

IoT based Smart Shopping Cart

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ABSTRACT

A huge crowd in the supermarket at the time of discount offers or weekends makes trouble to wait in long queues because of a barcode-based billing process. It will introduce An automated smart shopping system is formed by introducing the concept of IoT to connect all items in the grocery shop. In the world of Internet of Things (IoT), interactions among physical objects have become a reality. Day to day items would now be able to be outfitted with computing power and communication functionalities, permitting objects everywhere to be associated with one another. This has brought a new revolution in industrial, financial and environmental systems and triggered great challenges in data management, wireless communications and real-time decision making.

Also, numerous security and protection issues have risen and lightweight cryptographic techniques are in high demand to fit in with IoT applications. There has been a lot of IoT experimentation on various applications such as smart homes, e-health frameworks, wearable gadgets, and so on. IoT is directly or indirectly tightly coupling of communication network and sensor network where the data management and data processing achieved by monitoring these processes intelligently. Using RF tag and ESP8266 Wi-Fi module one can achieve IoT based product, using ESP8266 module it is possible to interact with the web server using http or ftp protocol.

Designed system is using the http get method to send and receive the data from web server. Web server will be loaded with MySQL database to store user and cart information, using RF ID scanner system will send get request to the web server to check for valid user information and valid product information. Server uses active php pages to receive the information from ESP8266 module and to get connected with MySQL data base, if it found the valid information then it will reply with pre-define message to the system, so that system can decode message and processed accordingly.

Keyword: - Smart Market, IoT Shopping Mart, ESP8266, Smart Cart, Wi-Fi.

1. PROBLEM DEFINITION

In existing system person is required to read barcode on product. Barcode must be visible on the surface of product. Line of sight required to a read barcode. The readability of barcodes can be impaired by dirt, moisture, abrasion, or packaging contours Short reading distance. Barcode does not have READ & WRITE capabilities. It will be painful for customer to handle trolley reader system as well as android mobile phone.

2. LITERATURE SURVEY

Mobeen Shahroz, Muhammad Faheem Mushtaq , Maqsood Ahmad, Saleem Ullah , Arif Mehmood , And Gyu Sang Choi [1], This paper deals with the solutions related to the Internet of Things (IoT) based Smart Shopping Cart is proposed which consists of Radio Frequency Identification (RFID) sensors, Arduino microcontroller, Bluetooth module, and Mobile application. RFID sensors depend on wireless communication. One part is the RFID tag attached to each product and the other is RFID reader that reads the product information efficiently. After this, each product information shows in the Mobile application. The customer easily manages the shopping list in Mobile application according to preferences. Then shopping information sends to the server wirelessly and automatically generates billing.

This experimental prototype is designed to eliminate time-consuming shopping process and quality of services issues. The proposed system can easily be implemented and tested at a commercial scale under the real scenario in the future. That is why the proposed model is more competitive as compared to others [1].

Hiba Sadia, Shubhansu Jee, Krishnendu Pal, Shikhar Singh, Mebansharai Marbaniang [2], In author proposed system automatically asks for a client based on RFID. In shopping malls or supermarkets, the merchandise are supplied with modern RFID tags rather than bar-codes. The different trolleys embrace the setup

which includes modern RFID reader, Infra-Red sensor, door with motor, relay, normal GSM module, LED, LCD, data input device and an electrical switch. Author concluded with RFID tags are additionally sturdier than the barcode that gets damaged this ensures the method of scanning simple and precise. Then the countersign authentication method aids in avoiding the banned usage of good cards and conjointly prevents knowledge sniffing. The door within the trolley car doesn't open till a product is scanned that doesn't permit to put a product within a trolley that is not scanned

Thakur Prerana, Shikha Ranjan and Prachi Kaushik[3], Presents possible exploits of RFID systems and some proposed solutions as well. RFID is the special type wireless card which has inbuilt the embedded chip along with loop antenna. The inbuilt embedded chip represents the 12 digit card no. RFID reader is the circuit which generates 125 KHz magnetic signal. This magnetic signal is transmitted by the loop antenna connected along with this circuit which is used to read the RFID card no. In this project RFID card is used as security access card. RFID reader is interfaced with microcontroller. Here the microcontroller is the flash type reprogrammable microcontroller in which we already programmed with card no. the microcontroller is interfaced with keypad.

