Self-checkout smart cards for Smart Shopping

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Abstract

Smart cities are the built-up area that implements different types of electronic Internet of things (IoT) sensors to collect data. The data that the sensors are collecting is used to manage assets resources and services efficiently. Those cities are digitally transferring to improve the financial, environmental, and social aspects of urban life. **(M. Saraju P., etc. 2016)** The traditional consumer of buying is continuing to evolve, that is what makes the merchants think about their sales opportunities. Lots of people are searching for the fast and easiest way to collect the products that they need. **(H. Blanca., etc. (2010)**

The main objective of this project is to implement a smart shopping cart with the help of RFID technology to optimize the purchase. Is to use the RFID-related implementation practice in the cart. In this project, the RFID card is used as a protection entry to get the goods in the mall. If the item is placed in the shopping cart, the price of the product will appear, and therefore the total amount will be displayed. If we want to remove the product from the cart, you can withdraw the product and get the amount of this specific product deducted from the total amount, thus enhancing security performance and speed during purchases in shopping complexes. The key point of the proposed framework is to give innovation that is geared to a minimum of effort, adaptable effectively, and efficiently to assist shopping individually. So much time is saved on billing counters. **(Megana 2018)**

This paper presented a smart shopping cart that is implemented by the Internet of things (IoT). This technology is driving IoT research in the future. The smart shopping trolley is implemented by using an RFID card. The trolley is full of sensors and it giving the customers their needs.

Keywords:

IoT, RFID, Smart Trolley, Smart City, Smart Shopping

Introduction:

Shopping is the most activates that lots of people love to do all over the world. That's because some of the people like to choose the best items that are in the shop. But there are some problems that the people face, for example, a crowd and waiting in a long line to pay and lots of other things that. Nowadays shopping is using some technology's that helps to get rid of the crowding and waiting in a line. These technologies are using in self-driving cars is the same that that is powered to this trolley: computer vision, sensor fusion, and deep learning algorithm. **(C. Josh. 2019)**

This technology is changing the trolley in the supermarkets into a smart trolley that is having sensors to make shopping easier. This will help to get rid of the checkout lines, and an easy way to pay the charge. The trolley is built-in with a barcode scanner and credit card swiper, but there are three image recognition cameras and a weight sensor that automatically scans the items that are drop-in the trolley. Doing this trolley is going to help the merchants, in having lass number of cashier's labor and they will help the customers and keep the shelves stocked. **(C. Josh. 2019)**

The trolley is having sensors all over it, when the customer wants to add things to the trolley, they need to scan the item by using the barcode. There is sensor fusion that helps to know all the items that enter the trolley and it can know if the item was scanned or not. The fusion sensor is giving red lights if the item wasn't scanned. While the customers are shopping the screen in giving them some notification about the things that have been offered. Also, some sensors count the weight of the fruits and vegetables. The is a search option that helps to find the items that you want and it's giving the in-store map to find the item quickly. The system is having Recipe Recommendations and Scan-less Recognition. The pay charge is by credit/debit and the receipts are digital that we send to the customer when he pays. In the end, if there are any problems the trolley is giving red lights; in this case, the workers will help the customer, and if everything is going well after the paying it is going to give green lights. **(Caper 2019)**

Similar Studies:

RFID is an upcoming innovation that has as of late pulled in mild authentic concern for the exploration crew because of the amazing benefits it offers over the other existing recognizable proof and data detecting advancements. RFID is a specific term utilized for systems that use

radio waves to naturally distinguish things. RFID is a technology that allows alternate of statistics amongst labels and readers besides the need of viewable pathway over a separation up to a couple of 10 meters relying upon the sort of label engaged. For this framework, the facts are being swapped by using radio waves, and distinct tags can be scrutinized or gathered normally. This phase is designed to survey the current technological know-how writing and probe the problems in the current RFID organization starting from the transformation to yet in its cognizance phase. From previous the boom of this revolution from the 1900s, aside from this expressed dependable perspectives, accordingly innovation likewise helps a few affairs or points. A planned motivation at the back of section for seem to be at the writing recognized with the above referred to technological know-how additionally develops scholarly analysis with giving a deal into a segment of the super and noteworthy cases hindering the growth of this alteration. It ought to confront these instances with a precise end goal to give a more distinguished permeability and a better item pace of the RFID innovation.

