A Proposed Technique for Implementing Smart Cart Based on Artificial Intelligence

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Abstract—Over the course of time the craze of shopping has been increasing tremendously. With this increasing trend the queues in the shopping mart are increasing proportionately. Customers end up in wasting their precious time in long queues and standing by the billing counter. Moreover, in this fast pace life, people tend to forget the necessary articles to be purchased at the shopping center and thus could not make the optimum use of their planned visits. Keeping these things in mind, in this research paper, we propose the recommendation system to make sure that the customer do not forget to buy the crucial articles in their visit. Also, to prevent the problem of long queues at the billing counter and for the ease of the customer, the automated billing system have been proposed in which cost of each product will be per-calculated through smart basket or trolleys. Thus, it will not only save the time of the customers but will provide them hassle free shopping experience.

Keywords— *RFID, Arduino Uno, Shopping centre.*

I. INTRODUCTION

In today's world, it is not an easy task to schedule a shopping session and visit a mart frequently therefore people prefer to buy all the necessary articles in the least visits possible. Making frequent visits to the shopping centre is already a bit difficult and hectic task for the buyers and then forgetting some necessary or relevant items would only exacerbate the situation. Also, it is not possible for the people to pay a visit at shopping centres, for all the small products they remember momentarily or for the ones which they easily tend to forget while they are out on shopping. Generally, people recall products only when they need it or when they have already come out from the shopping mart. So, there is imperative need for a system that can assist customers in buying all the

products that they need currently or the ones which they might require in near future in a single visit. Recommendation System can resolve the above dilemma with ease. Implication of a recommendation system in the above scenario will undoubtedly serve as an appropriate solution, as it can suggest the products to customers which they may probably buy while they are out on shopping in addition to the ones which they are already buying. In this system, various suggestions will be given to the customers based upon the products which are already in their carts [1]. The aim of this approach is to make sure that the customers make an optimum use of their visits in stores and go home with satisfaction. It will make sure that customer does not forget any necessary item.

For majority of customers budget is a primary concern. But when the customers are in a supermarket, they tend to forget everything as they are surrounded by endless tempting shelves which attracts them. Sometimes their budget tends to overshoot and the amount of bill goes beyond their limit. Then they have to exclude some articles at the billing counter or they have to pay those extra bucks [2]. Therefore, to solve this problem, this system has been proposed in which the customer just has to enter his payable capacity right before starting his shopping session and in case at some point or the other if the customer will exceed his payable capacity it will immediately notify him.

Standing in the long queues at shopping centre is not only very onerous but also a very mundane task to do. It consumes lot of time for an individual to get their products scan exclusively at the reception and as a result we always found long restless queues in the shopping centre especially on weekends or on some festive occasions.[3] Also, this approach is not at all efficient if someone is in rush or when one has only few items in their buying list, as one would not be able to complete this whole task early. Even if one manages to collect his required items briskly, one has to ultimately stand in long queues and also have to bear the entire time consumed in manual scanning & billing of other customers' products at billing counter. Our proposed approach of automated billing system through smart

basket will help the customers to skip this tedious task. According to our model, smart cart at shopping complex will automatically calculate the total amount by adding up the prices of every single article that are being put in the cart/basket by the customers. When total amount has already been calculated by smart cart, customers then only have to quickly pay the bill at counter and leave with a hassle-free shopping experience [4]. This approach can simplify the problem of long queues to a large extend.

II. PROPOSED MODEL

A. Block Diagram

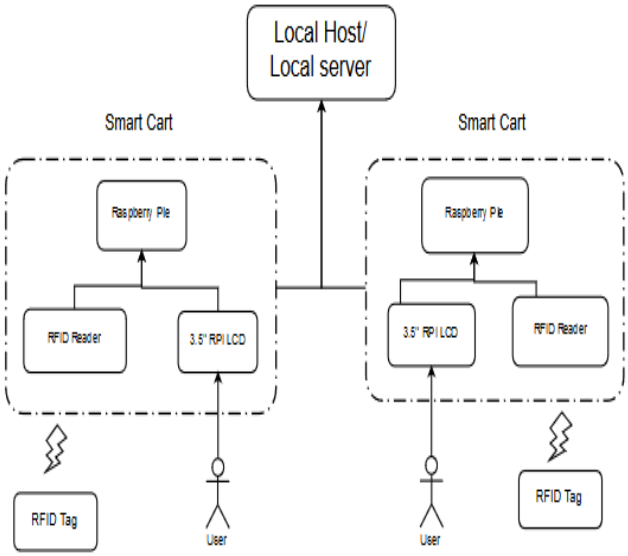

Fig 1: Block Diagram of the proposed model

B. Hardware Components

1. Raspberry Pi

Raspberry Pie has all the capabilities as that of a computer and therefore work as a functional single board, small-sized computer. It consists of only one circuit board. Raspberry Pie will the main component of this module as it will assist the interaction between various hardware devices and user. The fig-2 demonstrates the Raspberry Pie with other associated components present in it.