Irene Cappiello Stefano Puglia Andrea Vitaletti [4] authors have presented a ubiquitous touch based remote grocery shopping process. This fits well with the advantages and characteristics of RFID as well as NFC. Design and implementation of prototype system software is proposed to test the process of customer's touch based approach. Evaluation of the process has been carried out in an initial study on a group of 5 customers, comprising of trained as well as non-trained computer users. The shopping was carried out with an NFC equipped mobile phone for various RFID tagged items. Average completion of time was estimated to be 40 seconds while the error rate was calculated to be quite low. Qualitative study disclosed that the percentage of users that considered the web-based approach to be more convenient was much higher than the other ones. The approach undertaken by the author was quite successful but following limitations has to be considered:

- Limitation 1: This research paper is mainly focused on comparison between web based shop-ping experience and in-house shopping experience
- Limitation 2: There is no any hardware model proposed in this paper, which can be in application. Based on the study in this paper, a working prototype needs to be designed. The benefits and percent-age acceptance rates of the technology have already been estimated to be far beyond the acceptance level. Hence, the next step will be practical implantation of the concept in working reality.

Dylan Hicks et. Al [5], in this paper, the authors have presented a feasibility study for incorporating smartness, in products or items found in retail stores. Internet of Things (IoT) technology will prove helpful for this by enabling these items to automatically register and update their location information in a retrieval system. This will allow the customers to search, map and locate the products on the store floor using their mobile phones. A freely accessible Android based mobile app named 'SmartArt' has been developed to demonstrate the promise of this preliminary work.

- Limitation 1: This paper provides brief view on how we can create map dictionary of product placed in the store. But does not provide any access to object or billing.
- Limitation 2: There is no any solution provided on how to read product localization using RFID. The research carried out in this paper will be helpful in developing a better application by adding personalized searching options feature to the proposed design.

Mr. P. Chandrasekar Ms.T. Sangeetha [6] main aim of the authors in this paper was to devise a system with automatic billing. This avoids the long queues in supermarkets and shopping malls. The use of Radio has been proposed in this work. This paper proposes a centralized, feasible and automated system for billing using RFID and ZigBee communication. This requires assigning an RFID tag to each and every product of super markets. This will enable its unique identification. Each shopping cart containing components like microcontroller, an RFID reader, EEPROM, LCD and ZigBee module, is designed with a Product Identification Device (PID). RFID reader enables reading product information associated with the product being purchased. Meanwhile, EEPROM stores the product information attached to it and the data is sent to Central System for billing via ZigBee module. Central system gets access to information like the cart and EEPROM data, thereby allowing easy calculation of payment amount. The following points were noted in this research paper:

- Limitation 1: In this paper I found out that microcontroller they are using does not support I2c protocol
- Limitation 2: Authors didn't specify that how they will access their database to read and write data. Apart from this, the system can be modified as per requirement to develop a complete working prototype.

Dashmir Istrefi, Betim Cico [7] present paper examined the idea of implementing additional security layer that will enable protecting NFC transactions. Also, idea for improving customer's online shopping experience has been proposed. The proposed solution will help to reduce the supply and demand side barriers, which provides added value, compared to the existing payment system. Customers would not replace the existing methods of making payments to any retail shop unless a quicker and more beneficial way is provided. That was the purpose of the paper to add value added services on top of the existing shopping experience with a model that merchants and customers would be interested in participating. Recent announcements and speculation regarding the increasing incorporation of near-field communications (NFC) support in mobile

phones suggests there will be more mechanisms and modes for making connections between the physical and digital worlds. As future work for the topic is planned to develop ticketing and couponing services as a value added service for special events and improvement of the Personal Assistant application. • Limitation: This system is applicable only for smart phone users. It does not incorporate any provision for NFC reader on the shopping cart, which serves as a better alternative.

