

SMART TROLLEY FOR SUPERMARKET

Project ID: 2020-078

Project Proposal Report

Satheesan.P

Nilaxshan.S

Thisanthan.R

Priyanka.R

Bachelor of Science Honours Degree in Information Technology

Department of Information Technology

Sri Lanka Institute of Information Technology

Sri Lanka

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Declaration

“We declare that this is our own work and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.”

	STUDENT NAME	STUDENT NO.	SIGNATURE
1	Satheesan.P (GROUP LEADER)	IT17095136	
2	Nilaxshan.S	IT17037648	
3	Thisanthan.R	IT17386296	
4	Priyanka.R	IT17033374	

Supervisor: Mr. Jesuthasan Alosius

Co-Supervisor: Ms. Janani Tharmaseelan

The above candidates are carrying out research for the undergraduate dissertation under my supervision.

Signature of the supervisor:

Date:

Abstract

Electronic commerce has developed to such an extent to provide convenience, comfort, and efficiency in day-to-day life. Nowadays there are lot of shopping malls are emerging. A supermarket is a place where customers come to purchase their daily using products and pay for that [1]. Lots of people spending too much of time in the supermarket to purchase their goods. Because there is no proper way to pay the bills, they have no idea about present day deals / offers and people face difficulties in choosing the products. The study aimed to provide a smart trolley for a supermarket which helps the customers to get benefit through the system. Techniques such as recommendations, voice assistant, and image processing and loyalty customer program are used in order to enhance the performance of a smart trolley. Membership card is used to differentiate the loyalty customers from others. Recommender system will analyse the existing things where we can find the frequently purchased products which the customer like most and wish to buy will be recommended for them, it increases the sale percentage. Customers can able to get the location of all products in the supermarket. Voice assistance will help customer to get details about deals/ offers and upfront without the need of reading the lengthy product specification and also without the need of any interaction with customer support executive. Smart trolley contains scanner which will scan the product and display all the information in the LCD screen. It helps the customer to get the bill for their purchase in a flexible manner.

Keywords: - Recommendation, Voice Assistant, Image Processing, Loyalty customer Program

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List of Abbreviations

Abbreviation	Description
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1. INTRODUCTION

Nowadays there are lot of shopping malls are emerging. Shopping mall is a place where individuals get their everyday necessities [2]. The people always need something to help them doing a works rather doing themselves because of their engaged life. In this inventive world, each malls and supermarkets utilize shopping trolleys to help customers to choose and purchasing the items which they expect to buy. Smart trolley system which provide fast purchase and great convenience to customers. This system works only for those customers which are having the membership card of the supermarket. The proposed system starts to work when a customer gets into the supermarket and take the trolley. Each trolley has its own RFID reader. So, the smart trolley reads the RFID tag which is in the membership card of the customer. There is a QR scanner facility to read the QR code of the product which the customer is taking and shows the price details and other details of the system. The QR scanner is working with the use image processing which helps to read the QR code of the product. So, customers can easily get to know the total amount and can purchase according to their budget. And also, with this there is no need for customer to wait in the queue for the scanning for the product items for billing purpose. The customer requires downloading a mobile application. The system will also give recommendations for customers before choosing products and also after they purchased products. This design will reduce the efforts and time consumption of the user.

Background and Literature Survey

1.1.1. Background

In the early days of retailing all products had to be fetched by an assistant from shelves on one side of a counter while the customers stood on the other side and pointed to what they wanted [3]. Also, many foods did not come in the individually wrapped consumer-size packages taken for granted today, so an assistant had to measure out the precise amount desired by the consumer. These practices were obviously labour-intensive and therefore quite expensive. The shopping process was slow, as the number of clerks employed in the store limited the number of customers who could be attended at one time.

The concept of a self-service grocery store was developed by Clarence Saunders and his Piggly Wiggly stores. His first store opened in Memphis, Tennessee in 1916. Saunders was awarded several patents for the ideas he incorporated into the Piggly Wiggly stores. The stores were a financial success and Saunders began to offer franchises.

A&P was another successful early chain in Canada and the United States, having become common in North American cities in the 1920s [3].

