Smart I – CART Automation System Using Zigbee and Communication Technology

Miss. Sai Deshmukh[1], Mr. Kiran Lingoji[2], Mr. Megh Makwana[3], Mr. Rohit Pardeshi[4]
(Symbiosis Institute of Computer Studies and Research)

Abstract- The main aspiration of this technology is that to reduce human efforts and time in mall using Smart I-Cart Automation System. This Automation is inherently the part of Communication Technology, it consists of communication devices to improve the effective performance of system.It is supreme and user friendly concept to reduce the efforts of public in day to day life at the time of shopping as well as billing too.

Keywords- RFID tag, LCD, RFID reader, Barcode reader, Trolley, Zigbee, Central billing unit, Recommendation Engine.

I. INTRODUCTION

We live in an age where humans are trying to automate every tasks which are repetitive and time consuming in nature, with the recent advancement in IoT based systems and wireless technologies like ZigBee and RFID it is possible to automate task which require manual intervention and is time consuming. For example waiting in long queues for billing at grocery, medical shops, shopping malls, gas stations etc. Such places usually have huge number of users and few counters for handling the billing process. The vendors are not mindful about the time wasted of the customer during this process, especially during rush hours and during weekends in few scenarios. There is a high probability of decrease in number of footfalls in such places. Thus our aim is to solve this problem with the help of wireless and IoT based system which are quiet popular these days, our solution is to improve the customer's user experience by automating the shopping process in an agile, rapid, transparent and less time consuming way. The solution includes an intelligent shopping cart called I-Cart which is an embedded system which be used in such places, it has a centralized server system for billing, recommendation, offers. For security purposes we will have RFID reader tags at the exit doors for anti –theft detection which would help reduce embezzlement. Also recommendation would help the user to navigate through the latest offers i.e our system consist of different types of recommendations like non-personalized, collaborative and content based filtering which is explained in the recommender section. This system is partially inspired by Delhi metro stations which has a huge number of users on a daily basis, users come swipe their card to enter the station and travel to their destination where another RFID reader is present which automatically charges the users based on the distance travelled.

,

Recommendation Engine

There are two basic architectures for any recommendation system:-

Content-Based Filtering: Such type of filtering focuses on properties of the product, i.e similarity of products is determined by measuring the similarity in their properties of the product and the tags associated with it.

Collaborative-Based Filtering systems: Such type of filtering focuses on the relationship between user and items, similarity of item is determined by similarity of the ratings of those items by the users who have rated both.

Each Recommendation System is discussed in the following sections: -

A.In a content-based filtering, we must construct for each item a profile, which is a record or collection of records representing important characteristics of that item. In simple cases, the profile consists of some characteristics of the item that are easily discovered. For example, consider the features of a movie that might be relevant to a recommendation system.

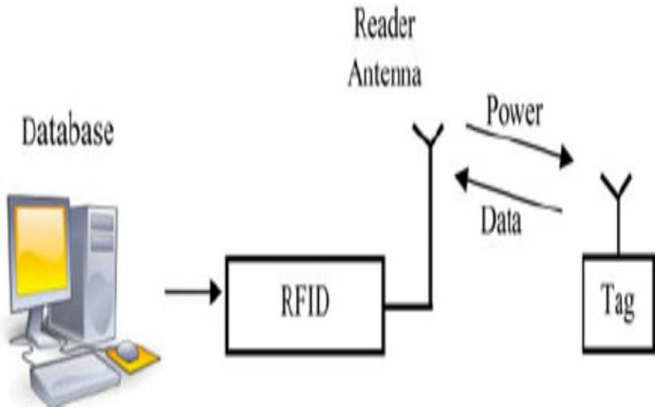
1. The set of actors of the movie. Some viewers prefer movies with their favourite actors.
2. The director. Some viewers have a preference for the work of certain directors.
3. The year in which the movie was made. Some viewers prefer old movies; others watch only the latest releases
4. The genre or general type of movie. Some viewers like only comedies, others dramas or romances.

B. In a collaborative based system we shall now take up a significantly diff erent approach to recommendation. Instead of using features of items to determine their similarity, we focus on the similarity of the user ratings for two items. That is, in place of the item-profile vector for an item, we use its column in the utility matrix. Further, instead of contriving a profile vector for users, we represent them by their rows in the utility matrix. Users are similar if their vectors are close according to some distance measure such as Jaccard or cosine distance. Recommendation for a user U is then made by looking at the users that are most similar to U in this sense, and recommending items that these users like. The process of identifying similar users and recommending what similar users like is called collaborative filtering.