Pascal Urien Selwyn Piramuthu [8] in the present paper, authors have considered the identification and communication technologies as well as their advances. RFID (Radio Frequency Identification), smart phones, real-time response, and automated checkout systems have been considered in devising an NFC equipped smart phone. LLCPS protocol has been used as an envelope in order to establish communication between the Smartphone and the NFC reader, A suite of authentication protocols i.e. SISO has been developed for secure processing of payment in a retail store. • This paper provide better light on secure transaction between two devices, which uses NFC for secure transaction. • LLCPS provide better security to authenticate transaction between to device which uses P2P protocol for communication

3. HARDWARE DETAILS OF DESIGNED SYSTEM

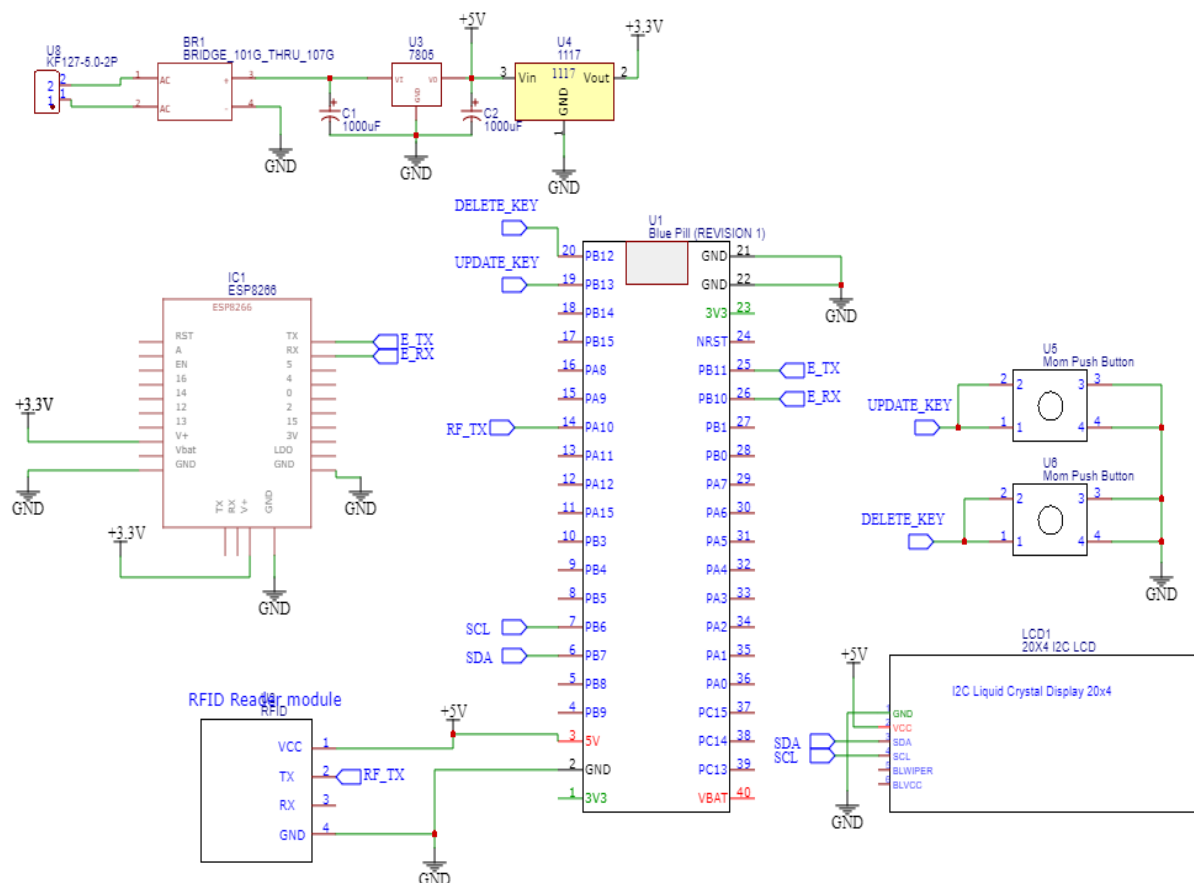


Figure-1: Circuit Diagram of System.

