7.	Report draft and approval, and Project presentation						
8.	Final report submission						

Appendix B: Project Budget

Table 2 showing project budget

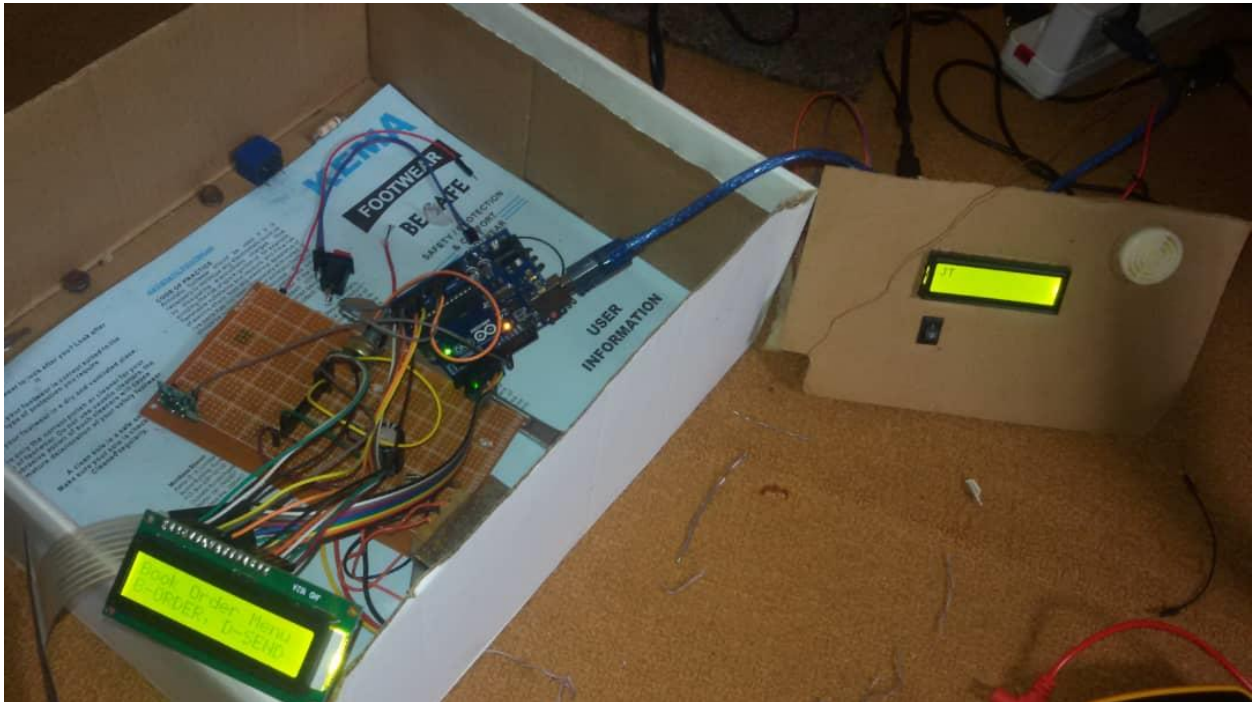
No	Item	Quantity	Price	Cost
1	Software tools	NA		100,000/=
2	Hardware (breadboard, microcontrollers, RF modules (transmitter and receiver), LCDs, Transformers, Capacitors keypads, Transistors, Voltage Regulators LM7805 PCBs, Jumpers (female and male), soldering lead, soldering iron, Digital Multimeter, lead Sucker and Packaging tools)	NA		850,000/=
3	Stationary			30,000/=
4	Airtime & Transport	NA	200,000	200,000/=

6	Printing and binding		35,000	35,000/=
7	Modem	1	80,000	80,000/=
8	Internet bundles			40,000/=
9	Miscellaneous		100,000	100,000/=
	Total			1,435,000/=

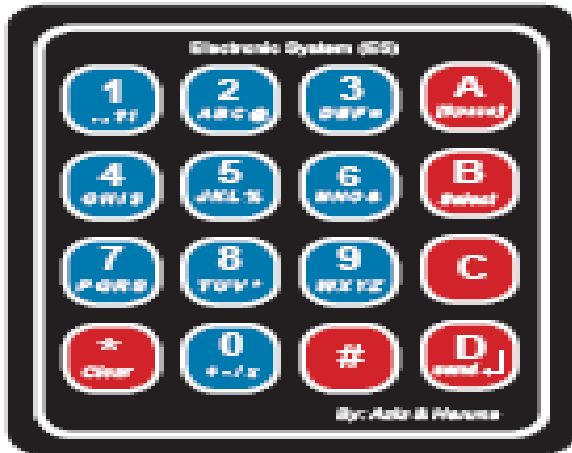
Appendix C: assembling components on PCB



Appendix D: working circuit on PCB



Appendix E: showing the keypad design model



Appendix F: showing final devices after packaging and ready to be presented to the public