Algorithm:

Step 1. Create a utility interaction matrix of the user and all the items available in the mart
Columns item1 item2 item3 ... item n
Rows user 1 user2 ... user n
This matrix will be of dimension
number of users X number of items sized.
This is matrix is usually called utility or interaction matrix.
Step 2. Once this matrix is populated there would be many users who wouldn't have rated enough products i.e example there would be many users whose would have rated few products like 2-3 or even null. Hence to make it morerich we would element such users.
Step3. Set threshold value (minimum number of items which are rated by the user) say for ex 100 out of millions.
int threshold => 100
Step4. Apply this conditional threshold and filter the users.
Step 5. Apply any machine learning or deep learning techniques like knn or autoencoder on it
Step 6. Query the output of knn of autoencoder for given users and decide the number of top n recommendation using Argmax function on the array of items
Step7. Query the array using the users rating vector for all products

Diagram

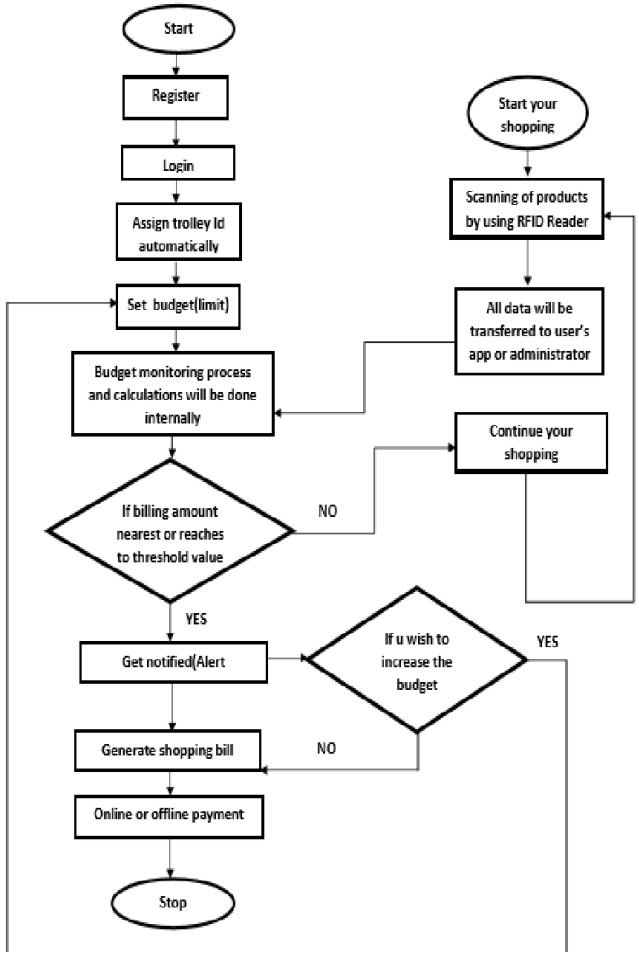


Steps of Execution:

All the items in the mall will be equipped with RFID tags. When person puts an item in the trolley, its code will be detected by RFID reader which is interfaced with processor. Reader send this code to ARM processor, after matching code with codes stored in SPI memory, processor reads item's name, cost & other details. Then it displays on LCD. The item details like name, cost & total bill of items inserted in trolley are displayed on LCD.
As we put the items, the costs will get added to total. Thus the billing is done at the trolley itself. Concurrently all details are displayed on LCD. We want to remove some inserted item then we press the deduct key and remove that particular item. That item's cost will get dedcuted from total bill and item removal message is displayed.

At the billing Counter the total bill data will be transferred to PC by wireless ZigBee transmitter interfaced with processor. It is 2.4 GHz RF module which works in free ISM band so does not require licensing.

Flow Chart:



Zigbee:

Zigbee is only used for communication purpose in it. It consist low power consumption, low bandwidth. When ward person communicate with other one then that time zigbee will be used in it. It is reliable, self-healing ,selfconfiguring network. It takes less battery at the time of communication. Its transmission packets are small in size so it will helpful to easily communicate with each other. It is also more popular in an acknowledge based protocol.

