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BillSmart- A Smart Billing System using Raspberry Pi and RFID

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ABSTRACT: As the technology is developing and seeing new inventions in various fields including machine learning, artificial intelligence, internet of things and so on, there is an increase in the expectations in the consumer point of view. With the fast moving lives, the consumers absolutely have no time to stand in long queues in order to get their work done. In this paper, we are presenting a smart shopping system using RFID and Raspberry Pi controller. The trolleys in the shopping malls are protocoled so as to automatically bill the products put into them and the final bill is sent to a web application which can be accessed in any phone or any hand held device. The system is also subjected to anti-theft management where the system doesn't let any customer take non-billed items.

KEYWORDS: RFID, Smart shopping, Internet of things, Raspberry Pi, IR sensor, Python.

I. INTRODUCTION

The word smart is trending lately in the field of IoT. Every object around us is being made smart so as to make our work easier. With the increase in internet technology, food items are available at our door steps whenever needed. But the experience of going to a mall and shopping the things all by ourself has its own advantages and disadvantages as well. The advantage is that we can carefully select the best product according to our choice and judge the product by seeing, touching and feeling it. The major drawback of this is standing in stretched out line of customers for paying off the bill. The brought forward smart shopping structure avoids this drawback and also has additional features for the convenience of the consumer. The intensified Smart Shopping Cart System helps the customers in minimizing the considerable amount of time that customers used to spend in shopping. In this smart shopping cart system , real-time updates on the inventories are also provided in the store management section. The main technologies that play a vital role in this proposed system are : (i) Raspberry Pi for achieving wireless communication with Server (ii) Infrared sensors (iii) RFID tags for product identification, and (iv) Web application displaying amount payable and managing the inventories detail. Radio frequency identification is swiftly and quickly advancing technology. Small tags present in the RFID systems are attached to the products. The RFID readers wirelessly read the tag attached to the product for collecting the information about it , that might be related with some random data records. Thus, RFID systems identify the objects and collect the information about it automatically, similarly as the optical bar code readers do. The Smart Shopping System with the Smart Cart has the prospective to make a very smart shopping affair easy, congenial, amiable and systematic to the customers, it also makes controlling of the inventories more comfortable and easier for the store management.

II. RELATED WORK

In [1] the authors have presented a their work in which eachcommodity in the Mall will be attached with a RFID tag, and each trolley will be attached with RFID Reader which would be working on the ZigBee. A centralized system would be there for any help and queries and for the billing transaction of the products by the customers.Even the exit gates of the mall will be laced up with the RFID readers for detecting any theft. There is no user interface and hence it is not a user friendly system.Vrinda et al in [2] have featured a cart equipped with an RFID reader, a ZigBee transceiver and an LCD display. This smart shopping cart keeps an account of the bill made by keeping running total of their

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purchases. LCD screen will show the total bill of the items present in the cart. System does not have a user interface and ZigBee is used instead of WiFi module.Authors in [3] featured that, the time spent at the queues for the bill payment in the shopping complexes can be cut off by the self scanning methodologies. Expiry date of a product is displayed while scanning. But there is no web application for user to communicate.The smart shopping with the trolley application in [4] state about creating an automated and centralized billing system (acbs) that can be used in malls and supermarkets. The customers need not wait in the queue at the billing counters for their bill paymentbecause by the use of pidsthey would be able to pay the bill online without any queue. Customers have an additional optionfor bill payment using their credit or debit cards. But this structure is not user friendly and efficient. Authors in [5] have proposed a shopping assistants that helps the customers in locating the products inside the store, if any product has any discounts on the move of the customers inside the shopping mall. There is no centralized system process presented in this paper.In general, the existing systems have the following features-

- A regular cart without any system integrated to it.
- No display of product details on the cart.
- Limit on the budget and alerting system is absent.
- Scanning of products only at the checkout counter with the help of barcode on the product.
- Barcode should be noticeable on the top of commodities else the product could not be read.
- The legibility of barcodes can be hindered by soil, humidity,water, corrosion.
- The employees or owner of the mart should manually check for demand or depreciation in stock of a particular product.
- Manpower is required to guide the customers through the mart to find the product of the product required.
- Payment is made only at the counter after waiting in long queues.

III. PROPOSED ALGORITHM

A. *Design Considerations:*

- Design of a web portal using python, html and php for creating a user friendly interface for paying bills and knowing the map of the mall.
- Use of Raspberry Pi so as to simplify the communication as it has inbuilt WiFi module.
- Display of product details in the card via LCD.
- Automatic scanning of products in the cart using RFID.

