iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** VII **Month of publication:** July 2020

DOI: https://doi.org/10.22214/ijraset.2020.30436

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue VII July 2020- Available at www.ijraset.com

IoT Application on Smart Shopping System

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Abstract: ***In the present day scenario, The Internet of Things (IoT) has taken the world by storm by simplifying our day to day lives through integrating devices together. For example, In places like a supermarket, A smart shopping system could be created by inter-connecting all ingredients and items with each other. Most IoT devices communicate through cloud or wireless services. In a typical IoT system for SuperMarkets, a Radio Frequency Identificaton (RFID) tag is used to connect with each item or product. This RFID tag is then attached to a shopping cart. When products are placed into it, The RFID reader reads the tag implemented on the producted. This information is then passed onto the central server located at the checkout terminal. As a result, Billing of items could be done from the shopping cart itself which saves time for the customers previously stuck at long queues. This method could also be integrated for Inventory Management to monitor stock of the products and then notifying it to the store managers if it is low. Another advantage of RFID tags is that it makes workflow much easier and less demanding since all items are automatically read and added instead of manually getting scanned by the checkout terminal operator. In this paper, We lay down the design prerequisites of a smart shopping system and construct a blue-print prototype system to display the functionality of the system. This paper introduces a concept to overcome the limitations of time consuming billing procedures like bar code system by adapting low cost smart system like RFID.***

Index Terms: Smart shopping experience, Pervasive Technolo-gies, Integration, Internet of Things (IoT), RFID tags, Reader, Privacy.

I. INTRODUCTION

Now a days with an influx in the growth of population in urban cities, Shopping at super markets and malls had increased exponentially. There is a demand and surge in crowd during weekends and on special occasions. While shopping, customers purchase various products and place them in shop-ping cart. After tallying prices of all the products, the customer needs to go to the bill counter where the cashier uses bar code scanner to read the prices of products which is an exceedingly time consuming process and often results in lengthy lines at bill counters.

This project provides a shopping cart and inter-related shopping system, that enables customers to shop and pay for their products autonomously. It's concept has been derived from Auto Checkout for Shopping Centers. The cart is fitted with device called Data Logger which collects and stores information. The details of the product like name, serial number, weight, date of manufacture etc are stored. When a user purchases it, The Data Logger retrives this information and displays it.

This system is also applicable for various apps and purposes. By using this system, the recorded information could be sent to the central database at the checkout counter of the supermarket. It allows more efficiency and productivity to customers by saving time and resources. It also allows Mall owners to preserve records of each item daily and keep track of prerequisites and customer consumption.

II. LOGICAL BASIS

Urban cities nowadays contain millions of people therefore the demand for large shopping malls increases. With shopping malls flooded with customers, it portrays a complex procedure of time spent moving around the shop corridors, item location in the shop as well as checkout queues.

This project showcases us the architecture and implemen-tation of faster shopping facilities in malls. The smart trol-ley explores the currently trending mobile technologies and automatic detection technologies such as RFID to increase the quality of our shopping experience as well as allowing consumers to save time and money.

RFID is easier and more productive way for identifying items than manual systems like barcode which are slow and outdated. The advantages of Radio Frequency Identification Systems over Barcode Systems are listed beneath.

Barcode readers uses a sensor to detect which require a direct vision to the serial label whereas RFID readers do not require a direct vision to read and transmit data.

The distance at which RFID tags can be read are at around 350 feet whereas Barcode readers length is very minimal.

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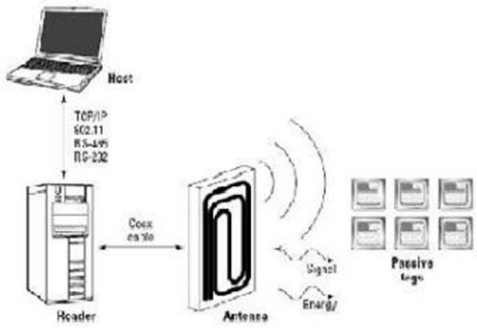
The RFID readers can detect and read RFID tags much swifter. They can capable of read rates of around seventy tags per second. In contrast to that, Reading barcodes is not only time consuming but also tedious. Barcodes usually require 1-2 seconds to read a serial label.

