Smart Shopping Cart System

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Abstract— In commercial and metro city areas there is a huge rush at the shopping malls on the evenings of weekdays, holidays and on weekends. When there are more offers and discounts at that moments, this becomes even more than the other days. Normally the customers purchase to various items and put them into the trolley. After total purchasing, customers should enter to the bill counter for billing step. At that moment, the cashier prepares all the items by using a Barcode reader, and sets the last bill. This time consuming process make a long queue at the bill counter. The research team presents this research about a Technology based E-commerce system named Smart Shopping Cart System to achieve some goals like low-cost, overcome the long queue, and specially security of the transactions. Because Ecommerce become very popular while arriving of wireless technology as well as the other communication techniques and methods, and E-commerce has developed to provide day-to-day convenience, comfort and efficiency of all. So the research team propose to use radio-frequency identification (RFID) technology readers and tags for scanning the purchased items. Node MCU for connecting the Smart shopping cart with the database with the help of MQTT Protocol, and Arduino for programming the source code and connecting devices too. A small LED screen set to the cart for showing the prices and last amount of the relevant cart. In this research, using unique customer card is uniquely difference thing among the other already done researches or projects. Recharging the loyalty card, and paying activities are happening by RFID technology. In here, low cost, time saving, technology oriented, reducing the queue are the impacts of the study outcomes in this research.

Keywords— RFID reader, RFID tags, Node MCU, MQTT Protocol, Arduino

I. INTRODUCTION

Today's in Sri Lanka, there are lot of Shopping Malls and lot of people who lived in metro cities are purchase items in that Shopping Malls. There are no any suitable customer oriented system in any Shopping Malls. Normally the customer get a Cart and get items and put them into the cart and enter to the cashier and cashier takes the items one by one and show the item's barcode to the Barcode reader. After scanning the Barcode that system get the name of the item and price of it, then it adds to the bill. Then customer pay money in hand or through credit cards. This is way of doing nowadays in that Shopping Malls.

In that case the research team identifies some problems as follows. Customer has to wait until generating the bill. Cashier has to scan those purchase items one by one. Here is a lot of tine wasting. When it is a holiday or a weekend, there are huge rush in there. And no any solution for security like, if some customers take some items and exit from the Shopping Mall without paying, or by mistaking. There will be a loss to the Shopping Mall. Therefore the research team found some solutions for overcome these issues in a proper way.

This research is mainly consist of a Desktop Application. It is running on the cashier PC. Once the customers registered through a PC, Customers can recharge their loyalty card next time by login to the system simply.

In here the research team developed these functionalities such as Registering a new Customer, Login UI of a registered customer, recharging the Loyalty card, Redeem Cash, and check current amount.

When customers put the selected shopping items to the trolley, it updated the database of the Shopping mall and the purchased amount of the items taken by the customers. In here the research team developed these functionalities such as checking available stock, add update

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delete stock. And customers can pay the amount using any of payment method even the given loyalty card. In here the research team developed the function of POS system too. These are the covered and developed functionality areas of this application in this research.

The objectives are;
1. To identify and evaluate existing Smart Shopping Cart system.
2. To top up the loyalty card of registered customers.
3. To develop a Smart Shopping Cart that can identify the items using RFID, Node MCU, Arduino.
4. To calculate and display the total bill for the scanned items.
5. To display the list of items with the discounts. 6. To pay the future bill using the loyalty card.

II. LITERATURE REVIEW

There was a research named "Developing a Multitasking Shopping Trolley Based on RFID Technology". The authors of this research were Satish Kamble, Sachin Meshram, Rahul Thokal, Roshan Gakre. This research about the Shopping trolley which was used RFID technology. To design software interfaces the research team used VB.net, Embedded C languages. And this application compatible with only XP, Vista, Windows 7, Windows 8 Operating Systems. Used hardware were 80GB HDD, 1GB RAM, 3.1 GHz Processor. The benefits of this research are RFID card used as security access for product, calculated total amount of the items in the Trolley [1].

