

## IOT BASED SMART SHOPPING TROLLEY WITH MOBILE CART APPLICATION

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### ABSTRACT

Even through e-commerce and other online applications are growing rapidly the craze for traditional shopping has never stepped back. One difficulty is to follow up in a queue for the billing process. There, arises a demand for easy and quick payment of bills. The proposed Smart Cart in this paper, is capable of generating bill using IOT along with the mobile cart application. With the use of this mobile application and trolley, customer can make bill payment in no time. The smart cart uses the RFID tag and receiver to scan the product, load cell to prevent theft, LCD display and the Arduino Along with this the customer can also log in with the mobile app which will display the list of all the products mentioned and their amount. Once done, the customer can pay the bill through the mobile application.

### INTRODUCTION

SENSORS are electronic devices [1] that can collect information from the surrounding environment [2]. Wireless Sensor Network (WSN) is used to interfacing of multiple sensors to work together and share collected information wirelessly [3]–[5]. Isolated systems are less valuable than networked systems [6] which generate more intelligent and autonomous applications [7]. A wide range of information can be collected, when the coupling of the wireless sensors with networked systems [8]. 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 [9], [10]. The sensors and actuators have an important role in IoT that enables us to communicate with the physical world [11]–[13]. It consists of three terms physical, smart and connectivity [8], [11] which defines how smartly the sensors, microcontrollers, microprocessors and physical devices such as actuators which connect wirelessly or wired to manage information with other electronic devices [9]. IoT enables people to manage their lives, business in effective manners and provide fundamental changes to the world that can completely transform business and industry. The potentialities offered by the IoT make it possible to develop numerous applications that belong to the industry of aerospace and aviation, automotive, telecommunication, medical, healthcare, Independent living, Pharmaceutical, Transportation, Manufacturing, Retail, logistics and supply chain management [9], [14]–[16]. The most important objective of IoT is to monitor individual objects and environment wirelessly. This introduces electronic tags attached to individual objects. When these tags become in the range of reader it reads the stored information of object wirelessly which is known as RFID technology [17]–[19]. RFID plays an integral role in the applications of IoT. It consists of three components such as RFID tags attached to the object

that contain identity or data about an object, RFID reader that read the data from the tags and central processing system that perform communication in between RFID system to other electronic devices [20]. It emerging a revolutionary effect on a wide range of applications like aircraft maintenance, anti-counterfeiting, health care, baggage handling, and supply chain management [21], [22]. The merchandising process is the major part of the supply chain management that promotes the products to the consumers and distributors. Shopping is the activity in which a group of people uniting at one place for purchasing products. There are supermarkets or shopping malls that provide space for people to do shopping where retailers promote their products to the consumer and consumers purchase the product according to quality like ingredients, expire or not and brand of the product, reasonable price, and quantity of the product. This is also known as traditional retailing. Supermarkets are convenient for retail and urban planning. Supermarkets are the most crowded place at the time of the weekend. As most consumers have experienced, the basic steps involved in shopping are making a list, typically with pen and paper or on their mobile phone. They have to spend a lot of time in search of products in the whole supermarket one by one and spend time in long queues to pay bills. The waiting in queues is negatively affecting [23] on human morale and may cause misunderstandings or conflict amongst people, for instance, when someone breaks the line and stands in front of other people [24]. That is not an ideal development because traditional marketing promotes many local jobs, city life, and urban culture. The supermarket also needs to personalized the inventory according to consumer preferences [25], [26]. Due to that online shopping attracts a large number of consumers that provide products through the internet and web browsers [70]. Consumers can receive the product from specified locations in the meantime by selecting products according to prescribed specifications, ingredients or

