An Enhanced and Smart Model for Shopping Mart using Arduino

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Abstract: *We can see huge rush at shopping malls on holidays and on special discount days. Citizen buy different item, keep in trolleys and proceed to billing counter for paying the total amount. At the billing counter, using bar codes of each item, cashier prepares the bill. 30percent citizens buy groceries on a predetermined budget. Many a times, only at the end of purchase, buyers come to know that the overall purchase total is greater than their budget. Then they spend much time in reshuffling of preferred products and finally overall shopping process becomes more time consuming. Due to this, most of times buyers have to delete few items at the end and miss out on few desired items. The proposed system can be used to solve the challenges. The shopping trolleys are enabled with Arduino board which identifies the product and extract the details from rack's Arduino. The LCD displays product information along with total cost of the products in the trolley. Then finally buyer can pay bill directly at billing counter. This proposed system provides an enhanced and smart way of efficient shopping.*

Key Words: *Arduino, LCD, IR Module, Smart Shopping.*

1. INTRODUCTION:

Shopping is one of our regular tasks where we spent a considerable amount of time. To save time, many have started to buy online, where user's satisfactions is not up to the mark because there are issues like delay, defects and damages in products and harsh returning policies. Hypermarkets have a great range of goods and people spend much time in finding the details of the product, approximation of bill, calculating the amount of total products and paying the bill by standing in queues where they are spending a valuable amount of time. These issues are overcome by the smart way of using proposed system. Shopping mall trolleys are enabled with a gadget consisting of Arduino board which can recognize the products by communicating with the storage racks which consist of an Arduino board. This Arduino board is programmed with the details of the products in the rack. The communication is established using a wireless mechanism where the trolley and rack are connected using wireless connection. The customer can pay bill directly at the counter. Billing time is reduced. At the end of the shopping process the bill is retrieved by generating an interrupt. The total cost of the products in the trolleys are displayed on trolley device. Thus proposed approach provides an enhanced experience of shopping to the customers at reduced cost and time with efficient mechanism.

2. LITERATURE REVIEW:

P.Iyappan, S.Surya Jana,S.Anitha,T.Sasirega [1]et.al proposed a model for shopping in which the communication was established using a wired mechanism where the trolley and rack were connected using wires. But in smart cities there is huge rush in super markets and malls in which there stands no chance of using wires to connect trolley and rack. That means each time shopper needs to connect trolley with rack using wires which can consume lot of time. This is not convenient for shopping. Chandrasekar.P and Sangeetha. T. [2] illustrated the smart shopping system which dwells on providing automated billing system using RFID and Zig-Bee technologies. Shopping trolleys in the super markets are provided with product identification device which consists of RFID reader which recognizes the product information. The Zig-Bee protocol is used for transferring list of products to the centralized billing system. The list of products is recovered from the central system of billing at the time of billing. Zeeshan Ali, Reena Sonkusare [3]et.al has proposed an overview on smart shopping methodology using RFID technology. The goods and products in the shopping are provided with RFID tags.

The RFID reader reads information of the products which is recovered while billing. This paper makes the utilization of the RFID technology for providing smart shopping but no information is provided regarding the scalability of billing that is the stock maintenance for the shop when more number of persons are billing at the same time is not considered in this paper. Also the traffic that the Zig- Bee can handle is not mentioned. The price of the RFID is also considered to be as a greater issue. The author [4] has proposed a system to ease the queues in the malls using the RFID technology. According to [2] [4] [5] the information of goods is retrieved by the RFID reader in the trolley and it is sent to the database of the shopping mall by using the Zig-Bee protocol. Referring the Satish Kamble, Sachin Meshram, Rahul Thokal [2] [3] [4] et.al authors it is given that it covers reduction of shopping time by reducing the billing time but there is no management of the product list is provided. Implementation cost of RFID

technology in shopping malls is of a greater concern because the cost may be huge when RFID is to be implemented in all the trolleys of the shopping mall. The traffic that the Zig-Bee system can withstand also plays a major role in deciding the efficiency of the system. The system that is proposed in [5] consists of User Interface and display component, Server Communication component and Automatic billing component which co-ordinates each other to provide smart trolley that decreases billing time [5]. The author [6] describes and implements the smart shopping and automated billing using wireless sensor network. At the beginning it scans the barcode of the item using the barcode scanner and places on the cart [6], an image of the product is taken and stored in the system's memory. The camera is attached to barcode scanner [6].