Vision requirements also restrict the stiffness of barcodes as well as the reusability of barcodes. RFID tags are typically more rugged, since the electronic components are better protected in a plastic cover. RFID tags can also be integrated within the item itself, ensuring longetivity and reusability.

Barcodes cannot have reuse capability which means once the information is printed on the serial label, it cannot be altered. On the other hand, RFID tags can be reused to add or change information present.

Barcode scanners can only read tag one at a time while RFID scanners can read dozens of tags simultaneously within a single second.

RFID could be embedded inside item of any size such as when scientists attached RFID transponder to a live ant in the year 2009. Barcodes cannot be integrated into small items.



RFID System

The age-old Barcode systems must be replaced with state of art latest technology like RFID System to provide faster and smoother shopping experience to the customers.

III. HOW RFID IS USEFUL

A. Products placed in smart trolley attached with RFID reader can read information of the product and subsequently send it to the billing counter for the bill to be generated. In this way, customers need not hold up in long queues during checkout.

B. RFID tags could also be placed inside smart shelves where RFID readers can screen all stocked products and send product stock updates to the main server. Therefore, when products get sold out, the server can intimate the workers to restock the products.

C. In this way it becomes efficient for the store manager to keep track of all stock and manage it efficiently.

IV. WORKING PROCESS

The usage of Ultra High Frequency(UHF) based RFID technology is proposed here in this project as UHF tags have a far longer range than normal ones. Their range is typically from 1 to 15m. Previously, RFID readers used low or high frequency RFID which have insufficient range therefore customers have to manually scan their items with RFID scanner which is not much different from what barcode scanner does.

In our project, the proposed components for the smart trolley are - Ultra High Frequency (UHF) RFID reader, an LED display used to show the items added in the trolley, an alarm to notify whether items are added or removed, a micro controller like arduino to receive data, process and then send it and finally a circuit to connect all. In this project, the smart trolley can automatically read the products placed in the trolley through RFID reader. The data is then processed via arduino which we installed. We can use zigbee adapter for the trolley to communicate with the main server.

Security in every system is vital to combat increasing threats and vulnerabilities in today's world. Therefore, Our system is installed with a weight scanner for weighting products.

The weight scanner has another purpose which is to check if any customer removes off a product's RFID tag and puts it in his/her cart.

While billing, if the extra unaccounted weight is found, then it is removed and billed additionally. An RFID reader is also installed near the exit door to check if all the products in the shopping trolley have been paid.

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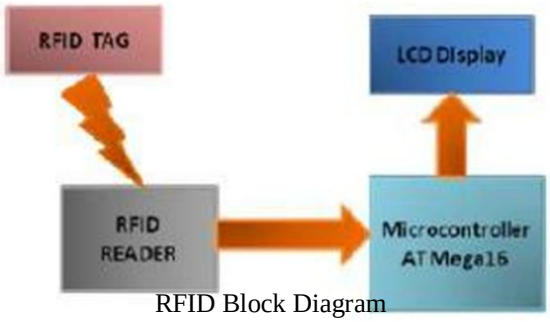

RFID Block Diagram

The RFID tags in this smart shopping system are used to speed up the billing procedure by creating a system that can read the RFID signals from all items placed within the vicinity of the RFID antenna. It also has a transmitter which transmits and relays back the item information to the checkout counter so that the customer could pay the bill directly without waiting in the queue.

The goal of this project is to ultimately reduce time taken by customers to shop and checkout safely. By using the above prescribed method, it eliminates the need to use barcode scanner for each product. Therefore, The product checkout is done significantly faster thereby increasing customer's shopping experience. It uses a simple logic where it tallies the total shopping made by the customer using the smart cart and then uses this to relay information to the checkout counter via cloud computing services.

This project has an RFID tag and a reader used for calculating the shopping bill from all the items kept in the shopping cart. The RFID reader is attached to arduino microcontroller which will then read the 12-bit RFID tag ie. the product ID. It will then display the details of the product such as name, cost and total amount of all items in the shopping trolley.