The general trend in retail since then has been to stack shelves at night and let the customers get their own goods and bring them to the front of the store to pay for them. Although there is a higher risk of shoplifting, the costs of appropriate security measures will be ideally outweighed by the economies of scale and reduced labor costs [3].

1.1.2. Literature review

Modelling of Future Automatic Trolley System based on Sensors and Image Processing Guidance for Supermarket [2]

This paper proposes a small trolley system which provide fast purchase and great convenience to customers. The main objectives are to eliminate human labour to push trolley and to reduce the time of the queue in supermarket. This automatic trolley system is an intelligent system which contributes as an efficient system in shopping mall to follow human and avoid the obstacles in the path. The proposed system starts to work when a customer gets into the mall and take the trolley. Each trolley has its own RFID reader. So, the trolley follows the customer who has the corresponding RFID card called as user card. The movement of the system is controlled by the ultrasonic sensor and RFID tag. The QR scanner working with the help of image processing used to read the QR code of the product which the customer is taking and it shows the price and other details of the product.

RFID Based Smart Trolley for Supermarket Automation [4]

This paper describes about the designing of a trolley based on RFID reader for supermarket automation. RFID reader with electronic hardware system is fitted with the trolley to make the purchase comfortable. Each and every product will contain the RFID tag, it has unique ID number so that it is used to identify the product. The RFID reader gets information about the product from RFID tag, and when the customer put the product in to the trolley, when item is shown in front of the reader, the amount of the item is added to the purchase bill, and is shown on the LCD display. The trolley is programmed in such a way that it will find the rack number displayed on the LCD. It also has the provision for removing the items from the trolley where the cost is removed from the total cost .Once the items are added, the cost is added up and when it crosses the certain limit, it gives an alarm signal to indicate that the customer budget has exceeded.

Automated Smart Trolley for Supermarkets [5]

In this paper, trolley has done with a prebuilt RFID reader and display. These readers can read RFID tags in which details of the products are present. In the supermarkets each product will have RFID tag that holds whole information about that product. That is price, quantity, etc. Customer can scan the product tags to RFID reader and add the products to the cart by switch present in the trolley for adding and removing of products. They can edit the basket anytime during shopping. The total products in trolley amount is calculated automatically and displayed on display. There would be a system for billing where customer would scan their tag ID and transfer the product details for billing. When customer finishes up shopping, shopping end button is pressed. When it is pressed, through Zigbee details of the customer purchased is displayed. Payment is also made by paying total amount.

Smart Trolley using Smart Phone and Arduino [6]

In this paper, RFID tag is attached to the membership card of the customer which is provided by the supermarket to their regular customers. RFID Reader is attached to shopping trolley or shopping basket which detects the presence of the regular customer and with this, shopping trolley will act as a Smart Trolley. The regular customer requires downloading a mobile application and then the smartphone act as a barcode scanner. With the help of barcode scanner, the barcode is generated which is send to Arduino through Bluetooth Module. Once the user is done with his/her shopping and near to billing counter, user press the button on the trolley and data which is displays on the LCD would transfer to the computer. This is done by using NRF24L01 which is a serial peripheral interface and with this data will be transfer from the trolley to the computer at the billing counter.

Smart Cart with Automatic Billing, Product Information, Product Recommendation Using RFID & Zigbee with Anti-Theft [1]

In this paper, the intention is to provide centralized and automated billing system using RFID and ZigBee communication. Each product of shopping mall, super markets will be supplied with an RFID tag, to identify its type. Every cart contains PID (Product Identification Device). Specifically, PID contains a microcontroller, LCD, an RFID reader, EEPROM, and ZigBee module. There will also be a centralized database from which we can give product recommendation to the customer. The centralized database will give product recommendation and information about the product on the LCD screen present on the shopping cart, which will help the customer in buying products.