Thus all the systems have found an alternative to the conventional shopping methodology by using the RFID device along with various other technologies but the major issues with these systems are implementation cost. This may lead to a state where the purpose of implementing the above systems may not be accomplished.

3. EXISTING SYSTEM:

Major improvements are being done in the field of shopping. Among which finding an alternative for the existing barcode system by using the upcoming RFID technology is one of the main improvements. The existing barcode in the products is switched with the RFID tags. This tag is similar to that of the barcode which is used for retrieving the product information.

The RFID reader which resembles barcode scanners are used to get the information of product through the RFID tags. The shopping trolleys that are available in the shopping malls are mounted with RFID readers and the products with RFID tags. When the item is being dropped into this shopping trolley the RFID reader reads the product information from the RFID tag and this information is send to the central database where the entire list of products is maintained. At the time of completion of this buying process this list is retrieved at the billing counter and the bill is generated which can be paid directly without waiting. RFID technology usage has certain issues that are discussed below.

The RFID technology requires emission of radio frequency waves continuously when the trolley is in use [1]. The radio frequency waves may be harmful in certain cases and also the implementation cost of RFID based smart trolley in a big shopping mall which consists of hundreds of trolleys may not be as efficient as expected [1]. One other problem is that the barcodes are free of cost but the RFID tags are costly and fixing of RFID tags to all products is not considered to be as an efficient process. The protocol that is used for transferring the information of the product is of consideration.

4. PROPOSED SYSTEM:

Initially the trolleys in the shopping mall are fitted with Arduino board enabled with IR module. The rack in the shopping malls consists of the products. An Arduino board which is programmed with the information of products is kept in the rack is kept fitted to every rack in the shopping mall. The customer wanting to purchase in the shopping mall picks up the trolley from the trolley stand where all the trolleys of the shopping malls are located. When the purchaser is willing to pick a particular item from a particular rack the customer connects the trolley to the corresponding rack by using the HC 12 wireless microcontroller mounted in the rack's Arduino. This process establishes the connection within the trolley's Arduino board and the rack`s Arduino board . Once this information of product is received by the trolley it is displayed to the customers by using the LCD display instrument which is mounted on the trolley and is interfaced with the Arduino board in the trolley.

Once the customer finishes the shopping process, the customer reaches the billing counter here the list of product is transferred to the computer at the billing counter by using an interrupt. That list of products is transferred to the cash counter by making the trolley communicate with the computer in the billing counter by using a wireless connection. Now the customer can pay for the bill directly without waiting for the billing process.

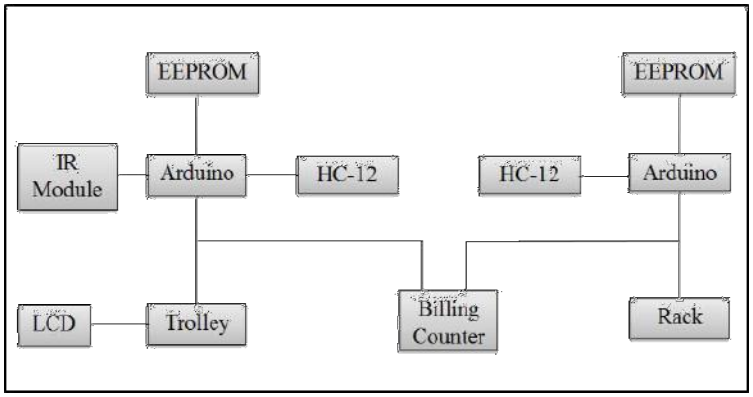

Figure 4.1: Architecture of Proposed System

During the billing process the list of product is cross checked with that of the shopping mall`s database for any miss match of the number of products is done in order to provide a secure shopping mechanism. Also the scaling of the billing process is done that is when more than one person is billing at a time the scalability of checking the products for secure billing process is also handled in the billing counter. Thus this shopping scenario provides an efficient and secure shopping process to the customers in the shopping malls.