Another research called "The RFID Based Smart Shopping Cart". The authors of this research were Ms. Rupali Sawant, Kripa Krishnan, Shweta Bhokre, Priyanka Bhosale. This research developed to provide a technology oriented, reduced cost, time saving, hassle free, commercially oriented system for an enhanced shopping experience. This research used these technologies such as RFID (Radio Frequency Identification), Zigbee, Universal Product Code (UPC). These were the benefits of this research. Efficiency and productivity, can immediately identify products, no wasting time. The limitation of the proposed research group analyzed that most of the time customers had to face some difficulties in the queue for the cashier, high cost, as well as wasting time, and even this is a smart shopping cart system, the payments should handover to a certain cashier. So as a result of that there will be a queue and will cost time for each payments [2]

Another research called "RFID Based Smart Shopping and Billing". The authors of this research were Zeeshan Ali, Reena Sonkusare. This research team also integrated a RFID based shopping and billing system with the usage of Wireless ZigBee Module, Infra-Red (IR) transmitter and receiver, RFID tags, Microcontroller, Server database technological tools. The benefits and the specialty of this research were detecting the location dynamically, the shopping cart and server communication was made by the wireless ZigBee unit, Automatic billing, Inventory update of products purchased and billed Identifying items based on RFID tags and synchronizing with central database, Retrieval of relevant information based on the shopping cart location from server and display on the display unit. [3]

Next research named "Futuristic Trolley for Intelligent Billing with Amalgamation of RFID and ZIGBEE". The authors of this research were Varsha Jalkote, Alay Patel, Vijaya Gawande,manish Bharadia, Gitanjali R. Shinde, Aaradhana A Deshmukh. The research team observed that there are large queues at the billing counters of the supermarket. So they are trying to use RFID and ZigBee technology to overcome these issues. The benefits of this research are Labor Reduction, Enhanced Visibility, Reliability, and Security. The limitation of this research was this system cannot be used to keep the all sales track and item availability at the shopping malls [4].

Then the research "Smart Cart Using Wireless Sensor Networks". The authors of this research were Shwetha, Nikhil Gowda, Sneha, Pooja. This project team aims at developing a system that can be used in shopping malls to solve the long checkout queues. Consumers often face problems and inconvenience when shopping like insufficient information of the items, and wasting unnecessary time at the cashier. This system used RFID technology with ZigBee Module. Benefits of this research were cost efficient and requires less power. Limitation of this research was there was no security feature implemented in this system to avoid shop lifting [5]

The next research "Smart shopping cart with automatic billing system through RFID and Zigbee". The authors of this research were Hingham Chiang, Wan-ting You, Shuhsuan Lin, Wei-chih Shih, Yu-te Liao, Jin-Shyan Lee, And Yen-lin Chen. This research team also integrated a RFID based shopping and billing system with the usage of RFID reader and tags, face recognition with GPS technological tools. Advantages of this system were this shopping cart provides the customer with several options such as product searching, map, information, and automated billing. And the system could recognize the customer by face recognize and further provide the associated assistive shopping information based on the purchase history. Limitation was that customer cannot change, and their logging information. [6] The research named "A Review of Smart Shopping Systems". The author of this research were Sagar Sojitra, Rahul G. Patel. This research also about the automated Smart shopping cart. The used technologies were IoT, RFID, NFC. Used hardware were RFID readers and tags, trolley, LCD screen, etc. The advantages of this system were no long queue at the billing, cost was so low, no wasted time for any activity done at the shopping mall [7].

TABLE I RESEARCH GAP

Existing Literature	Limitations	Solutions
Cashier need to read the barcode item one by one	Wasting time	Using RFID Technology to scan and fix the data
Barcode must be visible on the surface of product	High cost	RFID can be placed inside the product
Short reading distance	Inappropriate technology	Long reading distance
Long queue at the bill counter	No efficiency or suitable technology	No queue at the bill counter
Mistakes and loss of payments	No proper security	Accuracy of payments
Hand operated invoice	No suitable technology	Instinctive invoice
Only one single product identification at a time	Time wasting	Allows several products identification at a time
Customer has no chance to see the last amount before billing	No proper technology	Customer can see the updated last amount before the billing
Cashier takes time to settle the bill	Time wasting	Cashier can easy to settle the bill
Generating bills on a sheet	No proper technology	Bill is send to the mobile phone

III. METHODOLOGY

If The Iterative Waterfall model does not attempt to complete the full specification. Instead, the development of software will only begin with the development and implementation, it can be reconsidered for further identification. This process again creates a new version of the software for each cycle of the sample when we work iteratively we create rough product or product piece in one iteration, then review it and improve it in next iteration and so on until it's finished.