B. *Description of the Proposed Algorithm:*

The smart shopping system consists of trolleys that are incorporated with RFID readers and in all the commodities present in the shopping complex a RFID card is separately attached that has distinctive RFID number. As soon as the customerplace the product they want to buy into the cart, the RFID reader attached to the cart detects the RFID card number of the product to identify it. Each RFID card number is linked to the product it describes. All the information regarding the product associated with the RFID card is stored in the database which can be retrieved using a centralized server. All the activities are coordinated together using a Raspberry Pi controller. Each customer is given a membership card. When the customer swipes the membership card, all his login information is displayed on the web application. The application is dynamically updated as and when the customer places the bought commodities into the cart. The informative details of the commodity is flashed on thescreen attached to the trolley. The addition and removal of the products from the trolley is monitored using IR sensors. When the customer finishes shopping, he/she has to swipe the membership card again and the server calculates the total bill which would be displayed on the web application. The customer can pay the bill online or through mobile wallet. After the payment of the bill, the database is updated and the user can leave the store. At the exit gate, the RFID reader and an IR sensor checks the bill for confirming that no non-billed product is taken by the customer.

Step1: Start
Step2: Swipe the membership card and login with username and password.
Step3: Put the item attached with RFID tag into trolley.
Step4: RFID reader reads the tag information
Step5: The Raspberry Pi sends this information to the server via the WiFi module.

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Step6: The server stores the information in the database.
Step7: The total bill is calculated dynamically in the web application.
Step8: Final Bill get displayed in the web application
Step9: Payment of the bill.
Step10: If customer wants to pay through online wallet then go to Step11 else go to Step14.
Step11: Swipe the membership card again.
Step12: The information about the wallet is retrieved from database and the amount is deducted.
Step13: The database is updated.
Step14: Stop

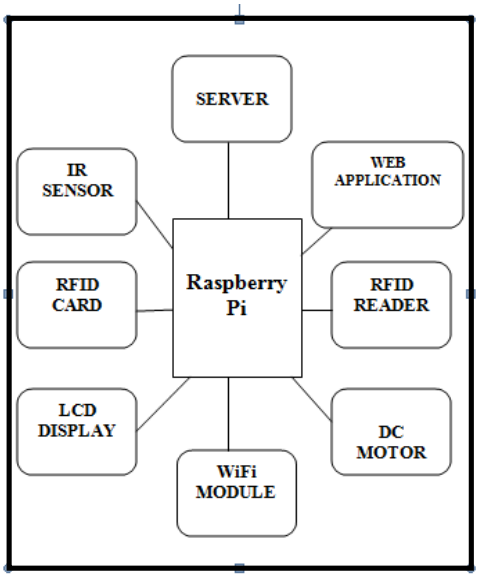

Figure. 1. Block Diagram of the system

- Server: It integrates all the components of the together.
- LCD Display: It displays the current product that is purchased and the total bill.
- IR sensor: It is used to count the number of products at the exit door as well as for addition and deletion of products from the cart.
- WiFi module: It is in-built in raspberry pi and is used to communicate information between the cart, server and the web application.
- DC Motor: It is used as a gate to reflect anti theft.
- RFID modules: it is used for scanning the products.
- Web Application: It contains the front end design for customer login and the map of the supermarket. It also displays the amount to be paid and mode of payment.
- Raspberry Pi: It is a controller which controls all the system components.

IV. PSEUDO CODE

Algorithm for the frontend:
Pre-requisites for algorithm to work:

- The customer has to be a registered user.
- The customer has to know the address of the webpage.

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- The user should first swipe the membership card and only then login in the webpage.

Begin

Enter Login credentials
If (user is admin)
Display the admin page with inventory and new user registration.
End If
If(user is customer)
Display dashboard, cart and route buttons.
If(dashboard is clicked)
Display the discounts available.
End If
If(cart is clicked)
Show the cart details dynamically.
End If
If(route is clicked)
Show the route map of the shopping mall.
End If
Pay the bill via cash, credit card or wallet.
If(credit card)
Redirect to the bank website
End If
End If
Customer has to log out.

End

Algorithm for hardware:

Pre-requisites for the algorithm to work:

- All the components should be connected to the right GPIO pins of the Raspberry Pi.
- The LCD had to be initialized using the python code.
- There shouldn't be any object near the IR sensor as it may detect it.
- The DC motor should be supplied with 5V power supply.
- NOOBS OS must be installed in the Raspberry Pi with all the backend code in its SD card.

Begin

If (IR sensor is activated)
Open the gate via the DC motor.
Display welcome message on the LCD.
If (Membership card is scanned)
Display the customer information on LCD.
Prompt budget entry.
While (Products are being scanned)
Display the product information on LCD.
Alert if the product is expired.
Alert is budget is exceeded.
End While
If (Membership card is re-swipped)
End of shopping.
Display the bill
Open the gate after payment of the bill.
End If
End If
Else
Keep the gate closed.