Currently, the exercise of barcode for commodity recognition demonstrates various restrictions: statistics is constant; allows only one scan at once; involves neighborhood; less extent and low surveillance. This technology is in addition immune, secure, acknowledges gadgets in a specific order, and facilitates distinct types of data, several synchronous scans, will not require vicinity, and has a large scope. So that instinctive item awareness is workable if and only if all prevailing gadgets inside the mall are recognized with tags and every trolley with a scanner. The usage of this science, as a result, encompasses many blessings like enhanced security, a subsequent decrease in misplacement of products, reduced person interference, and inaccuracy, extended rapidity in assigned operations, remarkable recognition of gadgets with auxiliary details, and obtainability of practical when compared to different computerized identification systems. **(Megana 2018)**

Automatic Identification Systems: There are quite a few applied sciences accessible for Instinctive Recognition systems. In phrases of implementation, fee necessity and the technique related single or a combo of consequences are selected for Instinctive Recognition effectiveness.

Barcode Systems: This implementation contains a double code comprising of the showcase of bars and spaces organized in a parallel format as depicted in the figure below. The sequence is huge with

limited bars and spaces which are depicted numerically and alphanumerically. This is done by optical laser scanning. Despite equality in their cloth implementation, there is much more contrast among the code designs.

Optical Signal Identification: This was commenced in the previous 1960s. For this, an especially designed font was developed which styled the signs so that they are studied without problems in the ordinary mode by using the humans and instinctively via the equipment. The primary utilization related to this technology is the huge solidity of information and the feasibility of decoding information graphically during emergencies. This technological know-how was once applied in the banks for the registration of checks, productive and administrative fields. Despite many advantages also this technology vanished globally due to massive prices along with complexity when in contrast to other identification systems. **(Megana 2018)**

Biometric Procedure: Biometrics is the science of computing and having magnitude methods involving human beings. It makes use of tactics to differentiate living beings with the aid of error-free and unique physical characteristics. In the implementation, they include thumb marking, palm marking methods, vocalized recognition, and optic disk recognition.

Smart Card: Smart card is an automatic records application likely with greater calculating the magnitude which is blended into a plastic card. These playing cards are furnished by electricity and a timer beat from the desktop through the touching exterior. Information shift between the computing device and the card takes area via a two guiding sequential connector. One of the fundamental advantages related to the smartcard is that the information saved in it can be defended in opposition to not appropriate strategy and exploitation. The downside is most cases worried about the contact primarily based smartcard is the susceptibility to corrosion, dirt. The reader machines that are used regularly are also expensive to preserve due to the fact their accountability to fade. This smart card technology is kept in improving the sales and letting the customer feel free in choosing the products. In this technology, the customer is having the ability to search for the things that they want and to find them by using the store mapping that's is helping to find the items very quickly. **(Megana 2018), (H. Hasilza., et al. 2014)**

Objectives of the proposed research:

1. Understand the requirement of Customer's Smart Shopping
2. Develop the Prototype for Smart Application

3. Propose the framework for the Smart Shopping Trolley APP

Research Methodology:

The Research methodology is DSM Model

DSDM Model is stranded for Dynamic System Development Method, it's an agile method that is primarily used as software development for project delivery framework. It's a framework that is current knowledge about project management. The DSDM is an iterative and incremental approach that is focusing on fast deliveries and involving the user throughout the project. DSDM is a software development community that is rooted, but some convergence of software development changed the DSDM framework, which makes it complex for problem-solving tasks. That is what helps us to develop a system dynamically. The use/implementation of it can be for agile and traditional development processes. Also, it is suited for both systems if they are the requirement and not fixed in advance. From the development life cycle, we can go to the previous phase of software development. Some people may be working on requirement analysis, and other people working on development at the same time, that's because the work is not iteratively and incrementally. Any changes were done during the development of the project by the user can be correctable. Throughout the project development, testing is conducted. The DSDM is simple, extendible, straight forwarding that's based on the best principle that starts to implement the project structure, and it's not the calming to solve all kinds of projects. **(K. Aiman., Z. Iqra., A. Muhammad. 2017)**