A. Planning

During the planning phase, first of all the research team identified how can the required system develop as required? The research team have done the feasibility study then found were the requirements available or easily find or collect. And also estimation of the cost, technological limitations, techniques, knowledge areas too. Should defined can the research develop practically as well? The research team observed and collect data for 8 months and made Gantt chart with Work Distribution Structure according the proposed System.

B. Analysis

The research team collected data from 2 of modes. Primary data gathering and secondary data gathering were the used angles of collected data from the sources. Then the research team decided to take 20 people of sample size. In here the research team used judgment sampling as sampling method. As the mode of primary data gathered, the research team gave Questionnaires to the 20 people of sample for collecting data and did the face to face Interviews accidently met in the Shopping Malls.

As the mode of secondary data gathered, used and analyzed more than 16 existing related research reports and collected important information.

C. Design

Design of system is described on Fig. 1.
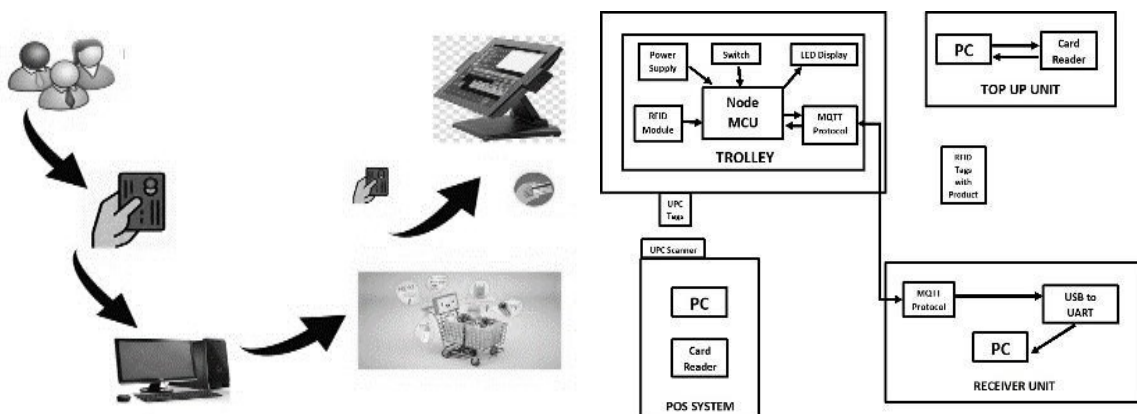
Fig. 1 System architecture diagram and Circuit diagram

D. Implementation

During the Implementation Phase, the system/application was moved from development status to production status. The process of implementation was dependent on the characteristics of the research, and thus may be synonymous with installation, deployment, and rollout. If necessary, data conversion, phased implementation, and training for using, operating, and maintaining the system are accomplished during the Implementation Phase. From a system security perspective, the final system must be certified and accredited for use in the production environment during the Implementation Phase. The Implementation Phase ends with a formal decision to release the final output into the Operations and Maintenance Phase:
- Develop the application of Top up Unit.
- Program the POS system.
- Develop the database.
- Integrated the device.
- Connect the database with the Top up Unit and POS system

E. Testing

The research team have done the testing part as the unit testing and the integration testing. Three members test each component one by one separately. It's called the unit/component testing. After that the application were integrated. Finally gather all the components one by one and test the system for errors and bugs.

Unit testing

The research team used unit testing method to test different parts in the system separately. Each unit is tested separately in order to check if the functionalities are working or not.

Integrated testing

Once the unit test was completed successfully, all the components integrated together as a complete system and test the whole function. This method tested all the functionalities in are working properly by communicating with each other.

IV. RESULTS AND DISCUSION

The research team identified that the reliability of this Smart Shopping Cart System was nearly 90%. When observed why that result of reliability was occurred, team could identified some of problems. Operating systems of each computer were not compatible, installed software was not compatible with each computer, when integration of all the application parts of the team in one computer, not connected accuracy level, when connecting the devices together those were not working properly were the few of problems that the research team had to faced. Due to those problems the research team found some solutions like upgrade the operating systems to one version and the relevant software too. Removed the incompatible device parts and replace the suitable devices each together. As an example the team suggested to connect the database using ZigBee module, but that module was incompatible with the whole device, therefore the team used Node MCU device instead of ZigBee module. This is the small background description of this research.