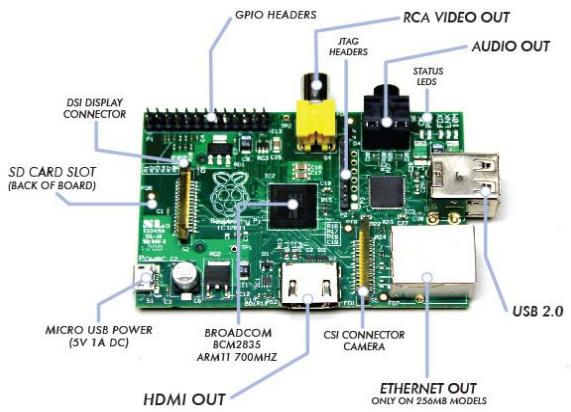

Fig 2: Raspberry Pie with associated components explained

2. RFID TAG

RFID Tags work on the RFID technology which is short for the Radio Frequency Identification. It is a semi passive tags that does not have their own energy and relies totally on the RFID reader for identification or transferring information. It works on the Radio waves. RFID tags can be automatically identified by the RFID reader from a certain range. It can be placed on the various shopping items in order to keep a track of them and organize various items according to their type, price and various other factors.

Fig 3: RFID Tags

3. RFID Reader

Fig 4: RFID Reader

RFID Reader also operates on RFID Technology. They are used to identify various RFID tags by using Radio waves and store their data into a device. Unlike barcode scanner, RFID tags does not require tags on the products to be in a

line of sight, in order to get scanned, as the waves emitted by reader is multidirectional.[5] Thus, any chances of the product being not scanned by user are severely reduced.

4. RPI LCD Display

Fig 5: RPI Screen Display

It is a 3.5-inch LCD display that can be easily mounted on the raspberry pi for its functioning. This is display is a user interactive display as it will be fully touchscreen and have quick response time. All the data regarding shopping amount, current budget, suggestions etc. will be displayed on this screen. Most importantly it's highly durable and would be easily able to tackle huge number of users in a mall on a busy day.

III. Integration of AI

C. Concept

The model implements the concept of recommendation system in day to day offline shopping scenarios. The aim of this model is to assist customer in buying all their desired products in the single transaction, instead of buying the same items in a series of transactions. This system will provide Non-Personalized recommendations to the user. These recommendations are not user-specific rather they present similar suggestion to every user. The main advantage of this system is that it does not require any real time update from the user, as it only operates on the data collected during the previous purchases by different users. This concept is also helping in future for big data analysis if there are multiple users from different location, we can distribute with respect to the clustering approach if possible.[9]

Based upon different customer's accredits the similar products which are frequently bought simultaneously are clubbed together in group of 4 to 15. This is achieved through 'K-means-clustering' or 'K-nearest-Neighbors' clustering algorithms. An allocation model is further built in order to predict a certain group based upon some particular accredits. Hence, a new customer will be classified into the already existing groups on the basis of the first product they will scan.

D. Methodology

A collaborative filtering recommendation technique is employed in this model in order to improve the accuracy of the suggestions. A database is being created by consuming this algorithm where we are going to administer an item as an input and then on the basis of the resemblance factor there is going to come up a whole list of items. [6] This filtering procedure operates only on the 3 data attributes i.e. a consumer, a product and an affinity score between products. Here, the affinity score is the compound score which varies on a scale of 1 to 10. Categorizing the similar items, on the basis of wide range of consumers who bought them, is the main objective of collaborative filtering in a secure manner by choosing the right choice. [8]

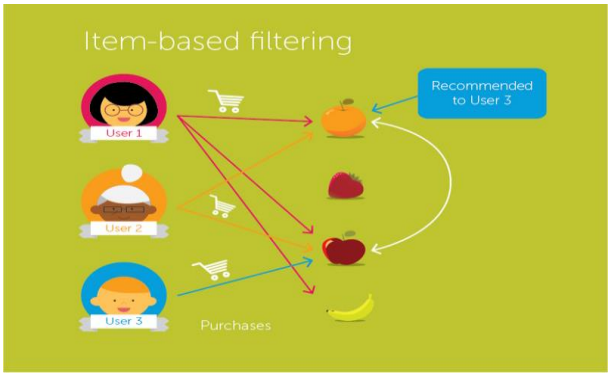

Fig 6: Demonstration of Collaborative Filtering model

Further, we have implemented the concept of MRR in the existing model. Evaluating the list of products is the main objective of the Mean Reciprocal Length. Let's say we have three products X, Y, Z in the mentioned order but the consumer only preferred product Y. According to the above-mentioned order the position of Y is 2. Therefore, the reciprocal position of Y will be ½. The recommendation of a product will be better if the average reciprocal position remains higher.

$$\mathrm{MRR} = \frac{1}{n} \cdot \sum_{i=1}^{n} \frac{1}{r(Q_i)}$$

Fig 7: MRR derivation formula

E. Implementation of Algorithm

Initially a user Id will be allotted to any consumer who will be using the cart for scanning their desired products. Only two attributes mainly the user-Id and the item-Id are analyzed by the system initially such that, all the item Id's are placed corresponding to the user who will scan them. This can be seen in the Table-1 as user with user Id 101 can

be seen to have bought different items with id's 7003, 7011, 7007, 7015 etc.