As in the following figure, the agility features of the DSDM are satisfied, and its basic concept is to adjust the time and resources. The DSDM has four main phases, (feasibility, functional model iteration, design and build iteration, and implementation). In those phases, they are having several sub-phases. **(S. Abdullahi. 2013)**

The following figure is showing the DSDM Process Model

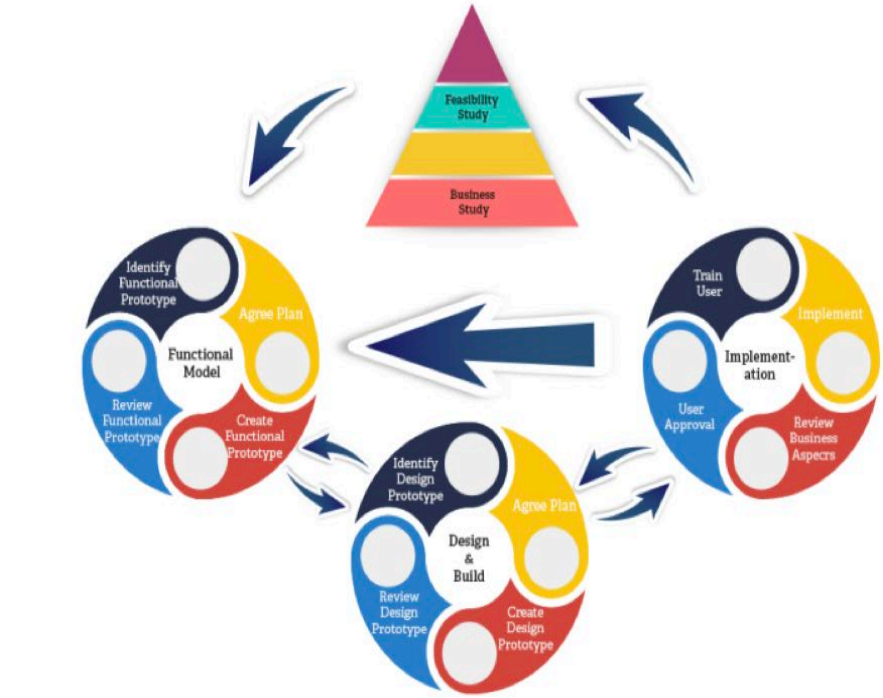


Figure 1: DSDM Process Model

(K. Aiman., Z. Iqra., A. Muhammad. 2017)

There are two major phases that the DSDM is divided into, Pre-project and Post-project phases.

Pre-project: that has the decision for setting the project in the first place on the business/Board decision. The sub-phases in this phase are several, like Feasibility study, Business Study, Functional Model, System Design and Build Iteration, and Implementation.

Post-project: to access the success of the project, this phase is maintaining the postimplementation review. **(K. Aiman., Z. Iqra., A. Muhammad. 2017)**

The way that DSDM methodology works are to impact the agile on the software project management. And the team must think and research about all the possible reasons that can affect project management (brainstorming) in the real world. And providing a studied related work, this

what helps to identify the main cause of the problem on the software. Make a questionnaire based on the knowledge of the literature review and brainstorming. After that, all the information that you need is from the questionnaire. **(K. Aiman., Z. Iqra., A. Muhammad. 2017)**

The following figure is showing the proposed methodology:

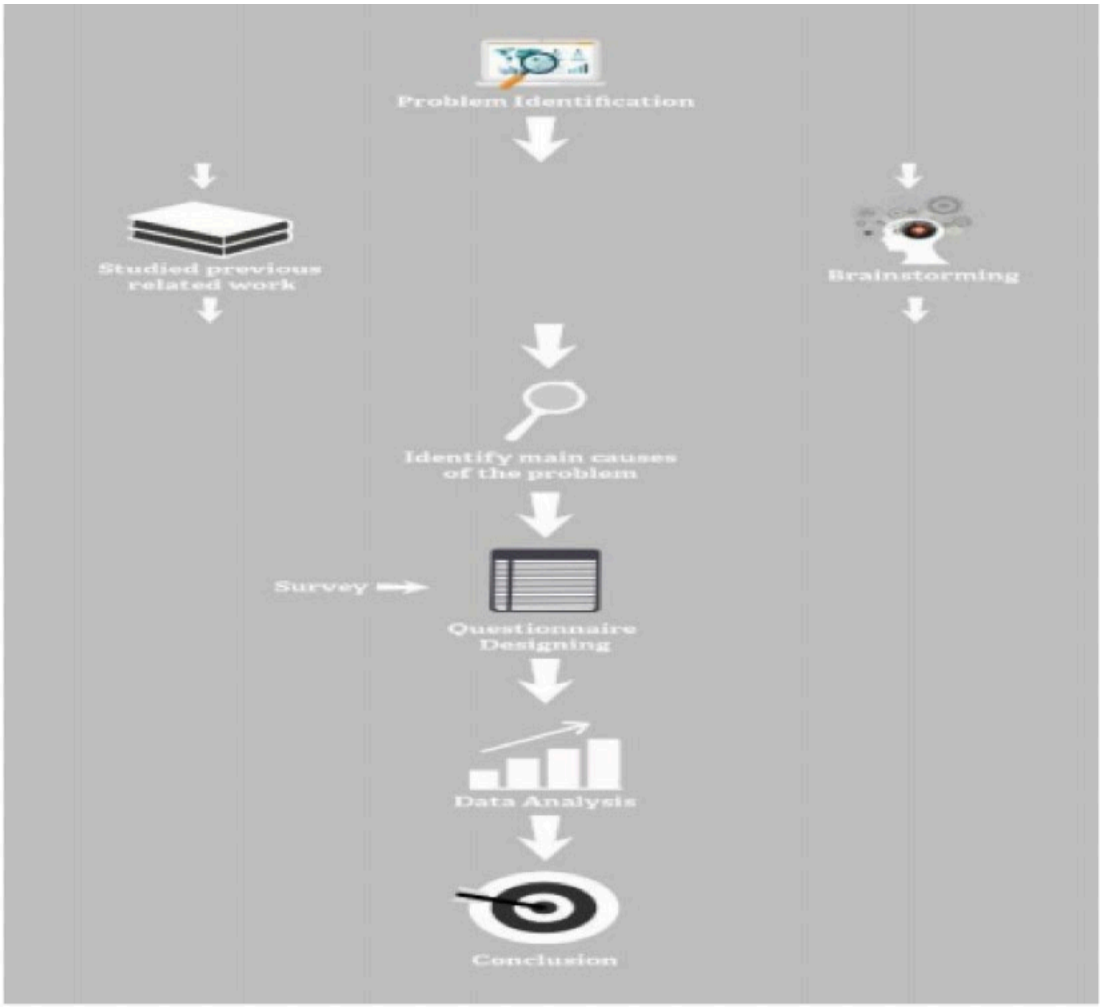


Figure 2: a proposed methodology

Framework and design of the proposed system:

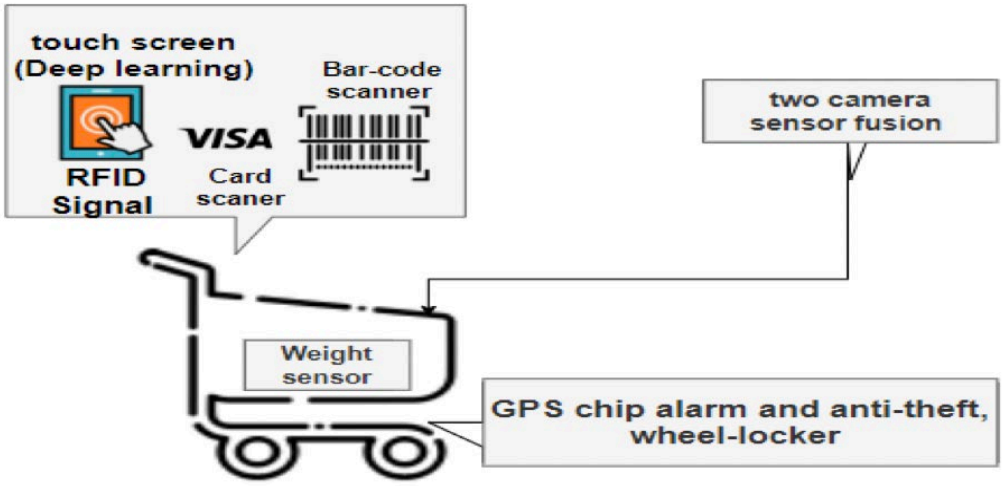
This system is developed in the stores for self-service. All the things needed are in the trolley, where you can search for the items, find the offers, and find the selected items by using the in-store map. The self-checkout system is implemented so that the customer is going to service

his/herself, the customer is having access control, electronic article surveillance (EAS), and directed personal advertising subsystem to know the offers that are available in the store and the place of them. **(L. Per Olof., B. Hillsboro. 2003)**

The description for the self-checkout of its merchandise from controlled areas, such as supermarkets and retail stores, system is implemented by collecting the identification of data about the selected item and connecting the information with the stored inventory, authorization, pricing, and payment data. The system can also integrate with an EAS system, so when the selected item is purchased then the attached EAS tag is deactivated.

Each item is identifying with (RFID) tag that is associated with each item to be checked out. When the RFID reader reads the RFID tag it's giving detailed information about that item. The stored information in RFID tags can be changed or augmented. To deactivate the attached EAS labels it's tied to scanning and capture of known the data associated with the items for the self-checkout.

This invention is integrated access control for a self-checkout system and the method for the lowing subsystems. The access control subsystem is having a database that contains a list of authorized members to restrict access to a control area. The system can have RFID, barcode scanner. **(L. Per Olof., B. Hillsboro. 2003)**



The Existing method of RFID technology is the most revolutionary technology that will be used in the future of retail sales. The use of RFID technology is improving the experiments for the customers to visit any self-service store, and to serve them self's without the need of anyone. This technology is going to be replacement the barcode system, where is low-cost but in a new way, that what makes this technology is increasing**. (A. Zeeshan., S. Reena. 2014)**

Improving the stores by using RFID: identifying radio-frequency data is showing the data of the item tagged that is attached to the trolley. The data that the RFID tag is giving to the marketing, is information about the item and the time of shopping, the distance of the number of the shelf visits. With the RFID data, there is POS data to analyze the movement information of the customer in the shop. **(A. Zeeshan., S. Reena. 2014)**

Improving commodity allocation: the important thing in the retail area is to deploy the items on different shelves in the supermarket to have better benefit for the sellers to choose the things that they want. This project is collecting the data of the customers' paths that to deploy the items on the shelves based on the thing that the customers need and based on the customer's paths. The way to have the path of the customers are from the shopping card trolley that is having RFID tags, those tags are having POS technology where the shopping transaction data are there. All the

data of the different customers are collected together for the best sales items. Based on the best sales they can count the sales volume considering the profit and purchase probability of the commodity. Also, the shelves are going to be modified based on the best sales products. **(A. Zeeshan., S. Reena. 2014)**