A. Result

On Figure 2 a is the first main interface of POS System. By clicking to the buttons simply transfer to the related layout. This application integrated on the Cashier PC. This interface was about available stock at the database. By searching the Item Name, it gave the current updated information of the relevant item.
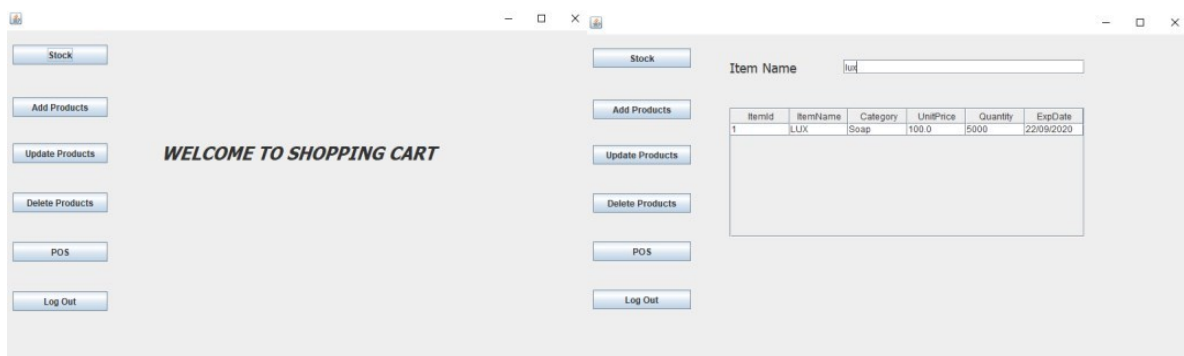

Fig. 2 Interface of Welcome and Interface of Stock

On Figure 3 is interface about adding new items to the database. There had an auto increment id and item name, category type, unit price, new quantity and the expiry date details. Then the

newly added item data saved in the database. Tested few of times and got the result as added new Item to the database. This interface used to edit and update the current item in the database. When some items were added to the stock, then the current quantity should be updated with the new details. And may be price changes can occur. Due to these reasons stock should update with new information.
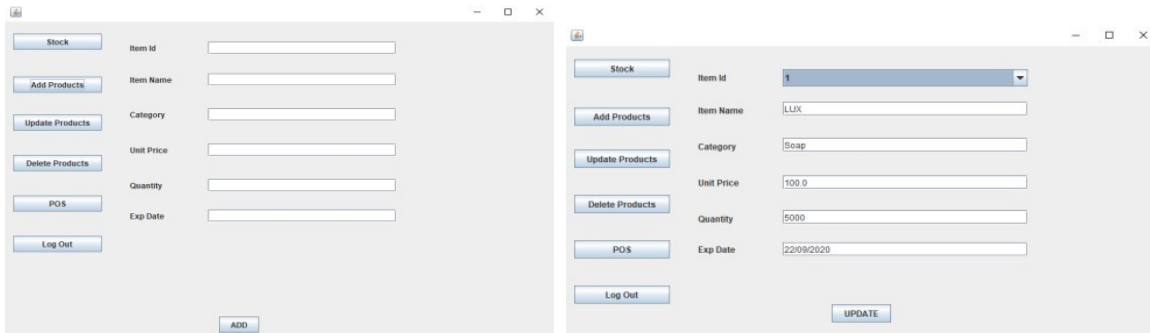

Fig. 3 Interface of Add New Item and Interface of Update Items

On Figure 4 is interface used to delete the items in the database. When some items are out of date, or any inconvenience reason items should be removed from the database. Tested few of times and got the result as removed the relevant Item from the database. This interface used to pay the amount which the Smart trolley mentioned. According to the result, it showed the purchased items too.
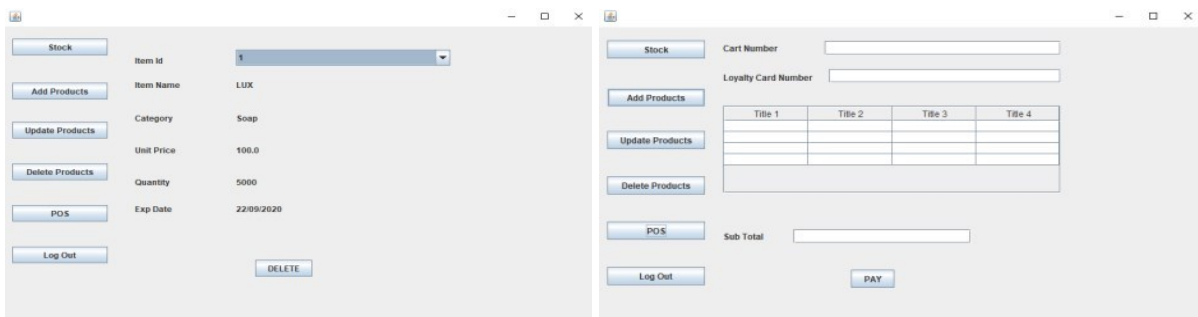
Fig. 4 Interface of Delete Item and Interface of Payment (POS)