instructions. Also, there is higher risk of fraud, lack of inspection, item may not work properly or defected, not be the same product as item pictured, transaction from stolen credit card, Phishing in which customer thinks that they purchase product from reputable seller, disruptor in retail industry and not provide the pricing negotiation [27], [28]. Instead of online shopping, people feel more valuable, entertain, enjoy and get the quality product with traditional shopping. In these critical situations, traditional shopping and supermarkets have to reinvent to survive in the current age. Shopping hubs or shopping malls are the places where several small business groups together known as a market. Many people have shown their efforts from time to time to make a revolution in the traditional shopping. Many supermarkets are working with barcode technology [29]– [31] Mobile applications [32]–[35], Zigbee [24]–[26], [36], [38], Arduino microcontrollers [31], [38]–[40], RFID and wireless sensors [38], [41], [42]. Today barcode technology implemented and working in several supermarkets. Barcode is the continuous black vertical bars that have some stored information about an object. There is a smart trolley in which user self-scan every product by using ultrasonic sensors. Product id stored in barcode printed bars which are linked with backend databases [43], [44]. There is a barcode scanner that scans that printed barcode when it became in line of sight. That is a slow process than the RFID sensor system. Consumers or cashiers need to scan every single barcode to create bills and to check ingredients or specifications of the product. Barcode can only read, not writeable again, the scanner can read one barcode at a time and the barcode contains a very small piece of information in it [12], [30], [31]. This printed barcode can easily damage due to harsh climatic conditions. This can easily be hacked by a third-party user because does not support encrypted data form. The barcode system is a time-consuming process, which causes long queues. In 2009, Arkansas University completes the study to determine the business value of the RFID at the major retailer. That proofs the efficiency of RFID is better than the barcode system. According to their survey results, the accuracy of inventory management is improved by 27%, under stock decreased by 21% and overstock decrease by 6%. Because Barcode scanner scans 10000 items in 53 hours where RFID read in 2 hours [45], [46]. In traditional shopping systems, shopping carts are very helpful for the consumer to carry products. Installing a barcode with shopping carts enables the user to scan each product individually that consumes a lot of time, energy and makes it a bothersome process for the user. In other previous works, RFID reader implemented with an LCD display attached to the shopping cart that allows the user to interact with product information. Users are not able to interact with the complete or necessary information of

products due to non-attractive and not user-friendly user interface [47]. RFID reader read the product RFID tag based on the Arduino microcontroller [31], [40], [45], [48]. Automation of billing process focusses on to provide the antitheft controlling system that allows the online transaction for the billing system [49]. In another system, mobile phone inbuilt NFC used to read the RFID tags [50]. Using RFID and ZigBee module [72] to make a more effective shopping process for the users where ZigBee transmits the information to the backend databases [13], [40]. Manually, by pressing buttons the user can return the product from the cart and also pay the bill by pressing a button then details transfer to the billing system through ZigBee [24], [71]. Provide the facility to cart communication that allows multiple users to do shopping together. There is a high-security risk of user's information safe and also need to modify the data transfer process. By localization of everything in the supermarket allows the user to locate the exact location of the product using data collection and filtering components based on IoT [51]. Supermarket can monitor and trace the customer. There is RFID based location-sensing technology that helps to identify direct or indirect privacy threats without losing supermarket relevant insights [69]. Further, RFID based smart secure shopping system is implemented on the bases of threat and security issues. Encryption and Decryption algorithms are used for the symmetric and asymmetric methods. That provides the security techniques based on encryption keys [71]. The focus of this study is to facilitate the supermarket and indoor marketing. Speech to text application based on Natural language Processing is also used to analyze the customer opinion and feedback about traditional shopping instead of online shopping [70]. BoltESP IoT kit is used to manage the supermarket effectively. But the unattractive display is used to entertain the customer [73]. RFID plays a very vital role in the retailing process to manage products from the manufacturing to the Inventory and from inventory to the consumer. The major use of RFID technology is to trace the object. In this research, IoT based Smart Shopping Cart as shown in Figure 1 is proposed by using RFID sensors that used to make the shopping process much better than the previous efforts. RFID system embedded with a shopping cart that helps the consumer to purchase desirable and cost-effective products. As mentioned above, an RFID system consists of three main parts RFID reader, RFID electronic tag and central communication device [18], [20], [52]. Arduino microcontroller allows the android application to directly communicate with product information that is stored in the RFID product tag. There is an android application based on a user-friendly and attractive display attached to the shopping cart connected with the RFID system. This application provides services to the consumer i.e. display the

product information, previous shopping history, manage a current shopping list, product promotions, special offers, product location to the consumer and RFID based login process for better security. When products come near to the RFID reader in the shopping cart. The consumer can interact with product information. This information extracted by mobile applications from backend databases stored in the server system. The consumer can also search for the desired product location in the supermarket via interact with a static map of the supermarket. The consumer can also interact with previous shopping history, product promotions, and special offers. That helps the consumer to remember products to purchase, manage shopping list and can get the best products according to the preferences. The main contributions of this paper are following:

- RFID sensors with a shopping cart are proposed that connected with Mobile Application makes the consumer get desirable and the best quality products in the meantime.
- The searching and shopping list management modules are added in Mobile Application which helps the consumer to find the location in the supermarket, to remember the shopping list and to manage the shopping list according to preference.
- The promotion module helps the supermarket to promote the product and offer special discounts to the consumers that can enjoy different product promotions and discount offers.
- Wireless communication will provide flexibility to the shopping and supermarket management system.
- The backend supermarket management system facilitates the supermarket to personalize its shelves and products according to consumer preferences.