Figure-1 shows the circuit diagram of alternate developed system for Smart Shopping Cart, it is featured with LCD display to show user and cart information, like user name, items in cart, total price of cart, quantity of items added, etc. The display will be of 20x4 type LCD display that is 4 lines of 20 characters each. ESP8266 module will be used to communicate with host computer using Wi-Fi wireless technology.

The heart of whole system is Micro-Controller; have used STM32F103C8 from ST-microelectronics. Controller will be responsible for controlling Wi-Fi module and RFID reader. Controller reads RFID tag and sends data to server using ESP8266 to retrieve the user information as well as item information.

Here key pad will be used to do some important action on cart items, like adding similar items, deleting item, etc. In power supply section bridge is used to convert bi-polar AC signal to unidirectional signal, Capacitor C1, will act as filter to filter out AC signal that is rectified by bridge rectifier. As some part of system works of 3.3V LM1117 is used to convert 5V regulated by 7805 in to 3.3V.

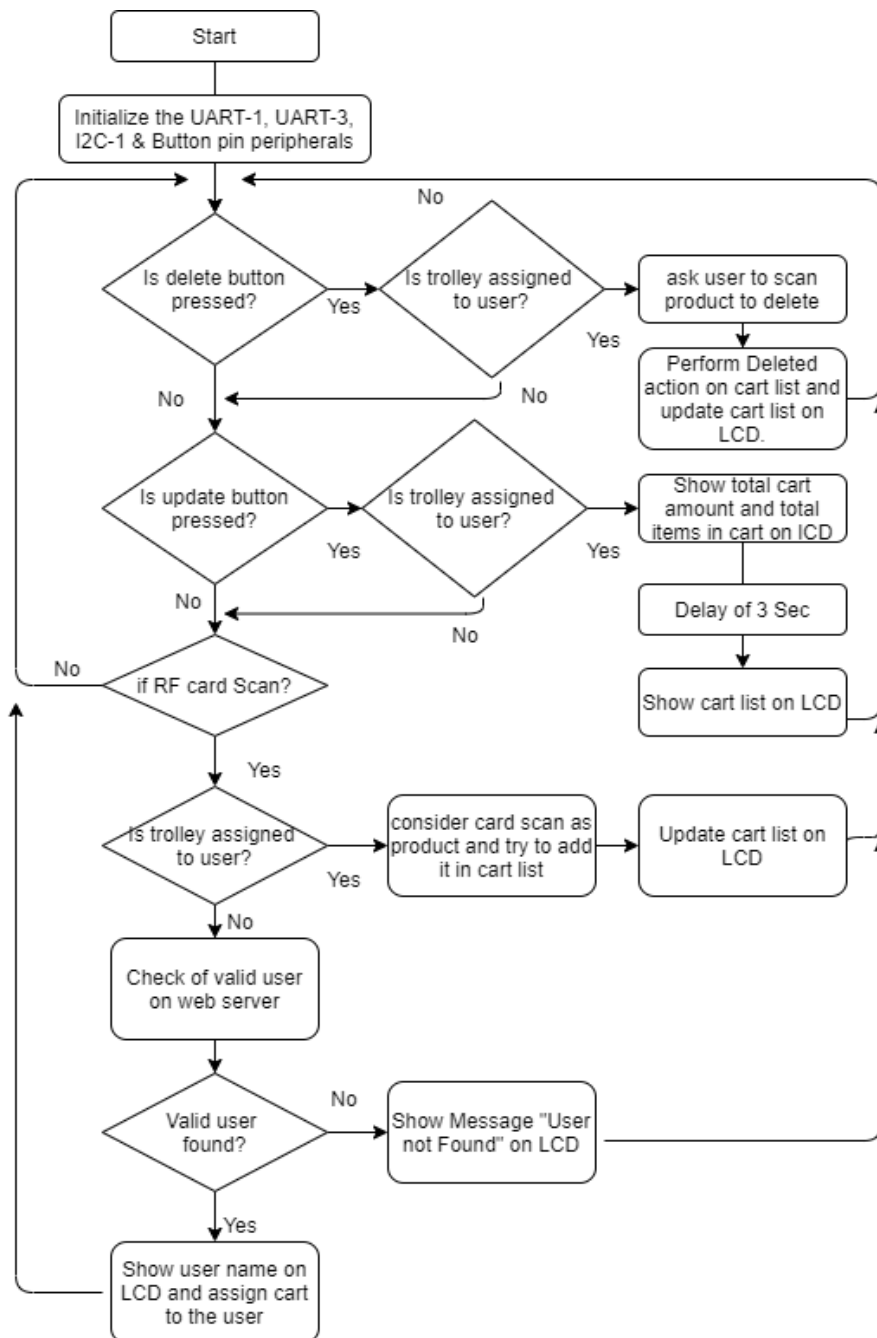


Figure-2: Flow Chart of System.

- 1) At very first step STM32F103 controller will initialize all the required peripherals at desired communication speed. Like UART-1, UART-3, I2C and general purpose input outputs.
- 2) After initializing all peripherals controller will keep waiting for RF tag scan of valid 12 digit string, if it found tag scan then it will first check that whether trolley is already assigned to user or not..
- 3) If trolley is not assigned to any user that means someone has just enter in shop and borrow a trolley, in that case system will try to find the scan tag in user table of cart database. It will call php page <http://localhost/cart/getuserinfo.php?rftag=270016FBA66C> here: 270016FBA66C is 12-digit string from RF reader.
- 4) If web server finds any associated user information to scanned tag, it will reply to get method forwarded by ESP8266 module with user name. And if there is no user associated with tag web server will send and User not found response to ESP get method.