Research Gap

	Online Payment	Loyalty Customer Program	Weight Sensor	Detect Product Image	Recommendation	Voice Assistant	Location
Smart Cart with Automatic Billing, Product Information, Product Recommendation Using RFID & Zigbee with Anti-Theft [1]	✓	✓	✗	✓	✓	✗	✗
Modelling of Future Automatic Trolley System based on Sensors and Image Processing Guidance for Supermarket [2]	✓	✓	✗	✓	✗	✗	✗
Smart Trolley using Smart Phone and Arduino [6]	✓	✓	✗	✓	✗	✗	✗
Smart Trolley in Mega Mall [7]	✓	✗	✗	✓	✗	✗	✗
Automated Smart Trolley for Supermarkets [5]	✓	✗	✗	✓	✗	✓	✗
Smart Trolley using IOT [8]	✓	✗	✗	✓	✗	✗	✗
RFID Based Smart Trolley for Supermarket Automation [4]	✓	✗	✗	✓	✗	✗	✗

Table 1.1: Research Gap

Research Problem

In supermarkets, every time customer has to put item one by one in the trolley and estimate the total price. If the budget allows then go to billing counter where mall staff member does the scanning of each product then further move to the billing process. So, each customer has to wait in queue for his/her turn which takes too much of time. It is a troublesome process which resulting in a heavy crowd at the counters. If a person from outside saw people are waiting in a queue to pay bills, that particular person does not show eager to go to purchase. Supermarket customers find it difficult to choose products from a large variety of products. Access to products with common attributes prevents customers from searching in confusion or wasting time. They also, don't know about the present day offers/deals that exit in the store on the item that they need to purchase. There is no system for the customers to answer their queries.

2. OBJECTIVES

Main Objectives

Developing a smart trolley for the enhancement of supermarket for the benefit of the customers.

Specific Objectives

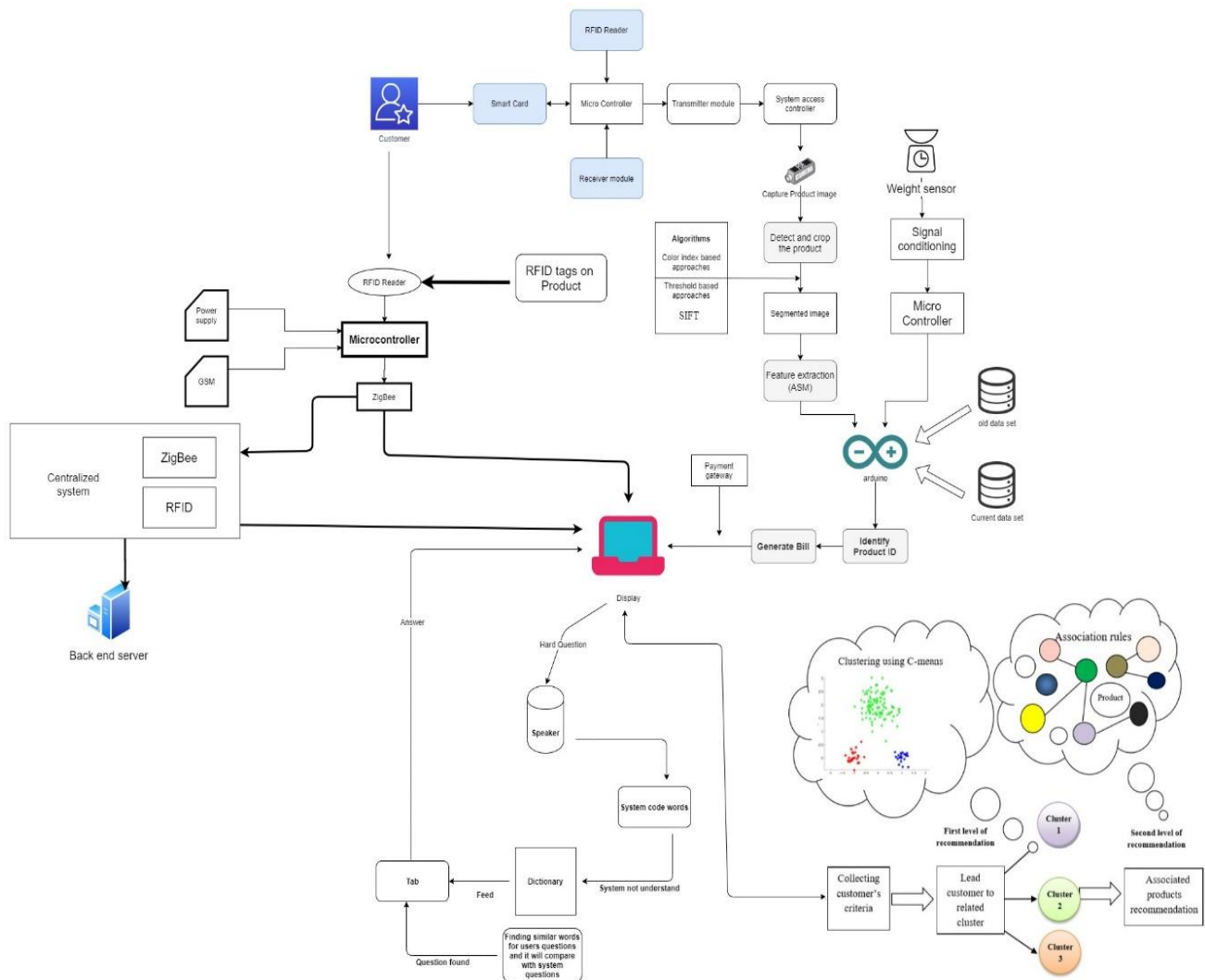
- Achieving faster billing system and also helps buyer to know the bill details in advance so that they can plan accordingly in affordable prices.
- Providing support for the customers while purchasing by giving details about present day offers/details through voice assistance.
- Recommending personalized items to customers to prevent customers from confusion of choosing products.
- Showing location of customers in order to prevent searching for products.