#### EXISTING SYSTEM

The drawbacks addressed in previous applications such as theft prevention, data storage, has been overcome in this application. Though, the manpower is required but it attracts many customers because of various available options particularly meant for the corresponding shop.

#### PROPOSED SYSTEM

Our proposed system makes the billing very simple, stable and as well as reliable. Customers doesn't want to wait in long queues for getting billed whereas bill can be generated automatically by using IOT [9-10]. Customers can easily pay the bill in the cart by using QR code or just sit at home and shop through the mobile application-ordering facility through mobile app along with smart trolley is the main advantage. Trolley consists of the RFID tag, that is unique to the products. Products can never be put inside the trolley without being scanned as the load cell is present in the trolley, thus to prevent theft or some errors. Also, as a backup, a security check is done with the items sent by the customer through

mobile app with items displayed in trolley with LCD display.

#### LITERATURE SURVEY

The presence of Remote Sensor Organization (WSN) progresses offers the ability to check furthermore, appreciate environmental pointers from delicate ecologies and ordinary resources for metropolitan circumstances. With the fast addition of these contraptions in an examining prompting framework makes the Internet of Things (IoT), where sensors and actuators blend well in with the earth around us, and the information is shared transversely over stages remembering the ultimate objective to develop a run of the mill working picture (COP). With the ongoing adaption of an combination of engaging device progresses, for instance, RFID names and per clients, close field correspondence (NFC) contraptions and introduced sensor and actuator center points, the IoT and is the accompanying moderate development in changing the Internet into a totally integrated Future Internet [1].

With the extending usage of wide area Remote Sensor Organizations (WSN) in the field of buyer applications, it winds up discernibly crucial for address the stresses, for instance, steadfastness, essentialness usage and cost-feasibility. This structure is used as a piece of spots, for instance, corner shops. It can help in lessening work and in making an unrivaled shopping foundation for the clients. Rather than impacting the clients to hold up in a long queue while checking out, the system robotizes the charging method. The client can similarly follow the unobtrusive components of the procured things and furthermore the current bill aggregate on the screen, which is joined to the truck [2].

Computerization of shopping basket utilizing RFID module and ZIGBEE module, in this framework, RFID labels are utilized rather than standardized identifications. These RFID labels will be on the item. At the point when the client takes an item and spots it in the streetcar, the streetcar will contain a RFID peruser which will detect the RFID label which is available on the item.

In this way displays the item cost on the LCD display. Like this, the cycle proceeds. Alongside it, comes a ZIGBEE transmitter in the streetcar, which moves information to the principal PC. The ZIGBEE beneficiary is set close to the principal PC which gets the information from transmitter [3].

This paper likewise, makes sense of about a computerized and an efficient framework for retail to further develop shopping experience. It is intended to make it client cordial and secure. In this paper, the proposed savvy truck is fit for producing a bill from the actual truck. The client will make the instalment through a Visa which will assist with keeping up with information base. This information can be utilized to in like manner present plans and offers in

the stores and furthermore give extra proposals to explicit clients. The brilliant truck utilizes RFID innovation for shopping and instalment, AVR microcontroller for fringe interacting and stock administration.

**COMPARISON OF EXISTING AND PROPOSED SYSTEM**

We use the Arduino Uno microcontroller, which helps to control the sensors of the electronic circuit that is controlled by the android mobile application. Different technologies like RFID sensors, Arduino Uno, Bluetooth, Wi-Fi, Supermarket management application and Android Mobile application embedded together to create an innovative automation shopping system. these proposed model technologies never embedded together in related systems. Barcode technologies are used in the most supermarket instead of RFID technologies that are very time-consuming process to scan every single product in the line-of-sight position. RFID technologies are uses in related works but they are not provide a friendly environment to the customer. ZigBee modules are also used to trace the shopping carts and multiple shopping cart share shopping information with each other that increases the security risks and cost of the system. The Proposed system implemented on wireless communication and provide different software-based modules that make it more reliable and flexible to the customer as well as to the supermarket