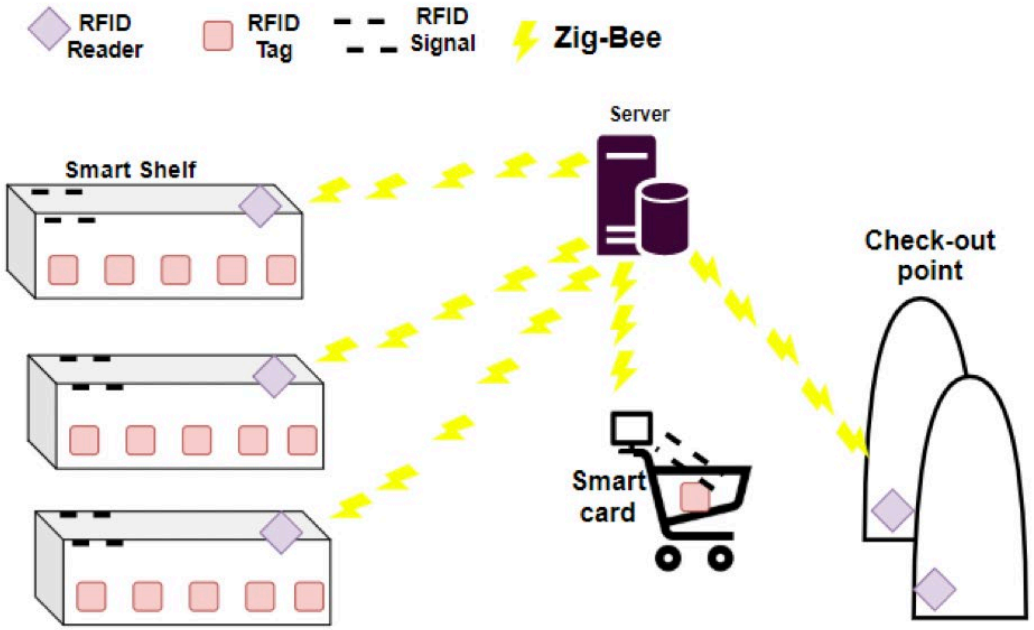


Figure 4: Design of the smart card with the supermarket

The hardware's needed are:

- **Sensors**: it's a device that monitors and its collet data and sends that information to the computer processor. There are lots of types of sensor depending on the need of them. the sensors that are used are weight sensors, sensor fusion.

  Weight sensor: the sensor is used to know the weight of the items; in this project, it's implemented to count the weight of the fruit and vegetables that the customer is buying.

  sensor fusion: this sensor is having the ability to the inputs from multiple radars, lidars, and cameras to collect the input together that's to make an image and to know the things. The result is more accurate because of the balance of the strengths of the different sensors. Then the system is seeding the results to support more intelligent action. This

sensor is implementing to know if the customer drops an item in the trolley without scanning the barcode label.

- **Barcode scanner:** it's using to encode the information by a machine as a visual pattern readable. The use of it is to track products, prices, and it's for centralizing the recording in a computer software system.
- **card swiper:** a machine banking, to pay the charge.

The software's that are needed:

- **Computer vision:** it's an artificial intelligen**ce** that makes the computer integrity and understanding the visual world. Developing this system in a shop is helping to enhance the shopping experiments, detect out-of-stock shelves, and increase loss prevention.
- **Deep learning Algorithm** is a type of machine learning that makes the computer perform humanlike tasks, the things that it can do are recording speech, making predictions, and identifying images. In deep learning just put the basic parameters about the data and trains the computer, then it's going to learn on its own by using many layers of processing.