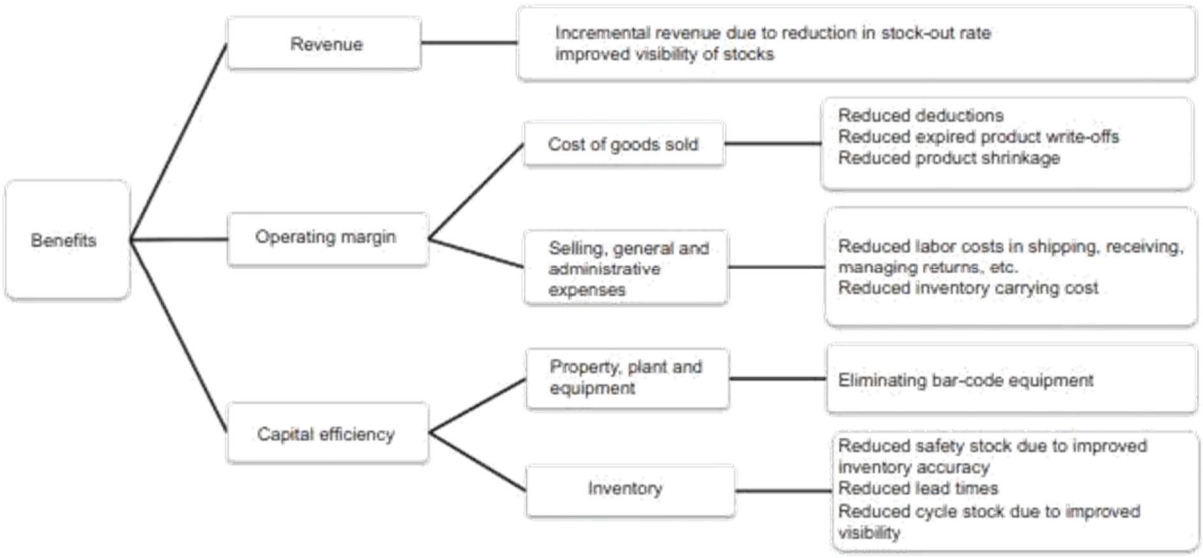

Fig. 1. RFID Benefits

In today's world, Security and Privacy issues are key elements for any working system. Therefore we have put considerable research into it to tackle the arising issues that come with it. In our system, Wireless communications to the server smart cart is vulnerable to various attacks such as interceptions by hackers to modify the information sent. To overcome these issues, We need to integrate proper security methods. Another bigger issue is the privacy concern where this leaked data could be in the hands of our competitor who might get access to it and gain financial strategy and customer data. To combat all these issues, We have to work on implementing a stronger security.

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TABLE 1
Different Algorithms

Symmetric	ECC	RSA
84	167	1024
144	262	2048
168	284	3072
192	421	8192
256	596	12288

V. LITERATURE SURVEY

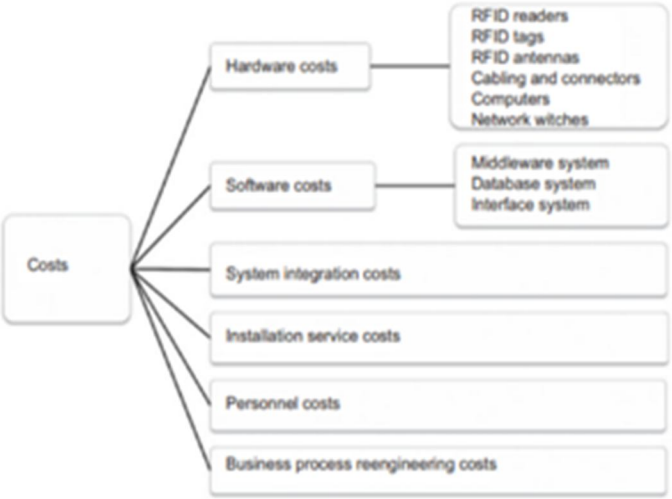
The available literature related to RFID technology and application of it in supply chains such as Supermarkets, Malls and Warehouses is very limited. Most of the journals were published only in recent years. These publications could be divided into 2 groups - practical papers which discuss about live implemention and reports about it, and academic papers which talk more about raw facts and findings. These studies were analyzed by different means and approaches. The table below shows about the implementation cost tree where we analyze how the cost for each component is divided and utilized in supply chains.