5. SYSTEM MODELS:

- Trolley Unit
- Digital Display device
- Arduino
- IR Module
- HC 12 Wireless Microcontroller
- Billing Unit

5.1 Trolley Unit

In this Trolley unit the trolleys are attached with Arduino board. As the user drops the products in the trolley, the Arduino board on the shopping trolley communicates with that of the rack's Arduino board and receives the information of products which is stored in the trolley's database in the EEPROM on the Arduino board on the trolley. This process is done through the wireless connection between the trolley and the rack. The information is then stored in the database and the total cost is displayed to the customer using a LCD display device.

5.2 Digital Display Device

The LCD display which is used in this system is 7x2display device. It is used to display the total cost of the products purchased and it also displays the information of the products corresponding to the rack to which the trolley is connected.

5.3 Arduino

The Arduino UNO R3 is a microcontroller board that is based on the ATmega328 [2]. The Arduino board that is kept fixed to that of the rack is programmed with the product information that is kept in the rack. This information is transmitted to the Ardiuno board of the trolley which is capable of storing the product list in the trolley that has been purchased by the customer.

5.4 IR Module

IR module is the device capable of emitting IR rays which when interrupted performs the required task. The IR module in our model is kept fixed to the Arduino board in the shopping trolley's which produces IR rays up to the range of the trolley when the trolley is connected to the rack [3]. Whenever a customer drops the product from the rack into the trolley the IR rays is interrupted and the count of the product in the trolley corresponding to the rack is increased by one. The same process occurs when more than one product is dropped into the trolley. By this way the quantity of a particular product being bought by the customer can be found.

5.5 HC 12 Wireless Microcontroller

The HC-12 is a half-duplex 20 dBm (100 mW) transmitter paired with a receiver that has -117 dBm (2×10-15W) sensitivity at 5000 bps. Paired with an peripheral antenna, these transceivers are capable of collaborating up to 1 km in the open. The HC-12 module has a microcontroller which actually doesn't have to be programmed by the user. For configuring the module we simply use AT commands, which can be sent from an Arduino, a PC, or any other microcontroller using the serial port. This allows trolley and rack to communicate with each other.

5.6 Billing Unit

When the shopping is over, the purchaser comes to the billing section. The total bill amount will be displayed on the billing computer which depends on the trolley's database in the EEPROM of the trolley's Ardiuno board when an interrupt is generated. This interrupt is generated at the end of the shopping process. The interrupt is created by using a wireless connection at the billing unit through which the list of product is transferred from the trolley to the system at the billing counter.

6. MATHEMATICAL MODEL:

a) Let 'S' be the | Shopping Cart as the final set S = {……}
b) Identify the inputs as D, E, A, Q, Z
S = {D, E, A Q, Z…}
D = {D1, D2, D3, D4 …| 'D' given database updates}

E = {E1, E2, E3, E4 …| 'E' given product details with price to register.}
A = {A1, A2, A3, A4 …| 'A' given arduino connection to transfer Product information.}
Q= {Q1, Q2, Q3 … | 'Q' gives product tag to add or remove product from cart}
Z= {Z 1, Z 2, Z3 … | 'Z' given Bill to check all products at out time.}
c) Identify the outputs as O
S = {D, E, A Q, Z, N, B, L, R …|Sample space}
N = {N1, N2, N3, N4 …| 'N' is the Response as to display Product information on LCD}
B = { B 1, B 2, B 3, B 4, …| 'B' is the Response as add product in Bill}
L = { L 1, L 2, L 3, L 4 …| 'L' Response as remove product in Bill}
R= {R1, R2 …| 'R' is the Response bill validate}
d) Identify the functions as 'F'
S = {D, E, A Q, Z, M, N, B, L, R, T, F…
F = { F1(), F2(), F3(), F4(), F5() ,F6(),F7(),F8(),F9()} F1 (D): Update Database
F2 (E): Process Requests on item details with amount to register
F3 (E): Reply as Produce link between Arduino
F4 (A): Process Requests on IR module to update purchased items information
F5 (A): Response as add item in Bill.
F6 (Q): Process Requests on product to cancel the item from trolley.
F7 (Q): Respond to cancel the item in Bill.
F8 (Z): Process Requests on Bill to check all item at out time.
F9 (Z): Response Bill validate.