**PROJECT DESCRIPTION**

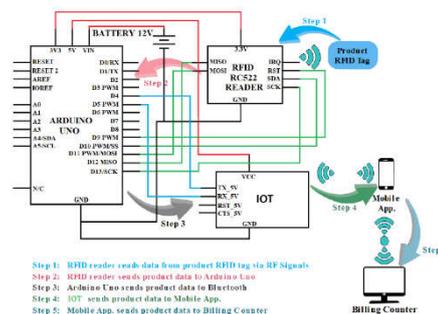
The main focus of this study is to facilitate both supermarkets and customers. The proposed Architecture of this study provides the hardware and software solutions that help the supermarket to improve the quality-of-service issues and eliminate the time-consuming process of the shopping. The retail industries invest further in exploring the potential of these technologies for the novel services for their customers. These novel services attract a huge number of customers that increase revenue as well. The innovation of the proposed study is the architecture model and services that come together to provide eco-friendly services in cost-effective manners.

In the modern era, when the customer wants to purchase an item then the customer has to put the product in the shopping cart then cart's RFID reader read the RFID passive tag which attached to every product. Corresponding data regarding the product will be display on the Mobile application that is in front of the customer attached to the shopping cart. Customers can easily interact with the interface and use different services of the proposed system. By using the proposed services, customers can select the efficient product put the product into the cart and the

cost will get added to the total bill. After complete shopping, the billing will be done by the customer and details will be sent to the central server. Themap given in the proposed system will locate the productpresent in the mall with the sectional specification for the easeof the customer. By using this system, customers can buy alarge number of products in very less time with fewer efforts.

Smart Shopping Cart consists of 4 basic elements hardwareintegration, software interface, wireless communication, andnetwork database shows in Block diagram.

**BLOCK DIAGRAM**



**ARDUINO UNO**

Arduino/Genuino uno is a microcontroller board based on the atmega328p (datasheet). 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 a ac-to-dc adapter or battery to get started. You can tinker with your uno without worrying too much about doing something wrong, worst-case scenario you can replace the chip for a few dollars and start over again.

"Uno" means one in Italian and was chosen to mark the release of Arduino software (ide) 1.0. The uno board and version 1.0 of Arduino software (ide) were the reference versions of Arduino, now evolved to newer releases. The uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

**TECHNICAL SPECIFICATIONS**

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
LED_BUILTIN	13
Length	68.6 mm
Width	53.4 mm
Weight	25 g

**RADIO FREQUENCY IDENTIFICATION**

RFID, short for Radio Frequency Identification, is a technology that enables identification of a tag (that is normally attached with an entity) by using electromagnetic waves. RFID Reader Module, are also called as interrogators. They convert radio waves returned from the RFID tag into a form that can be passed on to Controllers, which can make use of it. RFID tags and readers have to be tuned to the same frequency in order to communicate. RFID systems use many different frequencies, but the most common and widely used & supported by our Reader is 125 KHz.

**Features:**

- Reading Distance: 6-10 cm
- Dimension: 40mmx20mmx8mm (LxHxW)
- Frequency:125kHz
- Compatible Card codes: Manchester64-bit, modules64
- Current Rating: 35mA (Max)
- Operating Voltage:4.6V - 5.4VDC



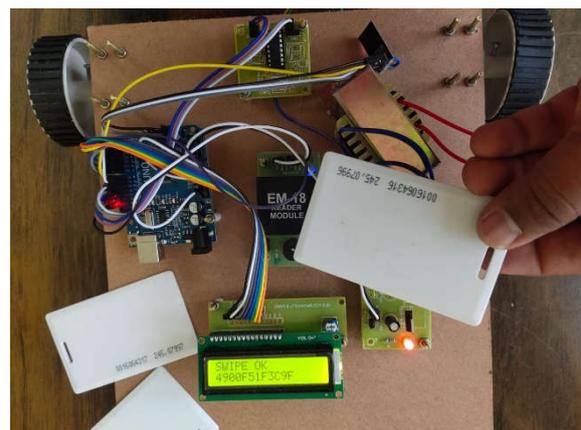
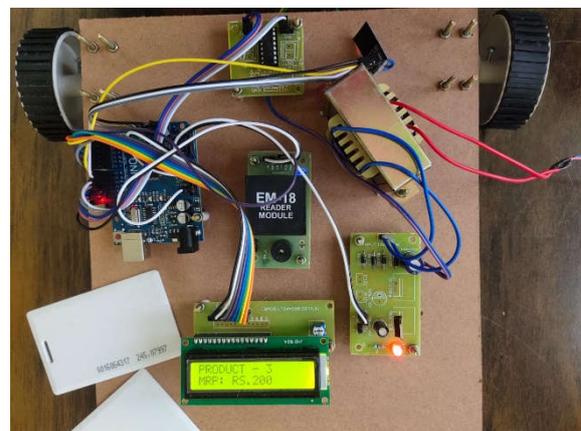
**SOFTWARE SPECIFICATIONS**