- 5) Once system gets user name response from web server it will assign trolley to the user and list of unbilled items will be displayed on LCD display.
- 6) In between the process STM32F103 continuously scan for the key pressed.

- 7) If user pressed the delete key, then system will ask user to scan the product than need to be deleted and wait for product scan. It will call php page,
<http://localhost/cart/deletefromcart.php?usertag=270016FBA66C&itemtag=1000D3E9AA80>
 here, 270016FBA66C is user tag string and 1000D3E9AA80 is a product tag string that is to be deleted, this means that using above http get method we are deleting product with tag ID 1000D3E9AA80 from user cart list with tag ID 270016FBA66C
- 8) To come out from delete product scan infinite loop user should either scan the product to delete or should press the update button that will be treated as cancel current action.
- 9) When user scan product for deletion, system will forward get method request to web server with user tag that is already saved in system and product tag to be deleted.
- 10) It is also possible to get the total cart amount and total items in cart, for these purposed user need to press the update button
- 11) Upon pressing update button system will do an addition of all items price that is already loaded in array and calculate total cart value(amount). And using array of cart quantity array system will calculate number of items in cart.
- 12) After showing the total cart value and total item in cart system will keep that information up to 3 sec on LCD and again LCD will start showing item list.
 If user is already assign to the cart then system will consider new RF tag scan as product scan, like user trying to add some product in cart. In that case system will call php page.
<http://localhost/cart/addtocart.php?usertag=270016FBA66C&itemtag=1000D3E9AA80>
 here: product with tag ID 1000D3E9AA80 will get added to the user cart with tag ID 270016FBA66C

3.1 STM32F103 development board (bluepill):

The Blue Pill is a development board based on ST Microelectronics' STM32F103C9T6 microcontroller that has an ARM Cortex-M3 core that runs at 72MHz max. Software libraries are available that allow users to program the chip using the Arduino IDE.