Practical papers usually tell us about prototype projects, case analysis and RoI analysis of RFID implementations in supply chains. Companies usually test these prototype projects initially and guage the reaction and observe the difficulties and problems faced when integrating it. They also use prototype projects to analyze the costs of implementation and profits derived from it.

RFID Block Diagram

Publications	Most used approaches	Main topics
Practical papers	Pilot projects Case studies ROI analyzes	Inventory management Logistics and transportation Assembly and manufacturing Asset tracking and object location Environment sensors
Academic papers	Analytical approach Simulation approach Case studies ROI analyzes Literature review	Inventory inaccuracy Bullwhip effect Replenishment policies

RFID Implementation Cost Tree



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A. Limitations

The procedure which we implemented in the review above comes with some limitations. Firstly, The data is collected from academic papers and journals. Secondly, From all the journals or papers we searched, only information from particular databases were collected. Therefore the review is in-depth. Final limitation is that we have used the above collected data from a time frame of over 11 years of RFID research. It also covers most recent research and analysis related to RFID.

VI. FUTURE OF RFID

A. RFID readers could be simplified even more especially in design and operation such that every employee could use it without much training. They must also be taught about education necessities and mechanisms which de-serve awareness.

B. The cost to install and operate RFID systems must come down even further for it to be practically possible to integrate. Operational costs including designing, main-taining and updating the computational systems.

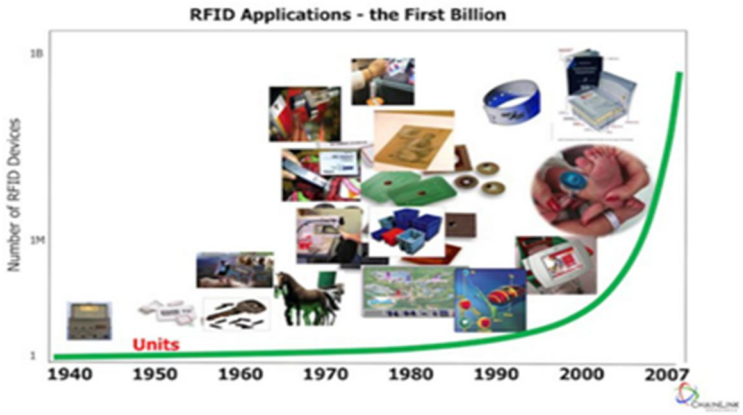
C. To educate the practitioners about technical and eco-nomic decisions so that they could choose appropriate RFID systems for implementation.

D. To create a sustainable business models for imple-mentation of RFID systems in various companies and organisations.

E. The impact caused by RFID systems on a corporation's supply chain management and relationships as well as leveraging the marketplace due to changes in informa-tion exchange among associates.

F. As we have stated earlier, Privacy and security issues are measured based on their impact in acceptance and implementation of RFID at consumer stage.

G. To remove barriers that prevent the implementation of RFID at various levels.



As we progress into the modern era, our dependence on technology and automation increases therefore countries are investing heavily in implementation of RFID technology by doing RD. The government of a country is crucial in promotion and implementing the usage of RFID systems. The policies and standards must be regulated by the government such that it is easier to adopt RFID. It is also crucial to determine if corporations are utilizing RFID technology for their strategic uses.

It is vital to understand the importance of RFID as it's integration by corporations will have a key impact in how supply chain management is handled.

With more and more corporations utilizing and implementing RFID for supply chain management, it's vital to ensure that production and operations researchers place emphasis on development and integration of RFID technology. We hope this journal will provide enthusiastic researchers with the better scope of RFID implementations and shed some light for future research work.

VII. CONCLUSION

Through this journal we proposed a smart and secure shopping system which uses RFID technology. We have used Ultra High Frequency(UHF) RFID to implement this to improve the shopping experience of customers and solve the security issues that come with it. We have also illustrated a detailed design of our shopping system. Our team believes that our research in this area would be utilized to spearhead and enhance the development in smart shopping system. In future, We will research on simplifying few things such as reducing computation overhead and improving communication efficiency as well as focussing on security issues.