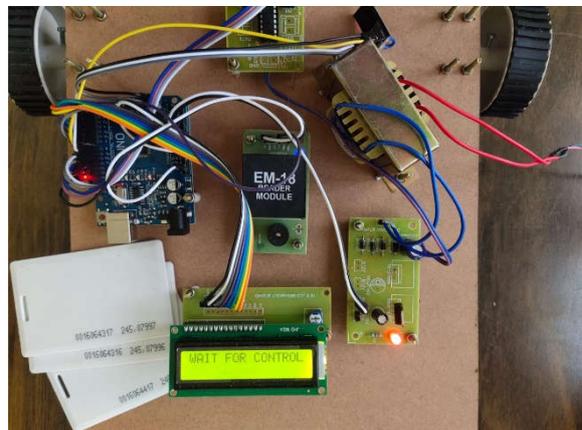
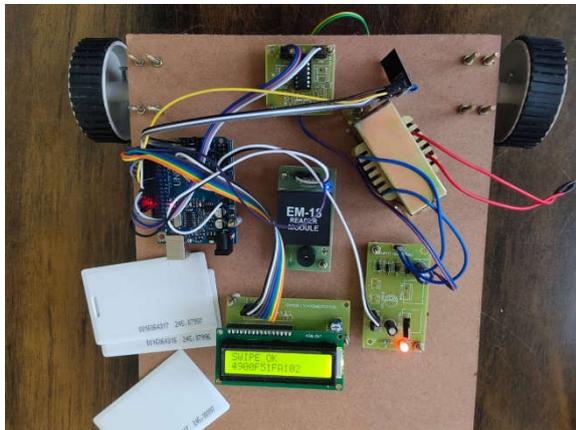
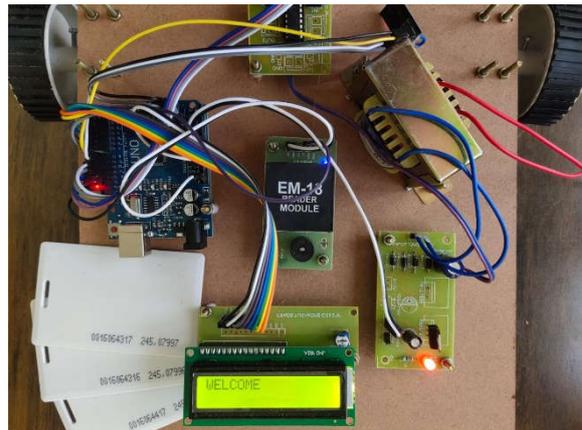
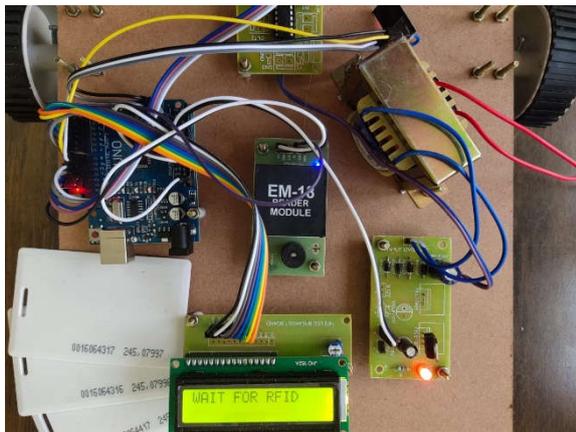
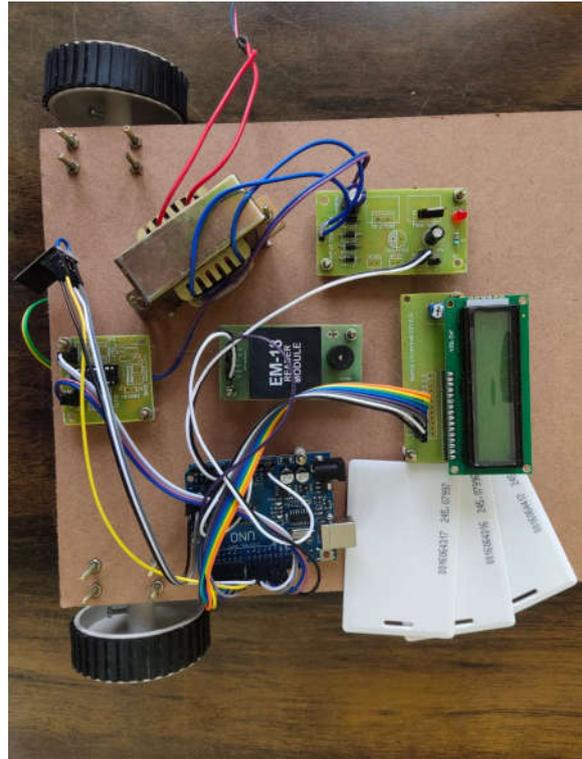
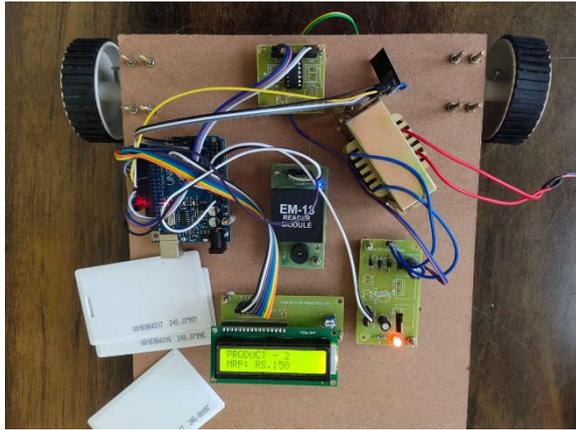
Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