The Blue Pill is a 32-bit Arduino compatible development board that features the STM32F103C8T6, a member of the STM32 family of ARM Cortex-M3 core microcontrollers. This board aims to bring the 32-bit ARM core microcontrollers to the hobbyist market with the Arduino style form factor.

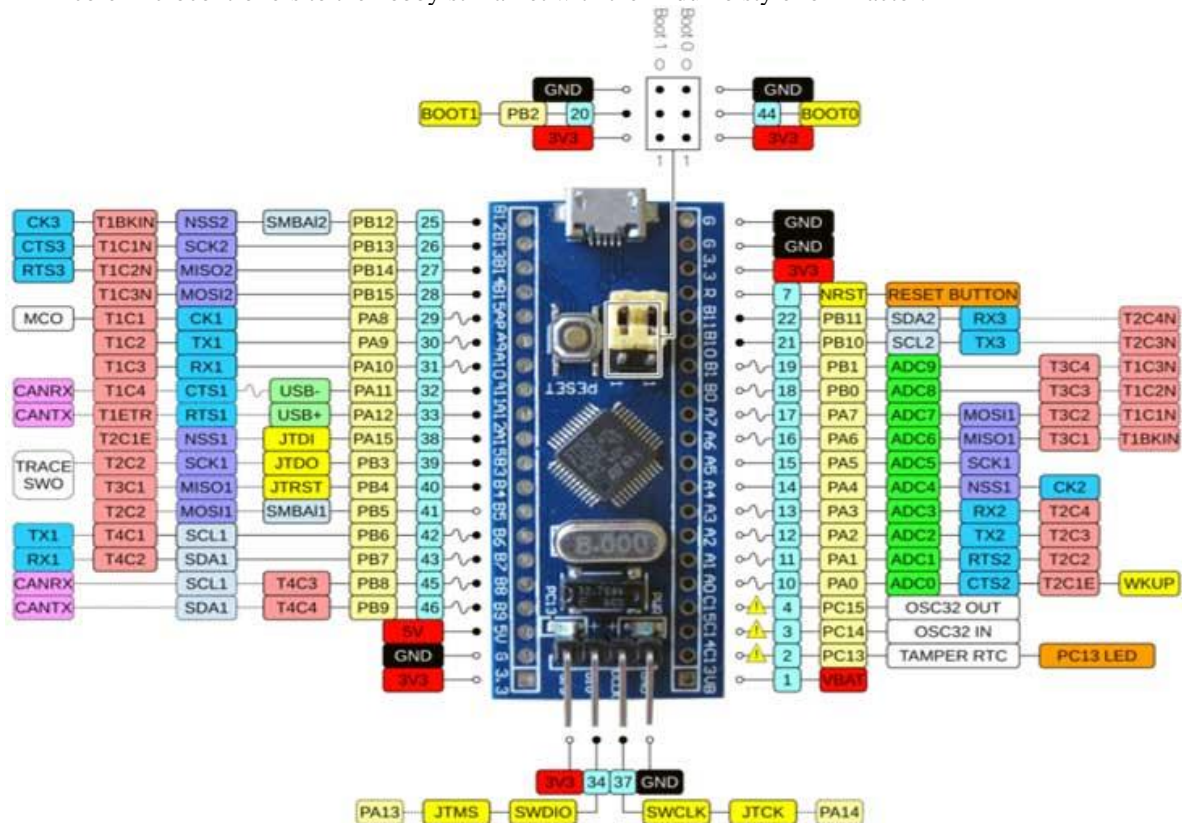


Figure-2: STM32F103 Development board.

Table-1: STM32F103C8T6 Technical Specifications.