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End If

End

V. RESULTS

The smart cart is developed successfully with all the above mentioned features and it can be put into use. Amazon Go has recently launched its smart shopping which is similar to this system but with the absence of the web application. The web application designed is very user friendly and can be used to see the map of the shopping mall as well. A new user can register via the admin and start shopping. The mode of payment also has 3 options (i.e.) through online wallet using membership card, through credit or debit card, or through cash as the counter. The system developed is feasible and can be easily fit into the cart due to its size. The LCD display, web application and the hardware setup is as shown in the figures below.

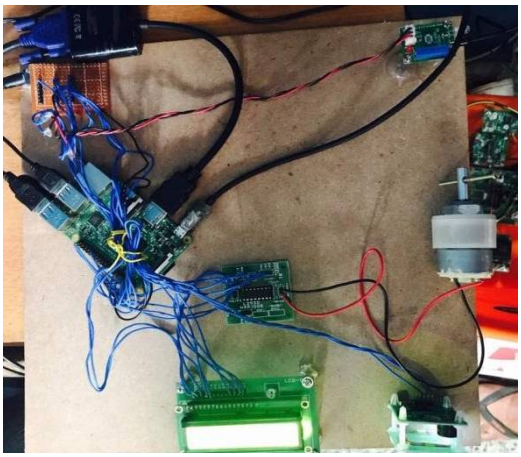

Figure. 2. Hardware setup of the system.

Figure. 3. LCD display of the system.

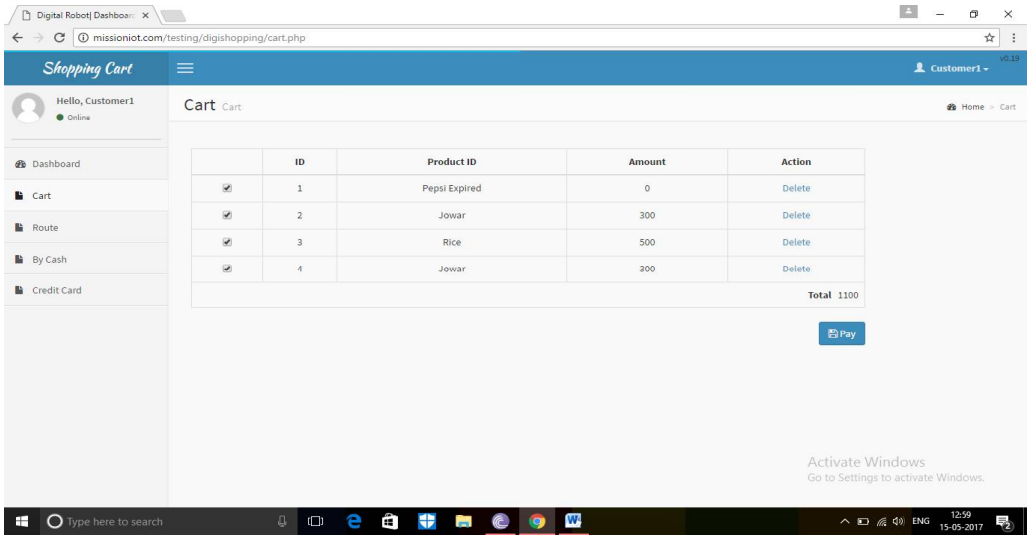

Figure. 4. Web application screenshot.

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VI. CONCLUSION AND FUTURE WORK

This prototype involves in providing the customers with a new and easy shopping experience. New technologies are implemented to provide the lowest delay time and smarter solutions. This shopping cart will enhance the method of shopping. Our hypothesis was to design a user friendly shopping cart that would enhance the shopping experience. The customer doesn't have to wait till the checkout or use their calculators or prick their heads to know how much the shopping cost has come up to and to see if they got it within their money constraints using the alert. Also for a person who is unable to read or find the product price printed on the product while purchasing doesn't have to seek the help of anyone to know it. They just have to scan the product and the product details are displayed. This shopping cart is user-friendly, reliable and very convenient for the customer.

The system can be extended to make the shopping cart "driverless" i.e., to follow the customer who activates the system and hence avoid the hassle of pulling it around.

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BIOGRAPHY

Dr. Mary Cherian is an associate professor presently working in Dr.Ambedkar Institute of technology, Bangalore. Disha DH, Chaithra KB, Ankita, Aishwarya Ravi are final year students pursuing an undergraduate degree in C.S.E in the same college.