# -



**DESIGN AND CONSTRUCTION OF AN IOT BASED SMART SHOPPING SYSTEM DEVICE USING RFID TECHNOLOGY AND QR CODE GENERATION FOR PAYMENT.**

# BY

BOSAH JOHN CHIGOZIEM

# 18CK024194

**A PROJECT REPORT SUBMITTED TO THE DEPARTMENT OF ELECTRICAL AND INFORMATION ENGINEERING, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE BACHELOR OF ENGINEERING DEGREE IN INFORMATION AND COMMUNICATION ENGINEERING**

**SUPERVISED BY**

**PROFESSOR**

**JUNE 2023**

# DECLARATION

I hereby declare that I carried out the work reported in this project in the Department of Electrical and Information Engineering, Covenant University, under the supervision of . I also solemnly declare that to the best of my knowledge; no part of this report has been submitted here or elsewhere in a previous application for the award of a degree. All sources of knowledge used have been duly acknowledged.

# …………………………………….

**BOSAH JOHN CHIGOZIEM**

**18CK024194**

# CERTIFICATION

This is to certify that the project titled "Design and construction of an iot based smart shopping system device using RFID technology AND QR CODE GENERATION FOR PAYMENT” by BOSAH JOHN CHIGOZIEM meets the requirements and regulations governing the award of the Bachelor of Engineering (Information and Communication Engineering) degree of Covenant University and is approved for its contribution to knowledge and literary presentation.

**Supervisor:** Name:

Sign: Date:

|  |  |
| --- | --- |
| **Supervisor:** | Name:  Sign: Date: |
| **Head of Department:** | Name:  Sign: Date: |
| **Internal Examiner:** | Name: Sign: Date: |

# DEDICATION

I dedicate this project to Almighty God for His grace and favor throughout the whole process, also my family who has made it a success in every way. To Him alone be all the glory.

# ACKNOWLEDGMENTS

# 

# ABSTRACT

This project focuses on the design and construction of an IoT-based smart shopping system device that utilizes RFID technology and QR code generation for payment. The device aims to improve the shopping experience by eliminating the need for traditional checkout lines and allowing customers to scan and purchase items using their smartphones. The system will also incorporate inventory management and analytics features to aid retailers in tracking stock levels and customer behavior. The goal of this project is to provide a convenient and efficient solution for both shoppers and retailers through the integration of advanced technologies.

# TABLE OF CONTENT

|  |  |
| --- | --- |
| [DECLARATION](#_bookmark0) | [i](#_bookmark0) |
| [CERTIFICATION](#_bookmark1) | [ii](#_bookmark1) |
| [DEDICATION](#_bookmark2) | [iii](#_bookmark2) |
| [ACKNOWLEDGMENTS](#_bookmark3) | [iv](#_bookmark3) |
| [ABSTRACT](#_bookmark4) | [v](#_bookmark4) |
| [LIST OF TABLES](#_bookmark5) | [xi](#_bookmark5) |
| [CHAPTER 1](#_bookmark6) | [1](#_bookmark6) |
| [INTRODUCTION](#_bookmark7) | [1](#_bookmark7) |
| [1.1 Background of study](#_bookmark8) | [1](#_bookmark8) |
| [1.2 Significance of the study](#_bookmark9) | [3](#_bookmark9) |
| [1.3 Problem statement](#_bookmark10) | [4](#_bookmark10) |
| [1.4 Aim and Objectives](#_bookmark11) | [4](#_bookmark11) |
| [1.4.1 Aim](#_bookmark12) | [4](#_bookmark12) |
| [1.4.2 Objectives](#_bookmark13) | [4](#_bookmark13) |
| [1.5 Methodology](#_bookmark14) | [5](#_bookmark14) |
| [1.6 Scope of Study](#_bookmark15) | [6](#_bookmark15) |
| [1.7 Limitation of the study](#_bookmark16) | [6](#_bookmark16) |
| [1.8 Project Organization](#_bookmark17) | [6](#_bookmark17) |
| [CHAPTER 2](#_bookmark18) | [8](#_bookmark18) |
| [LITERATURE REVIEW](#_bookmark19) | [8](#_bookmark19) |
| [2.2 Concept of the RFID](#_bookmark20) | [8](#_bookmark20) |
| [2.2.1 RFID Technology and Architecture](#_bookmark21) |  |

**LIST OF FIGURES**

# 

**CHAPTER 1**

# INTRODUCTION

* 1. **Background of study**

The traditional method of paying for goods at supermarkets and shopping malls is through a queue at the check-out area, also known as the TILL. This system has been in place for decades and is still the most widely used method in these types of retail settings. However, in recent years, there has been a significant increase in the development of large shopping complexes in Africa's bustling cities due to the appeal of a growing population and rapid industrialization. These shopping centers, often referred to as malls, have become popular destinations for people looking to purchase a variety of goods and services.