Microcontroller	STM32F103C8T6
Operating voltage	3.3V
Analog inputs	10
Digital I/O pins	37
DC source/sink from I/O pins	6mA
Flash memory (KB)	64/128
SRAM	20KB
Frequency (clock speed)	72MHz max.
Communication	I ² C, SPI, UART, CAN, USB

3.2 EM-18 RF reader module:

Radio frequency Identification (RFID) is a wireless identification technology that uses radio waves to identify the presence of RFID tags. Just like Bar code reader, RFID technology is used for identification of people, object etc. presence. In barcode technology, we need to optically scan the barcode by keeping it in front of reader, whereas in RFID technology we just need to bring RFID tags in range of readers.

3.3 ESP8266 (ESP-12E):

ESP-12E is a miniature Wi-Fi module present in the market and is used for establishing a wireless network connection for microcontroller or processor. The core of ESP-12E is ESP8266EX, which is a high integration wireless SoC (System on Chip). It features ability to embed Wi-Fi capabilities to systems or to function as a standalone application. It is a low cost solution for developing IoT applications.

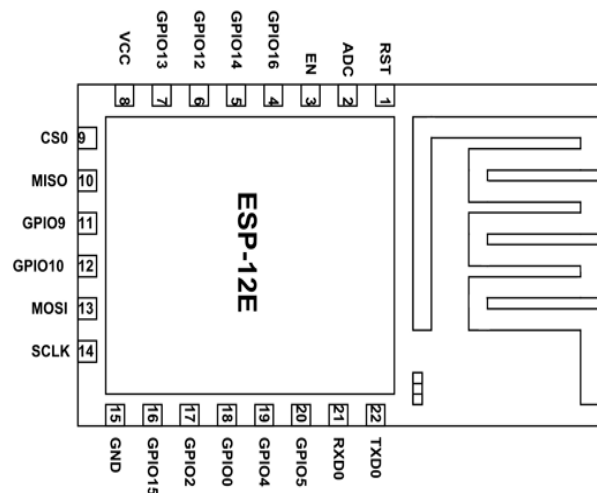


Figure-3: ESP8266 (ESP-12E) overview.

3.4 20x4 LCD Display:

The LCD stands for liquid crystal display, that works on the light modulation features of liquid crystals. It is available in electronic visible display, video display and flat panel display. There are numerous categories and features are exits in markets of LCD and you can see it on your mobile, laptop, computer and television screen. The invention of LCD gives new life to electronic industries and replaces IED and gas plasma techniques. It also replaces the CTR (cathode ray) tube that used for visual display. The input power consumed by the liquid crystal display is less then light-emitting diode and plasma display. In today's post, we will have

look at 20 x 4 LCD, its features, working, applications, and practical implementation in different electronic devices.