On Figure 5 is interface was the first main interface of around the Loyalty card. By clicking these buttons, simply transferred to the relevant interfaces too.
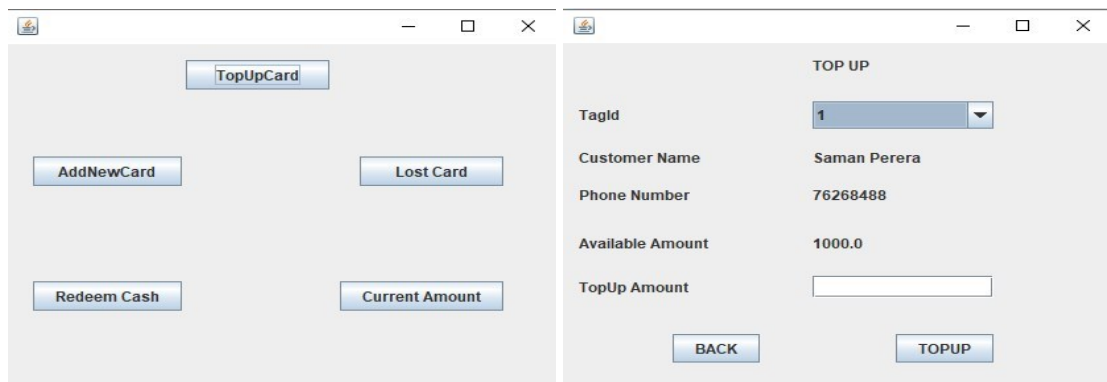
Fig. 5 Interface of Loyality Card and Interface of Top Up

On Figure 6 is interface used to recharge the loyalty card. In here selecting the unique Tag Id, can check the available balance with the relevant customer details. Customer can top up the

loyalty card by adding any of amount. This interface used to register a new customer with the System. All the details saved in the database for next steps. Tested few of times and got the result as added new customer with a loyalty card to the database.
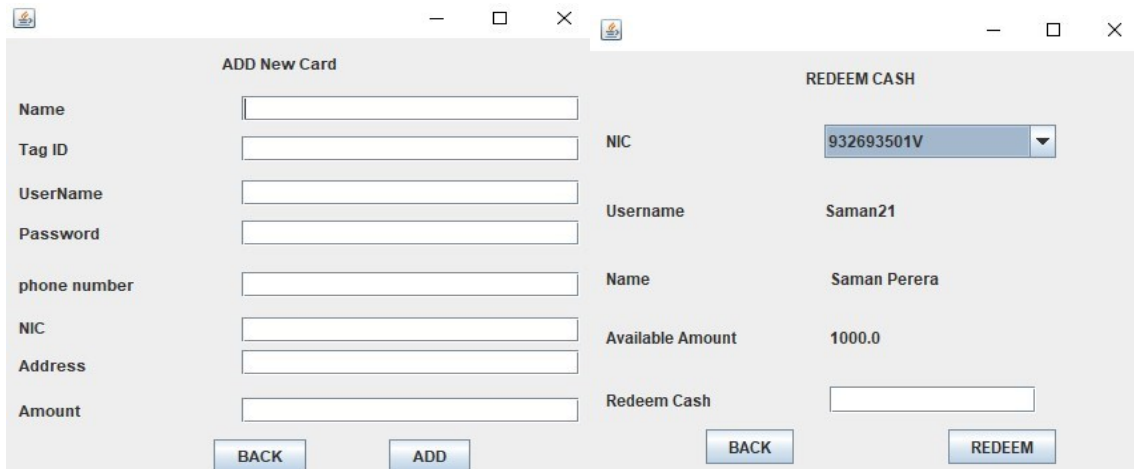