Hence, the functionality can be shown as per Figure the mapping of input to output done using functions. The functions perform the operation using inputs and provide output.

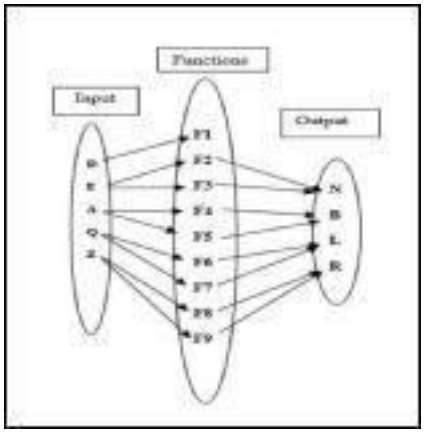

Figure 6.1: Function Mapping

7. RESULTS:

In Figure 7.1, initially the system in idle state. The Arduino microcontroller is currently running the setup() function which initializes all global variables and sets up communications with the modules.

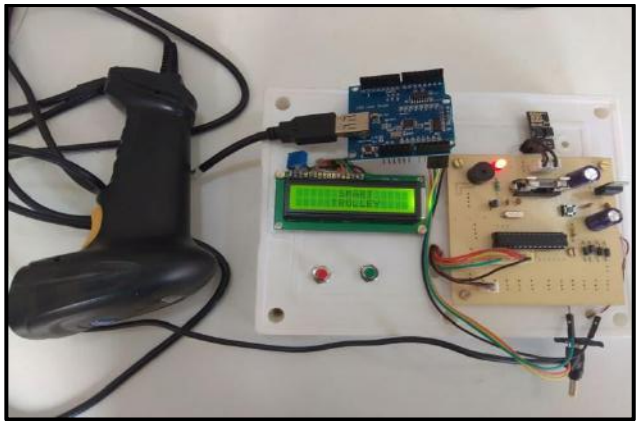

Figure 7.1: Initial Stage

In Figure 7.2, if user wants to cancel the item which he/she was firstly added by customer to the cart then he/she can scan those items in front of barcode scanner and press cancel button. This helps customer to remove the added product from bill automatically. This automatically updates the removed item by just scanning and pressing cancel button.

Figure 7.2: Item Cancelation

In Figure 7.3, when shopping is over, the purchaser comes to the billing section. The total bill amount will be displayed on the billing computer which depends on the trolley's database in the EEPROM of the trolley's Ardiuno board when user press the submit button. Means that after purchase over customer press the submit button so that all data which is in trolley's database is send to billing counter via WiFi module.

Figure 7.3 : Data sent for bill generation via WiFi

7. CONCLUSION:

The proposed system is easy to use, low-priced and does not require any superior training. It provides an easy, smart and effective way of shopping by using a simple design which is considered to be as enhanced and cost efficient mechanism for shopping providing flexibility and convenience to the customers in the shopping malls during the entire shopping process. This model keeps an account and uses of the existing improvements and various types of detection technologies which are used for item recognition, billing and record update. As the whole system is becoming smart, the prerequisite of manpower will fall, thus benefiting the merchants. The time efficiency will increase unusually since this system will eliminate the waiting queues. More customers can be served in same time thus profiting the merchants and customers as well.

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