4. SOFTWARE REQUIREMENTS:

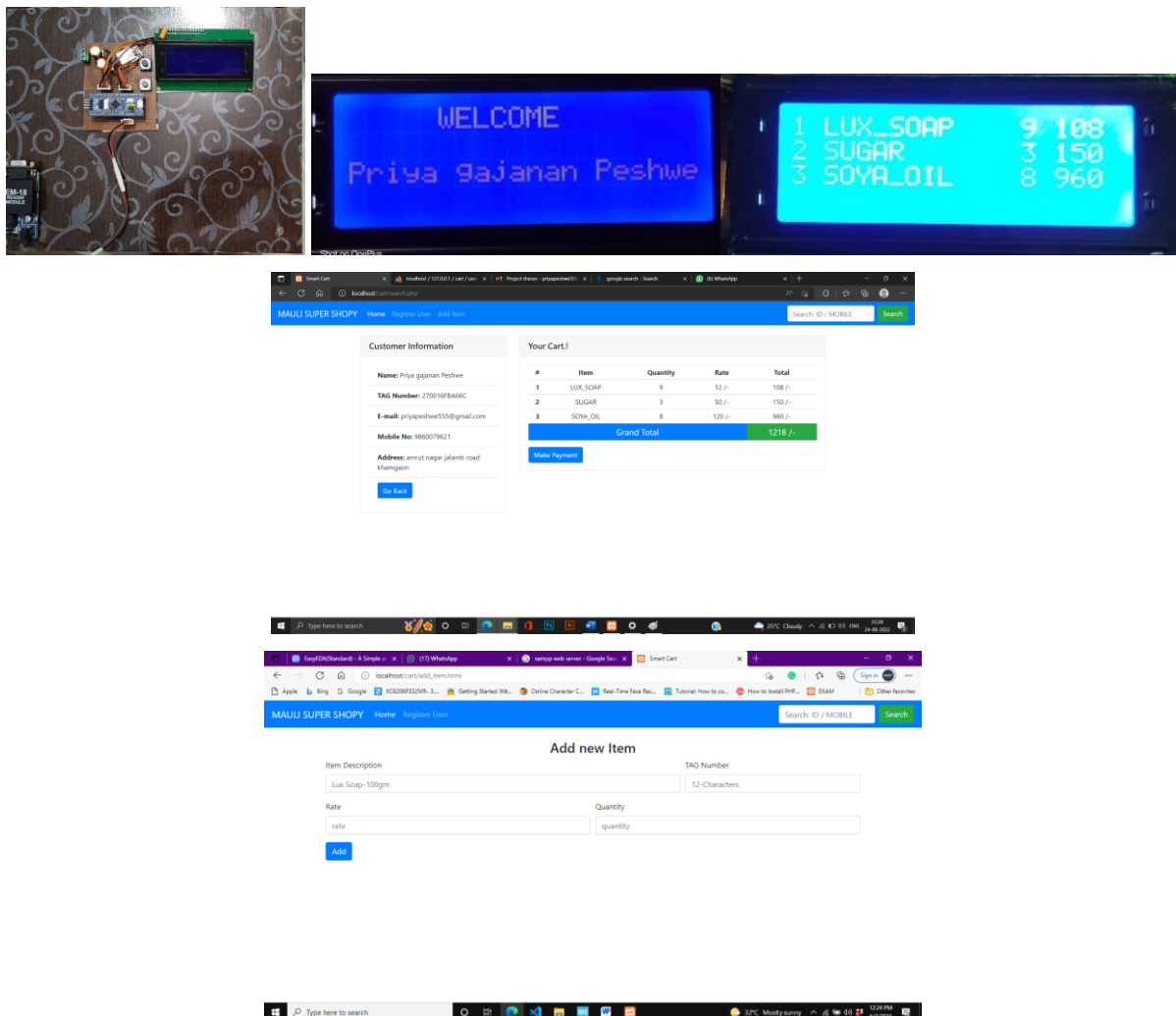
4.1 STM32CubeIDE:

STM32CubeIDE is an all-in-one multi-OS development tool, which is part of the STM32Cube software ecosystem. STM32CubeIDE is an advanced C/C++ development platform with peripheral configuration, code generation, code compilation, and debug features for STM32 microcontrollers and microprocessors.

4.2 XAMPP Web server:

XAMPP is one of the widely used cross-platform web servers, which helps developers to create and test their programs on a local webserver. It was developed by the Apache Friends, and its native source code can be revised or modified by the audience. It consists of Apache HTTP Server, MariaDB, and interpreter for the different programming languages like PHP and Perl. It is available in 11 languages and supported by different platforms such as the IA-32 package of Windows & x64 package of macOS and Linux.

5. RESULT:



5. Conclusion:

The main aim of this project is to increase billing speed at shopping mall or at glossary stores. System is implemented with the help of ESP8266 Wi-Fi module to get communicate with web server. System is very helpful in maintaining user information and purchased history, as well as unbilled item.

A system based on RFID technology that could replace the traditional barcode system was successfully established. The barcode system had various drawbacks including the strict requirements on line of sight and its need to be placed in one particular boundary while scanning, not to mention the issues concerning its durability and inability to update information. The project is feasible as it is built on technology that already exists. We have improved it by eliminating the long waiting time of queue at the time of billing and android mobile application use in reviewed systems.

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