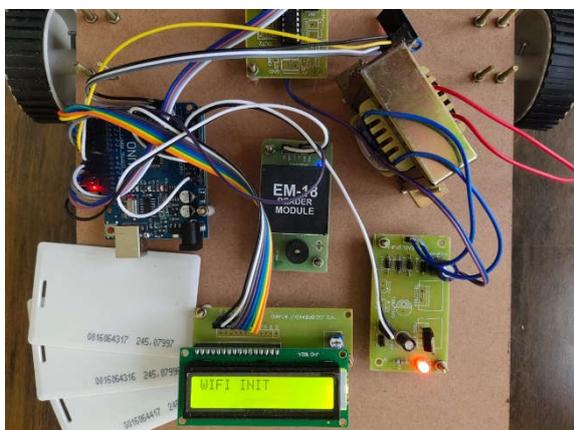
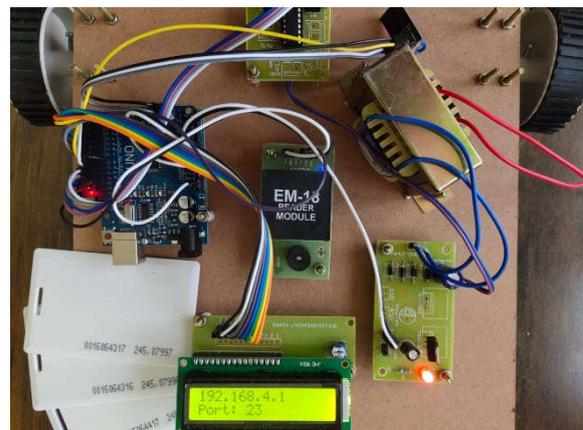
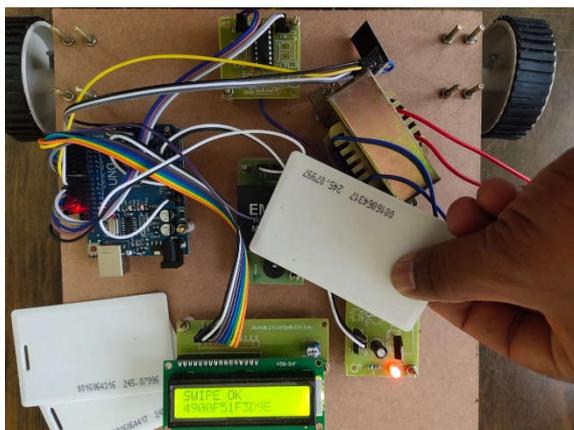
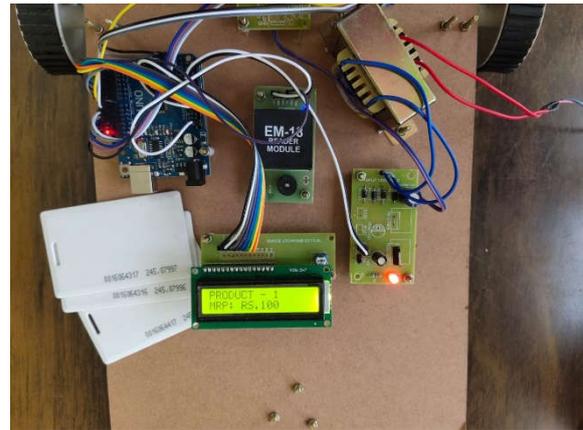
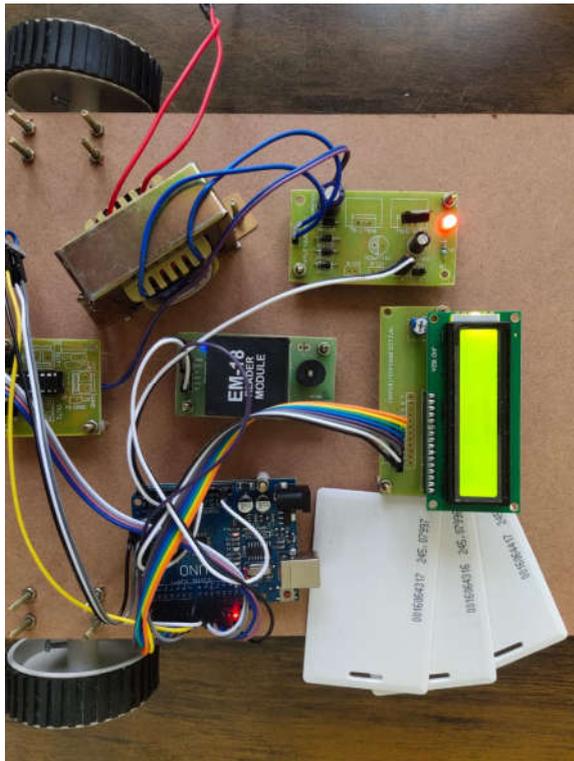
Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .ino. The editor has features for cutting/pasting and for

searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor. NB: Versions of the Arduino Software (IDE) prior to 1.0 saved sketches with the extension .pde. It is possible to open these files with version 1.0, you will be prompted to save the sketch with the .ino extension on save.

**IMPLEMENTATIONS**







**CONCLUSION**

In the aforementioned paper, the intended system design for automation of the shopping process by merging different technologies like Arduino Uno, RFID, and Android mobile application. That can be divided into two major categories electronic components and Software components. In Electronic Components, Arduino Uno operating as an intermediary microcontroller, which controls the RFID technology and built, communication between RFID technology and software components like android mobile application through Bluetooth module. In software components, there is an android mobile application in which customers login to the proposed system by using different proposed methods that can secure customer privacy. Searching for the product in the shopping mall becomes easy because of the searching module based on product position allocation on the map. The proposed system prevents the customer to get an expired or undesired product by providing an android mobile application. Customer directly interacts with the product information. This information affects the preferences of the customer about the product and helps them to get the best quality product. Shopping products can be displayed in a current shopping list of the customer that helps the customer to maintain its shopping list according to need or budget. That also helps to remind the remaining products to purchase. Besides, there is a server as a data center of the

supermarket, which also connected with the smart shopping cart. When an android mobile application needs to extract data from the server, according to the customer RFID card for verification of the customer login or extract information of the product according to the product RFID tags, then the mobile application can communicate with the server wirelessly. This feature of wireless information extraction helps the customer to move freely and can easily interact with information of products anywhere in the supermarket. Those technologies are programmed to work together to entertain the customer most efficiently. BY using proposed technology customers can search and effectively get the best quality product. As a lesson receive a proposed system can easily be implemented in real-life scenarios to support the shopping process by automation of shopping cart.

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