3. METHODOLOGY

This chapter explains about the methodology we intend to adopt to achieve the overall aim of proposing effective mechanism to develop a smart trolley for supermarket.

The proposed mechanism will be carried out by utilizing the following four components effectively.

Figure 3.1: High level Diagram



Loyalty Customer program with checkout and showing location of products

Read the Loyalty card of the tag and send it to the microcontroller. The microcontroller then send the card details to the transceiver, which send it to the server. The server then receives the relevant information and send it back to the microcontroller using the same transceiver. According to the customer information & Purchased product information are received, the microcontroller displays billing information about the LCD fitted on the display.

The system is almost similar to the one using RFID card reader for the addition of a smart card to each trolley. The system provides the customer with two options of payment namely through cash and/or through the smart card. The smart card works like a prepaid card. When the customer chooses the trolley, respective smart card will be pre-recharged with a certain amount of money. At the end of shopping, the customer can easily make the payment through the smart card.

Collect the comprehensive multi objective database for different element of supermarket product on the selected supermarket and develop a GIS based interactive application (iFaME) to manage different Product at the supermarket.

Image Processing and the use of Weight Sensor

Customers can easily scan the products to buy, and display all the information related to the product in the display (weight, quantity and price). Weight is measured by weight sensor when scanning the items to be purchased and placed inside the trolley. Weight sensor is used to match the measured weight with the actual weight to avoid abnormal activities. Each time when the products are placed inside the trolley its weight is checked. If any customer after purchasing the product changes his mind and wants to return the product, he just has to scan the product again, product picture will be taken to confirm intended product from the Smart Trolley's system and remove them from the system.

Wireless smart-device stores all the scanned products and the measured weight of the trolley. And it is linked to the supermarket's backend database, which contains the details of products such as the cost of goods, actual weight, and available stock. Scanned products are automatically added on a smart device in a smart trolley. This will reduce the number of customers who go to the supermarket central billing counter. With this system, we can reduce time spent at billing counter.

Recommending products to customers

The system includes two levels of product recommendation. First level recommendation is done before purchasing product. The second level of recommendation is after purchasing product. Initially product recommendation system recommends products that have closely related with customer's criteria. In second level it recommends associated products to purchased product by customers to complete buying process and to aware them from potentially related products with their desired products. First, we collect products' data of previous purchases. Then we cluster products based on previous purchases and seasonal buying patterns. Addition of new products to the system is done in two ways.