TABLE 1: INITIAL DATA OF USER ID AND ITEM ID.

S.NO.	User Id	Item Id
1	101	7003
2	101	7011
3	101	7007
4	101	7015
5	102	7003
6	102	7011
7	103	7007
8	104	7015
9	104	7011
10	104	7020

Now the third factor i.e. affinity score will play most important factor in generating the recommendation for a product. As shown in Table-2 an affinity score table can be generated by taking into account any two items which are bought together. The affinity score between the two items will be directly proportional to the number of times they have been scanned together. [7] For example, the two items X and Y with a score of 6 when compared to items X and Z with a score of 4, indicates that there are larger number of the consumers for the former two items which has a larger affinity score.

TABLE 2: DIFFERENT AFFINITY SCORE FOR DIFFERENT PAIRS OF ITEM BOUGHT AFTER ONE ANOTHER.

S.NO.	ITEM LIST A	ITEM LIST B	SCORE
1	7007	7003	6
2	7015	7011	6
3	7003	7007	0
4	7011	7015	3

Now as soon as the customer choose to scan a product (let say of product id 7020) the system will then traverse the data inside table number 2 and extract all the items in the B list associated with scanned item in the A list. This list will be then arranged in the descending order based upon their affinity score. For example, as shown in table-3, the affinity score for product 7020 with the product 7003, 7011, 7007, and 7015 is 8, 5, 5, and 1 respectively.

TABLE 3: AFFINITY SCORE TABLE BETWEEN ITEM ID 7020 AND OTHER.

Recommendations for item 7020

S.NO.	Item List B	Affinity Score
1	7003	8
2	7011	5
3	7007	5
4	7015	1

From this extracted data the first three items with the highest affinity score will be selected for the recommendation.

IV. WORKING PROCEDURE

F. *Working UI*

In order to completely interact with the system a touchscreen RPI LCD panel will be available to the user in his entire shopping time. This LCD will be attached to the shopping cart through Raspberry Pie module.

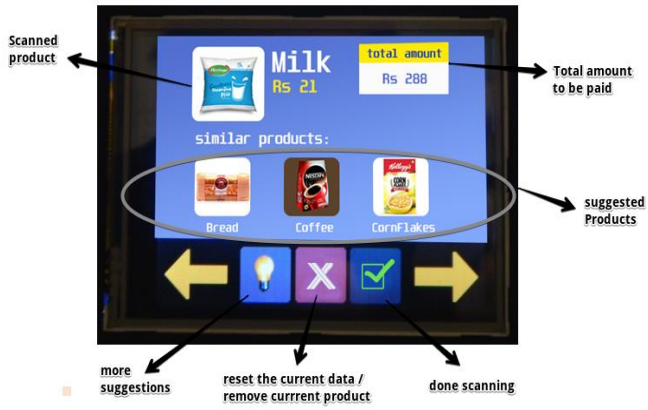

Fig 8: LCD Screen Display: scanning a product

When user considers a product to buy and brings his desired product near the RFID reader, it will immediately scan the product's MRP through the RFID tag placed on the product. The scanned product with the associated image and the price will be visible to user in the LCD panel, attached with the cart. The panel will also suggest 3 products based upon the products which are already in the cart or which are already scanned by the user. Suggestions will help user to also consider the related products which otherwise he might have skipped or forgotten. In addition to this, total sum amount will also be displayed on the top right corner which will further help user to keep a track on his budget as shown in fig-8.

Fig 9: LCD Screen Display: alert on reaching budget limit

In addition to this when any user will interact with the LCD for the first time during a visit to the mart, it will ask the estimated budget user wish to spend in the entire shopping. By storing the budget amount, the cart will give an alert to the user if in case he exceeds his budget amount. As depicted in fig-9 the panel will give a brief alert to the user on every new product scanned after the user has exceeded his preset budget amount.

Once user is done with the scanning his all desired products, user can press a completed button placed below the shopping screen. As soon as he presses this button a QR code will be generated on the user screen, which can be scanned at the billing counter. As all the product are already finalized and scanned, user will only have to pay the final amount generated.

V. CONCLUSION & FUTURE SCOPE

The suggestions for the products can be personalized based upon individual user experience, if the users are provided distinct login ids. Through this more accurate suggestion can be generated for the users to further ease their buying experience. Such data can store on the server in order to implement machine learning algorithms. Users can also be able to see and compare their previous months shopping expense to be more and more frugal in their shopping. Furthermore, this data can also be used by the owners to analyze customer buying patterns, tracking their movement or observing where his customer is spending more time, are they buying product from a place after looking it, or moves through, or did not stop at all. Analyzing these patterns can help owners significantly to organize their products better. Also, e-bill can be generated from the same server and could be share to user's contact number or mail id. Further this data of individual customer on server can be secured by decentralized technology such as Block-chain to make it tamper-free.

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