Fig. 6 Interface of Add new Card and Interface of Redeem Cash

On Figure 7 is interface used to withdraw the available cash if the customer request. Full amount of cash balance can be withdraw as customer wish. This interface used to check the information of the registered customers and their balance of the Loyalty Card.
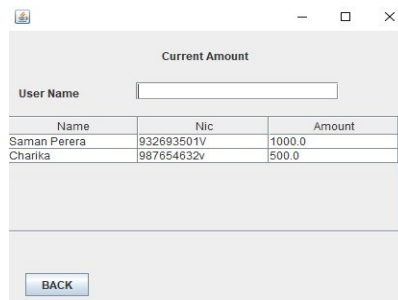
Fig. 7 Interface of Current Amount

If the RFID tag of the product set with the RFID reader then, price of the product and the total displayed in the LCD screen as Figure 8. Some selected items have discounts. When paying the total bill, system reduced the discount price from the relevant item
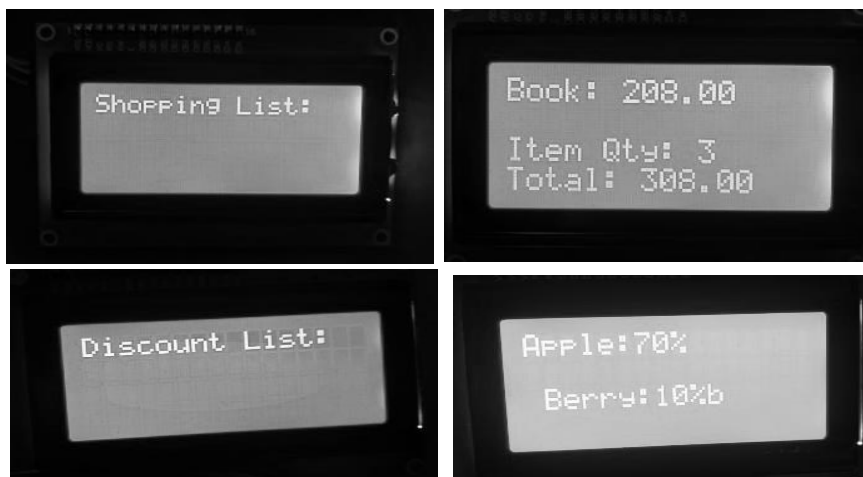
Fig. 8 Interface of LCD Screen

V. CONCLUTION AND FUTURE WORKS

This is the end of the research. Through this system the customers can save the time by not being on the billing queue, cost was low, and the customers can involve with new technology oriented system. Those are the benefits that the customers and the staff can get through this system. This system is most suitable for the Shopping malls, Supermarkets more. Because most of the workers deal with malls at the evenings and weekends because of their busyness. All the people like to save the time with quick service. Therefore this system is more suitable for these shopping malls:

- When there are lot of shopping carts at the Shopping mall, the cashier pc should identify the correct Shopping cart which one is reached there. Therefore, can set a scanning item like Barcode.
- Introduce this new system to the whole local market too.

A. Future Work

1. Proposed system currently doesn't have a sensor to weigh the weight of items, which are not factorypackages (e.g. Rice, Flour, Dahl, Onions, and Vegetables). Therefore this system could extend to measure the weight of such items
2. Install much larger and convenient display to the cart instead of the existing small display.
3. Install a payment device to the cart to increase efficiency and make customers pay easily by swapping a debit or debit card
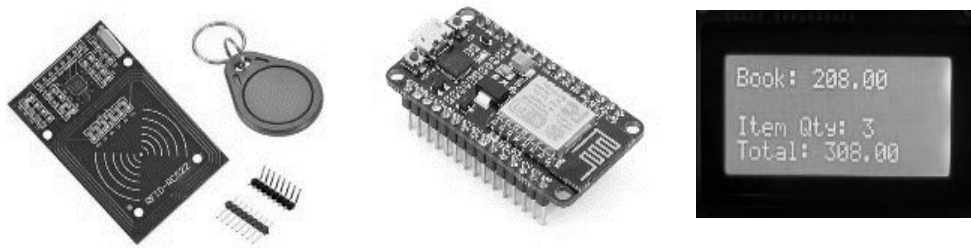

Fig. 9 Used Technologies Hardware

Fig. 10 Used Technologies Software

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