- New type of products
- Different type of available products

First case is simple because products have clustered by type and addition of a new type of product is easy. Second case is more complex than other one. These products after adding to the system should be in correct place between the clusters to accordance with other products in the system. It becomes a classification issue that we solve it using classification algorithms. Customers are clustered based on the profile built using previous purchases. Then collect information about history of shopping behaviour of customers. This information includes items that often when a product is purchased other products to be purchased with this. From this data we can explore the relationship between products by a data mining application called as association rule mining. Using these rules, we can find buying patterns. The relationship between the products will increase the likelihood of buying the products with together.

Voice Assistant

First we will let the customer to ask question using microphone system will check the answer with the already implemented system code words in some case system will not understand some similar words (ex: place =location) .In that case it will search the dictionary and find the meaning of the word and then display the answer to the customer according to the meaning.

4. DESCRIPTION OF PERSONAL AND FACILITIES

Member	Component	Task
Satheesan.P IT17095136	Recommending products to customers.	<ul style="list-style-type: none"> • Recommendation is done to analyse customer needs. • It uses the purchase history of the user and the user's behaviour of repetition during purchases in a supermarket. • The user's behaviour of repetition can be characterized by his/her or tendency to purchase the same item in regular time periods. • Association rule mining is to find insightful associations from transaction data.
Nilaxshan.S IT17037648	Loyalty customer Program with checkout and showing location of products	<ul style="list-style-type: none"> • Identify the loyalty customers from the rest and facilitate them to use the trolley. • Issuing digital loyalty card to the customer and scanning their profile from our loyalty reward application. • RFID tag is in the loyalty membership card and RFID reader in the trolley. This connect the loyalty card and trolley. • Application wise handling the payment. • Reward application and setup an account for their usage and that allows them to buy a product without having to swipe a card and standing in line.

<p>Thisanthan. R IT17386296</p>	<p>Image Recognition and use of weight sensor</p>	<ul style="list-style-type: none"> • Scan the products to buy, and display all the information related to the product in the display (weight, quantity and price). • Weight is measured by weight sensor when scanning the items to be purchased and placed inside the trolley. • Weight sensor is used to match the measured weight with the actual weight to avoid abnormal activities. • If you want to remove items inside the trolley, you have the option to remove them from the display. • If any customer after purchasing the product changes his mind and wants to return the product, he just has to scan the product again, product picture will be taken to confirm intended product from the Smart Trolley's system and remove them from the system.
<p>Priyanka.R IT17033374</p>	<p>Voice Assistant</p>	<ul style="list-style-type: none"> • Customers asks the questions using microphone. • It will check the queries with answers already implemented in the database • If the customer asks hard questions in hard words it will be checked in the dictionary • Then it will reply in text

Table 1.3: Description Of Personal And Facilities

Budgets

Item	Cost(lkr)
Weight Sensor	1500
Camera	2000
Arduino	3000
Raspberry pi	9000
LCD Screen	1500
Microphone	800
RFID reader	1200
Others	2000
Total	17000