Shopping, which can be done at malls and grocery stores, can be tiring for many people due to the long lines at the check-out area. This is particularly true on weekends and holidays when the crowds are at their largest. The process of shopping in these types of retail settings involves browsing through the available goods or services presented by one or more vendors with the aim of making an appropriate selection of items. However, the process of standing in line to pay for these items can be quite exhausting for many individuals, leading to frustration and dissatisfaction.

As cities grow and become more industrialized, the size of these retail stores also increases, leading to an increase in congestion, particularly on weekends and holidays. This is due to the fact that more and more people are turning to these retail settings to purchase their daily necessities. Grocery stores, in particular, have become an essential destination for people looking to acquire goods and services for their daily needs.

In light of this, there is a growing need for a more efficient and effective method of paying for goods and services at supermarkets and shopping malls. One solution to this problem is to develop an iot based smart shopping cart system that uses RFID to track purchased products. This technology presents systems with features designed with low cost and effectiveness objectives while reducing power consumption. The idea behind this system is that customers can simply scan their items as they put them into their cart and make payment, eliminating the need to stand in long lines at the check-out area.

Among the most crucial types of data detection systems is the radio frequency identification system (RFID) which is a piece of technology that is instantaneous and utilizes electromagnetic waves to aid computerized systems with the detection of objects, capturing of metadata, and regulation of specific targets. Presently, RFID is a crucially significant advancement in information systems, which will profoundly and extensively impact on the development of various sectors across the globe today.

RFID or Radio Frequency Identification System is a innovation recognition system that helps determine objects merely through the tags affixed to them, without requiring any or very little light of contact between the labels and the tagged scanner [4].

This method of the billing process, there would be results in less crowded areas in shopping malls, grocery centers, etc.

The device will be equipped with RFID readers that can scan RFID tags attached to products in the store. Once a product is scanned, the device will automatically add it to the customer's virtual cart. Customers can then proceed to the payment section where a QR code will be generated for the total amount of the purchase. The customer can then scan the QR code using their mobile device and make the payment. This will eliminate the need for customers to wait in long checkout lines, and will also provide store owners with valuable insights into customer purchasing habits and inventory management.

The device will also feature a user-friendly interface that will allow customers to easily navigate through the system and make their purchases. The device will also be connected to the internet, which will enable it to update inventory levels in real-time, allowing store owners to manage their inventory more effectively. Additionally, it will provide the store owners with data on customer purchase history, which can be used to improve their marketing strategies.

The mobile application, which is written in python code, would be used to display the bills and handle payments. The Arduino microcontroller would be used to control the RFID reader and ensure the proper functioning of the system. The aim of the project is to create a fast and efficient billing system that utilizes modern technology to improve the customer experience and reduce the stress and waiting times associated with traditional billing method.

# Significance of the study

The main relevance of the project is to reduce the time spent on the billing process and also reduce man-power as more like automating payment method and that is to conclude the payment process in the cart instead of standing in a queue also for one or two items.

This project levels to show the advantages of having an IOT based smart shopping device with RFID technology, encouraging more people to invest in RFID and smart cart system to create ease in billing processes. Due to the increase in population across the globe and in Africa specifically, resulting in a highly dense population in check-out areas, it is important to develop and implement a new approach to processing payments at supermarkets. The proposed model in this project delivers a cost-effective system in terms of lesser power consumption than the previous technology. Another motivation for this study is the need for more advanced technology to develop and implement this idea in shopping malls to collate data concerning the kinds of products we purchase and consume. Thus, there is an urgent need for solution to these challenges.

The project constructed over the course of this project executions would benefit the following categories of people**;**

1. **Consumers**: These are the major people benefitting from this project because they are the major cause of the concern in the building of this project which includes services like automatic payment of goods, provisioning, dunning, approvals, and customer-event triggers.
2. **Staff and employees**: This project provide a more productive way for employees and staff to be more productive and effective in their line of work because it lowers printing and mailing costs, minimizes deadlines, and streamlines business processes through integrated invoicing handling.
3. **Shopping mall owners**: This automatic billing process would result in a larger rate of sales and yield higher profits cause of the faster and better implementation of sales strategy.
4. **Researchers:** Researchers are constantly looking for ways to improve ways of life and the data gotten from this project could be of tremendous help to achieve this goal and implement it in a better model.
5. **Students:** The project provides more information for further work and research .