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VIII. ACKNOWLEDGEMENT

We would like to thank Ms. Ranjani for her valuable guidance, moral support and suggestions to improve the quality of this paper. We are deeply indebted to her for making our work worthwhile.

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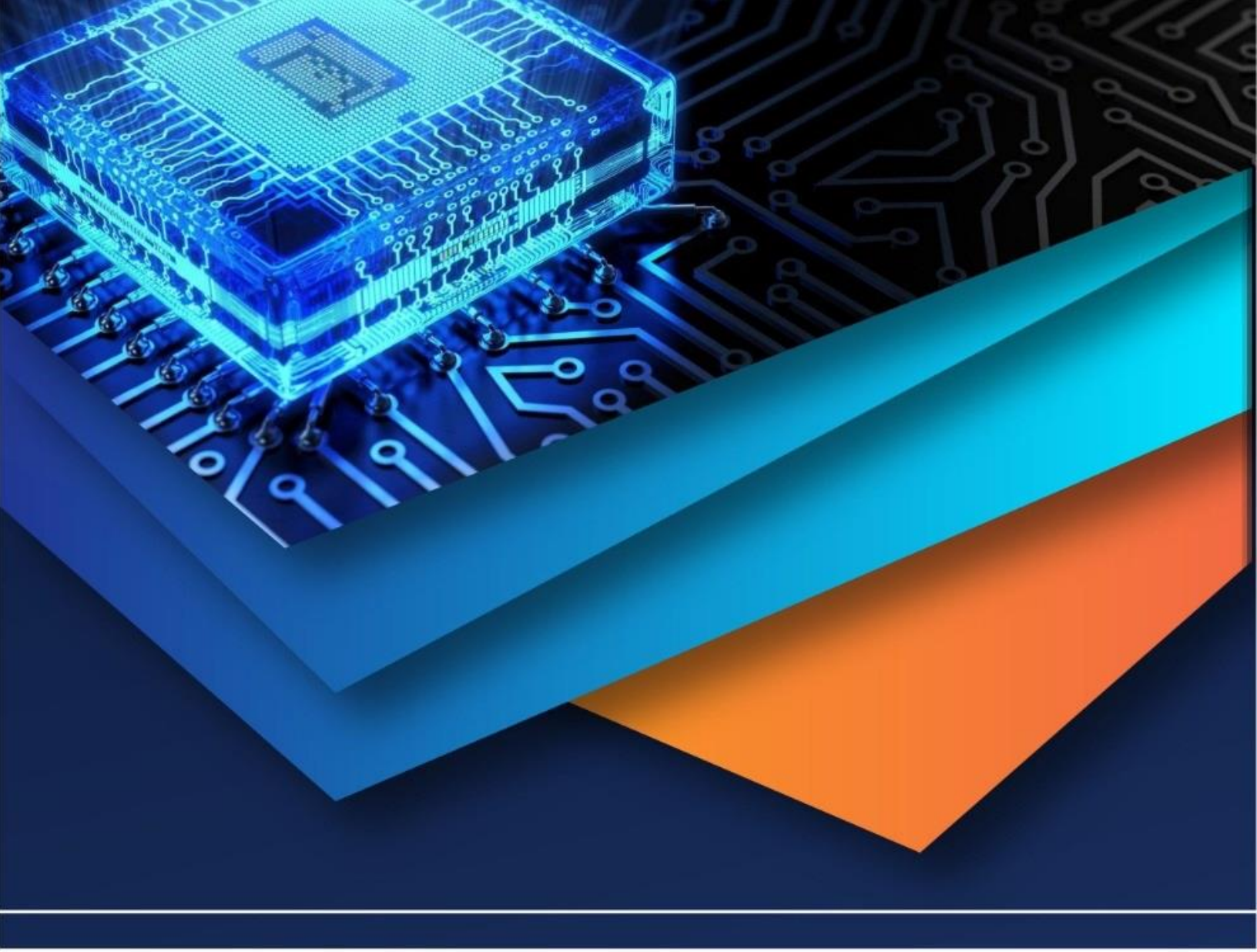

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