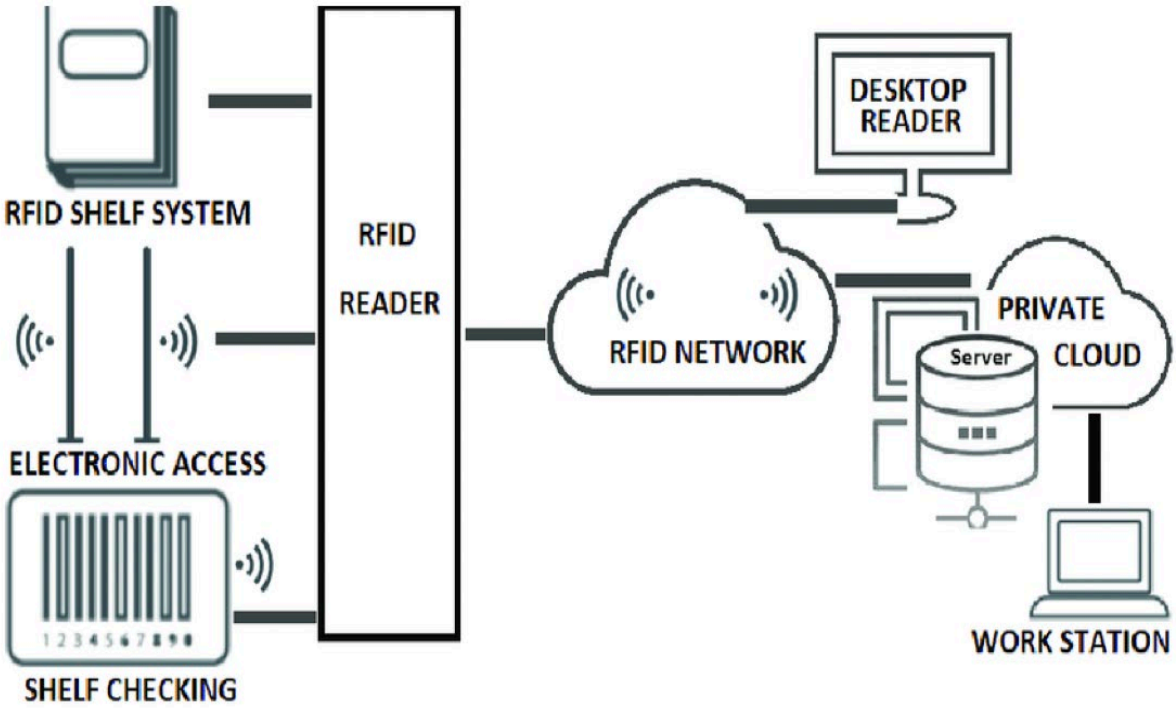


Figure 5: Design of the Network

Benefits to society:

For an easy and fast life in a world that is experiencing a major revolution in technology and artificial intelligence technologies, this project is implement a smart shopping cart with the help of RFID technology to optimize the purchase. And it will help in facilitating shopping in large and crowded stores, as the use of the smart cart reduces the time for the buyer during the purchase process since once the item is placed in the cart the buyer can know the price of the commodity and the nutritional value therein, If the item is placed in the shopping cart, the price of the product will appear, and therefore the total amount will be displayed. Adding and removing the product in the card is very easy, that's in the screen that the customer is using, and everything is very basic. And when an item is removed it's going to deduct from the total amount. Upon completion of the purchase process, he can obtain the total amount and pay either through a credit card or through the programs loaded on the phone. It will also save him time and

effort while waiting at the cashier. Implementing this system is helping to have a security performance and reducing the time during shopping complexes. give innovation that is geared to a minimum of effort, adaptable effectively, and efficiently to assist shopping individually. So much time is saved on billing counters.

Technology became the thing using every were, it helping to make the life easier and faster. Implementing any new technology is helping people to save their time and effort. Nowadays people are searching for new technologies to try them, in this way number of customers is increasing that's because lots of people are curious to discover about the new technical item and at the same time it's not going to take from them lots of time in shopping. When the number of customers is increasing, the customers are going to tell each other about the store that is having a self-checkout trolley then the store is going to have a good reputation about the store. Nowadays in this technology time, all people are searching for the easier and fast way to do everything. Implementing this system is going to help on keeping pace with the era of development. And that will help to increase the technologies ideas that people are having. Lots of ideas are coming to improve previse ideas, and the other of them are to implement new ideas. In this way lots of Omani people will like to implement or to improve an idea, that's going to help us having new ideas and keeping pace with the era of development. By reducing congestion in the stores, this helping to reducing the possible accidents as for the diseases.