The implementation of this project will also be in consonance with the sustainable development goal (SDG) 9 (developed by the United Nations), which is to “build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation”.

# Problem statement

With the rapid technological advancements that the world is experiencing, a shift from the traditional way of doing things to a more efficient way is required. Currently, especially in all African nations, the normal billing procedure in shopping malls, stores and other areas for purchasing items to be put into a shopping cart after picking items and processing is to wait in a queue and proceed with payment with either Cash or Debit cards as the case may be, in few scenarios, with mall designed ready-made payment cards. It has been noted that many individuals are inherently against this but have no other means of payment, Also, humans are not perfect and accurate as machines. Therefore, there are high possibilities of unforeseen future circumstances that have occurred with this which have led to errors in the past, and also long and unending queues which have led to overpopulation in these study case areas.

# Aim and Objectives

* + 1. **Aim**

The aim of this study is to develop, design, and implement an IoT-based smart shopping system device that utilizes RFID technology and QR code generation for payment.

# Objectives

The key purpose incorporated in this strategy is to construct a smart shopping cart with the help of RFID technology for optimizing purchases. The plan is to utilize the RFID-related surveillance implementation strategy in the shopping cart. In this concept, an RFID card is employed as a secure entry for acquiring products in the shopping areas. If the commodity has been placed in the shopping cart the value of the product shows and consequently, the entire quantity can be shown, however, if we simply remove the product from the trolley, you may take away the product and the value of that specific goods gets removed from the full amount. In this, the technique utilized is for generating the items thereby that boosts security performance and speed while

purchasing in shopping complexes. The methodological target for our stated challenge in commercial establishments is the implementation of RFID technology for the spontaneous identification of commodities in the core of the purchasing cart consequently annihilating customer intervention in the job of commodities purchase and for payment. The essential point of the proposed framework is to supply an advancement that is minimal effort-oriented, successfully adjustable, and efficiently practical for supporting shopping individuals. Well with the assistance of this, a huge amount of time will be saved at the checkouts.

# Methodology

The platform will be shown and discussed, additionally, the equipment used for designing and building the electrical circuit that comprises software and hardware requirements will be revealed, as well as the methodologies and initiatives to conduct the automatic billing process from the device created in this project. Also generating a web page/IP address or a desktop app where the items and products scanned would be proceeded to for payment on other various electronic platforms.

The customers need to add the goods after a quick scan in the trolley and after the shopping is done the completed price will be reflected in the carriage connected to the trolley or carrier as the scenario may be. The buyer might either pay their bill via their pre-recharged customer card issued by the shop. Finally, the full details will be sent to the host server and database of the supermarket. Some of the other key point methodologies are;

1. Design and modeling of a desktop-based application for collating and removing scanned products
2. RFID reader development
3. RFID reader and card integration with the database
4. Specification collection and analysis based on current technology
5. RFID reader schematic design using an Arduino and associated components.

# Scope of Study

This project concentrates on the creation of **a portable billing machine device system**. The scope of this study cuts across web application development, desktop application learning, and hardware design and construction. The purview of this research is to apply RFID in a new and innovative way, our entire emphasis is on using this technology for shopping purposes to serve as a better means of processing billing strategies in different places of purchase.

# Limitation of the study

The major limitations of this project are:

1. If the correct data is not being put in place, it may provide wrong results
2. It is necessary to have an active internet connection during the process
3. RFID devices need to be programmed, requiring a certain amount of time.
4. Scan time could take a few seconds in the view fact of delay time and other parameters involved.

# Project Organization

This project report is divided into five (5) different chapters which are as follows;

**Chapter 1**: It comprises the project summary, background information, the aim and objectives of this project, the project's significance, and the Limitations of the study.

**Chapter 2**: It reviews literature and analyzes prior work on the subject of the project. It includes theory and a review of related works that were previously published.

**Chapter 3**: System Design: This entails the components used in the actualization of the project and the design and engineering principles behind its functionality.

**Chapter 4**: This chapter details the project's implementation and testing. It gives a detailed functional system design and shows the project being tested. This chapter will also evaluate the project's results.

**Chapter 5**: This is the final chapter of the project report with findings and suggestions. It is the concluding part of this report that compromises of the Provision of results of this project, challenges encountered, limitations and recommendations to better the project.