MATHEMATICAL MODEL:

X is set of input. X={x1,x2,x3} x1=User Id for Login during payment.
x2=Password for Login.
x3=RFID tags for product identification.
S = {C, P, T, B, F,SS, Success, Failure} Let S be the system where,
C be the set of Customers where, C = {C1, C2, C3……Cn}

P be the set of Products where, P = {P1, P2, P3……..……Pn}
T be the set of Transactions where, T = {T1, T2, T3…….. Tn}
B be the set of Bills where, B = {B1, B2, B3……Bn}
F be the set of Functions where, F = {F1, F2……Fn}

- Add_Product ():Function to add product into the cart
- View_Product (): Function to Get list of all products
- Remove_Product(): Function to remove product from trolley
- Add_Transaction ():Function to add Transaction done by customer
- View_History ():Function to Get history of items purchased by that user
- SS is the of the server database. This database is responsible for storing user information related to cloud interactions

Suggested System and advantages: -

- Instinctive and prompt Invoices of the products
- Usage of RFID tags over barcode scanner
- 3.No human personnel is needed to process the billing.
- Simple to speculate or trace the product.
- LCD will show the accurate bill at each instance the shopper adds or removes any commodity from the cart.
- Allows multiple product identification at a time/parallel functioning.

II. CONCLUSION

Accepting the advanced technology is basic need of the country to compete with the rapidly growing market at international level. Our proposed system is one the step towards this objective. I-cart implementation in our country will help to reduce the total time required to buy a product from store. If someone compares E-cart and I-cart, I-cart will be always superior than E-cart as big part of our country's population prefer to go to shop or mall to buy the products. Ease of managing the stores and malls will also inspires the owners to think about other ways of automation in their businesses. RFID tags are more durable and efficient than the barcode system which can be damaged due to physical parameters. This ensures easy and precise scanning.The product and commodity catalogue features helps users to find the items accurately.Mobile applications can be developed to avoid smart card and GSM. Inventory management can be incorporated using IOT which in turn helps in automation of stock management.

III. REFERENCES

[1]. Roussos G, BirkbeckColl." Enabling RFID in retail"IEEE Computer Magazine,Vol.39 , Issue:3PP: 25 – 30 ,20 March 2006.[
[2]. Mr.P. Chandrasekar and Ms.T. Sangeetha "Smart Shopping Cart with Automatic Billing System through RFID and ZigBee ", IEEE,2014.
[3]. [Ms.Vrinda, Niharika, "Novel Model for Automating Purchases using Intelligent Cart," e-ISSN: 2278-0661, p-ISSN: 2278-8727Volume16,Issue 1, Ver. VII (Feb. 2014), PP 23-30.
[4]. http://www.rfidjournal.com
[5]. http://www.ise.ait.ac.th/wp-content/uploads/2018/03/Final-thesis-report-Smart-Shopping-Cart.pdf
[6]. http://en.wikipedia.org/wiki/zigbee.
[7]. Hsin-Han Chiang, Wan-Ting You, Shu-Hsuan Lin, Wei-ChihShih.,"Development of Smart Shopping Carts with Customer-Oriented Service.", InternationalConference on System Science and Engineering (ICSSE) [2016].
[8]. SatishKamble, Sachin Meshram, Rahul Thokal, RoshanGakre "Developing a Multitasking Shopping Trolley Based On RFID Technology", International Journal of Soft Computing and Engineering (IJSCE), Volume-3, Issue-6, January 2014.
[9]. Ashmeet Kaur, AvniGarg, AbhishekVerma, Akshay Bansal, Arvinder Singh, Arduino Based Smart Cart,International Journal of Advanced Research in Computer Engineering & Technology (IJARCET), 2 (12), 2013. *(PDF) RFID based Advanced Shopping Trolley for Super Market*. Available from: https://www.researchgate.net/publication/318946385_RFID_based_Advanced_Shopping_Trolley_for_Super_Market [accessed Jul 06 2018].
[10]. NarayanaSwamy J.C, Seshachalam D, Saleem Ulla Shariff, Smart RFID based Interactive Kiosk Cart using wireless sensor node, 2016 International Conference on Computational Systems and Information Systems for Sustainable Solutions, 2016.