Figure: 4.1 budgets

Work Breakdown

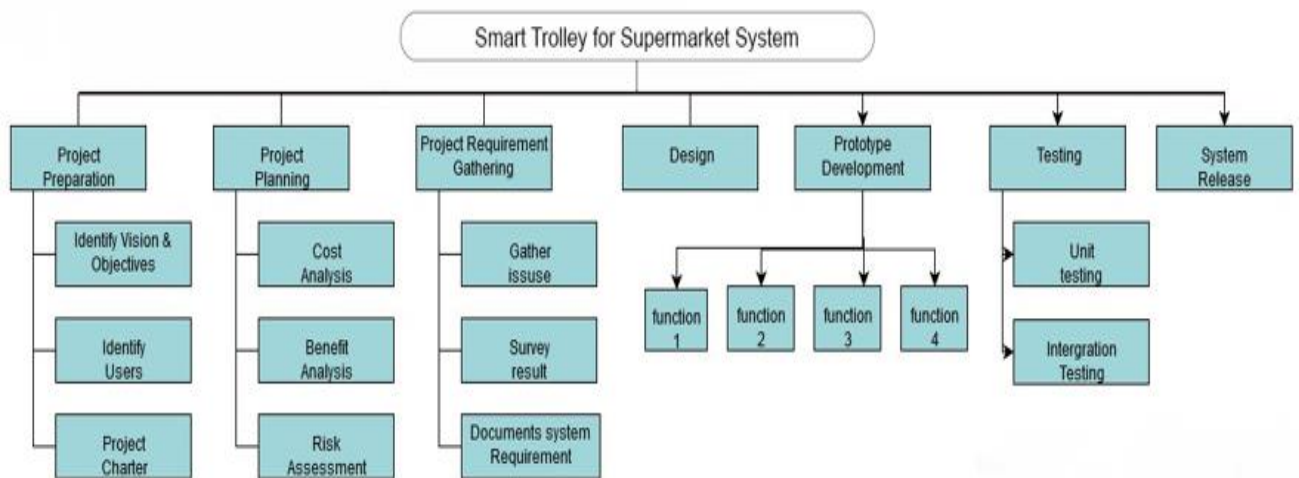


Figure:4.2 Work breakdown

5. References

- [1] F. I. R. S. A. A. B. Ankush Yewatkara, "Smart Cart with Automatic Billing, Product Information, Product Recommendation Using RFID & Zigbee with Anti-Theft," *7th International Conference on Communication, Computing and Virtualization 2016*, pp. 793-800, 2016.
- [2] A. S. A. K. R. Divya T M, "Modelling of Future Automatic Trolley System based on Sensors and Image Processing Guidance for Supermarket," *3Department of Electrical and Electronics Engineering*, 2019.
- [3] "New World Encyclopedia," [Online]. Available: <https://www.newworldencyclopedia.org/entry/Supermarket>. [Accessed 25 February 2020].
- [4] A. P. A. G. A. K. M. M. J. ANJALI PERADATH, "RFID Based Smart Trolley for Supermarket Automation," *International Research Journal of Engineering and Technology (IRJET)*, vol. 4, no. 7, 2017.
- [5] H. K. Sivaraman, "Automated Smart Trolley for Supermarkets," *International Journal of Engineering Research & Technology (IJERT)*, vol. 6, no. 13, 2018.
- [6] N. G. S. K. a. A. G. Harpreet Singh Bedi, "Smart Trolley using Smart Phone and Arduino," *Journal of Electrical & Electronic Systems*, vol. 6, no. 2, 2017.
- [7] S. J.S.Awati, "Smart Trolley in Mega Mall," *International Journal of Emerging Technology and Advanced Engineering*, vol. 2, no. 3, 2012.
- [8] G. P. K. G. Shraddha Nitnaware, "Smart Trolley using IOT," *International Journal for Research in Applied Science & Engineering Technology (IJRASET)*, vol. 5, 2017.
- [9] D. M. A. Yahya Dorostkar Navaei, "Dihedral Product Recommendation System for E-commerce Using Data Mining Applications," *International Journal of Computer & Information Technologies (IJOCIT)*, vol. 3, pp. 610-631, 2015.
- [10] K. C. A. S. A. Panayiotis Christodoulou, "A Real-Time Targeted Recommender System for Supermarkets," *19th International Conference on Enterprise Information Systems*, vol. 2, pp. 703-712, 2017.
- [11] R. K. B. S. G. Jatinder Kaur, "Product Recommendation Systems a Comprehensive Review," *International Journal of Computer Sciences and Engineering*, vol. 6, no. 6, 2019.
- [12] A. K. D. Loraine Charlet Annie M.C, "Market Basket Analysis for a Supermarket based on Frequent Itemset Mining," *International Journal of Computer Science Issues*, vol. 9, no. 5, 2012.
- [13] D. H. H. J. Jinyoung Kim, "Product recommendation system based user purchase criteria and product reviews," *International Journal of Electrical and Computer Engineering (IJECE)*, vol. 9, pp. 5454-5462, 2019.
- [14] A. Demiriz, "Enhancing Product Recommender Systems on Sparse Binary Data," *Data Mining and Knowledge Discovery*, vol. 9, 2002.