Conclusion

With the continuous advancement in science and technology, the world is competing in designing and developing the latest tools to facilitate life. Through this project, which depends on the idea of developing a smart cart that helps the shopper know the prices of goods and the nutritional value of each commodity, and also facilitates the payment process so that the shopper does not have to wait with the cashier, once he finishes the purchase process, he can pay by credit card or Programs available on iOS and Android systems. In the future this project can be more creative that's by adding some new systems that will count the price of its immodestly when the customer is putting the item in the trolley. There can be some sensors that will control the trolley, so the customer is only going to map the items that he/she wants then the trolley is going to move to the list of products that the customer need.

Through this project, we had a good idea of technological Artificial intelligence and a clear picture of how to employ it in our current life. We also aspire to adopt this idea in the future and try to implement it physically after completing the study in a commercial market. The meaning of RFID and how is it implement to be used with the pos to collect the data of the customers.

References:

1. A. Zeeshan., S. Reena. (2014) *RFID based smart shopping: An overview* [online] Available from<https://www.researchgate.net/publication/307786697_RFID_based_Smart_Shopping_An_overview> [30 May 2020]
2. Caper (2019) A*utonomous checkout with smart cards* [online] available from < https://www.caper.ai/ > [19 May 2020]
3. C. Josh. (2019) *Meet Caper, the Al self-checkout shopping cart* [online] Available from <https://techcrunch.com/2019/01/10/caper-shopping-cart/> [19 May 2020]
4. GeeksforGeeks. (2020) *Dynamic Systems Development Method (DSDM)* [online] available from< https://www.geeksforgeeks.org/dynamic-systems-development-method-dsdm/> [18 May 2020]
5. H. Blanca., J. Julio., and M. Jose. (2010) 'Age, gender and income: do they moderate online shopping behavior?'. *International Journal of Information & Management* [online] 3(1), 113-133 available from < https://pdfs.semanticscholar.org/0c3f/9e39c4f595da49894a5c4cf86131c6b45972.pdf> [31 May 2020]
6. H. Hasliza., S. Abu Bakar, and R. Muhammad (2014) 'Self-Service Technology for hypermarket checkout stations'. *Journal of Canadian center of science and education* [online] 10(1), 61-65 available from <https://www.researchgate.net/publication/269668360_Self-service_Technology_for_Hypermarket_Checkout_Stations> [31 May 2020]
7. K. Aiman., Z. Iqra., and A. Muhammad. (2017) 'The Impact of Agile Methodology (DSDM) on Software Project Management. *Journal of International Conference on Engineering, Computing & Information Technology* [online] 1(6) available from <

https://www.researchgate.net/publication/323572478_The_Impact_of_Agile_Methodology_DSDM_on_Software_Project_Management > [18 May 2020]

8. L. Per Olof., and B. Hillsboro. (2003) *complete integrated self-checkout system and method* [online] Available from <https://patentimages.storage.googleapis.com/bb/17/ab/5ff6cda53e951b/US6507279.pdf > [20 May 2020]

9. Laxmi, A., Shraddha, B. and Ajay, C., 2018. Smart Shopping Cart using RFID Technology. IJARCCE, 7(11), pp.146-150.
10. Megan, N., 2018. Design and Implementation of a Smart Shopping Cart by RFID Technology. School of Engineering and Technology,
11. M. Saraju P., U. Choppali., and K. Elias. (2016) *Everything You Wanted to Know about Smart Cities* [online] available from < https://www.researchgate.net/publication/306046857_Everything_You_Wanted_to_Know_About_Smart_Cities > [31 May 2020]
12. S. Abdullahi., F. Adila., R. Seung., and G. Imran. (2013) 'A Review on Software Development Security Engineering using Dynamic System Method (DSDM)'. *International Journal of Computer Applications* [online] 69(25) 37-44 available from < https://pdfs.semanticscholar.org/424f/92289a632f85f6ba9a611614d145c7d3393a.pdf> [18 May 2020]
13. Singh Bedi, H., Goyal, N., Kumar, S., and Gupta, A., 2017. Smart Trolley using Smart Phone and Arduino. Journal of Electrical & Electronic Systems, 06(02). 5
14. YouTube. 2019. [online] Available at: https://youtu.be/iCOWlGN1oL0