- [15] "towards data science," [Online]. Available: <https://towardsdatascience.com/what-are-product-recommendation-engines-and-the-various-versions-of-them-9dcab4ee26d5>. [Accessed 25 02 2020].
- [16] H. Y. Duc-TrongLe, "Basket-SensitivePersonalizedItemRecommendation," *Proceedings of the Twenty-Sixth International Joint Conference on Artificial Intelligence(IJCAI-17)*, pp. 2060-2066, 2017.
- [17] R. D. A. K. R. D. Debajyoti Mukhopadhyay, "A Product Recommendation System using Vector Space Model and Association Rule," *International Conference on Information Technology*, pp. 279-282, 2008.
- [18] Y. P. B. A. B. M. C. G. M. J. Y. K S Anupa Koti, "Digitalized Recommendation Engine for Supermarket Customers Using Frequency of Purchase," *International Journal of Innovative Research in Computer and Communication Engineering*, vol. 4, no. 5, 2016.
- [19] S. A. I. S. S. V. T. Andreas Kanavos, "Large Scale Product Recommendation of Supermarket Ware Based on Customer Behaviour Analysis," *Big Data and Cognitive Computing*, vol. 2, no. 2, 2018.
- [20] D. M. Ruma Dutta, "Offering A Product Recommendation System in E-commerce," 2011.
- [21] S. M. T. G. Satish kamble, "Developing a Multitasking Shopping Trolley Based On RFID Technology," *International Journal of soft Computing and Engineering*, India, 2014.
- [22] P. T. Aboli Hanwate, "SMART TROLLEY USING RFID," *International Journal of Research In Science & Engineering*, Indian.
- [23] R. G. Y. Galande Jayshree, "RFID Based Automatic Billing Trolley," *International Journal of Emerging Technology and Advanced Engineering*, India, 2014.
- [24] R. G. Y. Galande Jayshree, "RFID Based Automatic Billing Trolley," *International Journal of Emerging Technology and Advanced Engineering*, India, 2014.
- [25] A. A. R. K. S. R. K. M. Mr.Yathisha L, "AUTOMATION OF SHOPPING CART TO EASE QUEUE IN MALLS BY USING RFID," *International Research Journal of Engineering and Technology*, India, 2015.
- [26] K. A. R. Hamdy Ibrahim El-Gamily, "Deploying an Interactive GIS SYSTEM FOR FACILITY AND ASSET MANAGEMENT: CASE STUDY-MINISTRY OF EDUCATION,KUWAIT," *Journal of Geographic Information*, Kuwait, 2015.
- [27] P. B. Prajakta kulkarni, "MIFARE:A New Technique for Smart Shopping Cart," *IJIREEICE*, India, 2016.
- [28] P. B. Prajakta kulkarni, "MIFARE:A New Technique for Smart Shopping Cart," *IJIREEICE*, India, 2016.
- [29] I. ., M. a. I. S. Ishak, "A SMART TROLLEY WITH RFID IMPLEMENTATION:A SURVEY AMONG CUSTOMERS," no. 23 feb 2020, 2017.
- [30] N. S. Megana, "Design and Implemenation of a Smart Shopping Cart by RFID tECHNOLOGY," *Asian Insititute of Technology School of Enginnring and Technology*, Thailand, 2018.

- [31] N. S. Megana, "Design and Implementation of a Smart Shopping Cart by RFID Technology," Asian Institute of Technology School of Engineering and Technology, Thailand, 2018.
- [32] I. C. Ishak, "A SMART TROLLEY WITH RFID IMPLEMENTATION: A SURVEY AMONG CUSTOMERS," Ismila Che Ishak, Malaysia, 2018.
- [33] A. S. K. R. Divya T M, "Modelling of Future Automatic Trolley System based on Sensors and Image Processing Guidance for Supermarket," National Conference on Emerging Research Trend in Electrical and Electronics Engineering, 2019, 2019.
- [34] M. R. Sarmad Ali, "Smart Trolley," Technology Evaluation and Commercialisation Algorithm, Malaysia, 2015.
- [35] A. D. R. C. RachannaDoshi, "RFID Based Smart Trolley for Automatic Billing System," International Journal of Engineering Science and Computing, India, 2017.
- [36] A. M. M. Manikandan Thiyagarajan, "RFID based Advanced Shopping Trolley for Super Market," Manikandan Thiyagarajan, India, 2017.
- [37] A. U. K. S. Mrs D.M.Yewale, "Automated Shopping Trolley for Billing System," International journal for Innovative Research in Science & Technology, India, 2017.
- [38] Emi Moriuchi, "*OKAY, Google !: An empirical study on voice assistants on consumer engagement and loyalty*", January 2019. Available: https://www.researchgate.net/publication/330419587_Okay_Google_An_empirical_study_on_voice_assistants_on_consumer_engagement_and_loyalty
- [39] thanyaphorn Lerlerdthaiyanupap, "Speech-based-dictionary", june 2008, Available: <https://pdfs.semanticscholar.org/35ea/45dbd416576378bf709b517589896ef8e238.pdf>
- [40] [3] Prerana Das , Kakali Acharjee, Pranab Das and Vijay Prasad , "*Voice Recognition System: Speech-to-text*", November 2015. Available: https://www.researchgate.net/publication/304651244_VOICE_RECOGNITION_SYSTEM_SPEECH-TO-TEXT
- [41] Ahmad Bisker Tarakji, Jian Xu and Juan A. Colmenares Iqbal Mohomed, "*Voice enabling mobile applications with UIVoice*", June 2018. Available: https://www.researchgate.net/publication/325436368_Voice_enabling_mobile_applications_with_UIVoice
- [42] Aravind pai, "learn how to build your own speech-to-text model (using python)", Available: <https://www.analyticsvidhya.com/blog/2019/07/learn-build-first-speech-to-text-model-python/>, [Accessed: June 15 2019]
- [43] Shruti Joshi, Aarti Kumari, Pooja Pai, and Saiesh Sangaonkar, "*Voice Recognition System*", Available: https://www.academia.edu/33497914/Voice_Recognition_System
- [44] Pankaj Pathak, "*Speech Recognition Technology: Application & future*", International Journal of Adavnced Computer Research, December 2010, Available: https://www.researchgate.net/publication/289614337_Speech_Recognition_Technology_Applicati on_future

- [45] Ayushi Trivedi, Navya Pant, Pinal Shah, Simran Sonik and Supriya Agrawal , “*Speech to text and text to speech recognition systems-Areview*”, PP 36-43, Available:
<https://www.iosrjournals.org/iosr-jce/papers/Vol20-issue2/Version-1/E2002013643.pdf>
- [46] Eric hal schwartz, “The Decade of Voice Assistant Revolution ” ,Available:
<https://voicebot.ai/2019/12/31/the-decade-of-voice-assistant-revolution/>, [Accessed: December 31,2019]
- [47] Venkatesh C.R, “How to add voice search to your Mobile app” Available:
<https://www.business2community.com/seo/how-to-add-voice-search-to-your-mobile-app-02250123> [Accessed: October 17,2019]
- [48] Sentiance, “What voice assistants can learn from motion”, Available:
<https://www.sentiance.com/2018/07/11/motion-voice-assistants/>, [Accessed: July 11 2018] 4446
- [49] Jimcymol James , “*A Mobile Application for Voice Enabled Virtual Bot*”, International Journal of Applied Engineering Research, Available:
https://www.researchgate.net/publication/333893369_A_Mobile_Application_for_Voice_Enabled_Virtual_Bot
- [50] Galande Jayshreel, Rutuja Gholap, Preeti Yadav and Prateek on “RFID Based Automatic Billing Trolley”,IJETAE, ISSN (2250-2459), ,Vol 4,Issue 3, March 2014.
- [51] Gangwal, U., Roy, S. and Bapat, J. (2013). Smart Shopping Cart for Automated Billing Purpose using Wireless Sensor Networks. [online] Thinkmind.org. Available at:
https://www.thinkmind.org/download.php?articleid=sensorcomm_2013_7_30_10155
[Accessed 04 Feb. 2020].

6. APPENDICES