



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**DEVELOPMENT OF SMART SHOPPING CART USING
RFID & GPS SYSTEM WITH IOT – CART-O-MATIC.**

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical Engineering Technology (Industrial Automation and Robotics) with Honours.

by

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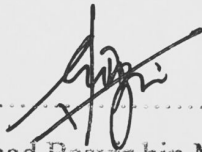
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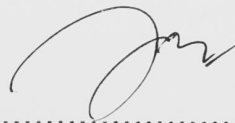
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APPROVAL

This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Automation and Robotics) with Honours. The member of the supervisory is as follow:

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DEDICATION

This pile of pages consisting valuable knowledges is dedicated to my beloved parents, Mohd Nizam and Wan Haliza who have risked and sacrificed their everything just for me to reach this stage. Without the support given, the journey towards the end of this chapter would be tons of burden for me.

ABSTRAK

Pusat membeli-belah ataupun pasar raya didefinisikan sebagai tempat dimana orang ramai datang untuk membeli keperluan seharian mereka. Pada era teknologi berkembang pesat kini, pengalaman bagi pengguna untuk membeli-belah dengan efisien berserta sesi pembayaran yang singkat amatlah diperlukan. Kerap kali pengguna tidak sedar dengan jumlah barang yang mereka masukkan kedalam troli telah melebihi had jumlah bajet yang mereka bawa. Sesetengah daripada pengguna juga tidak mempunyai masa untuk beratur bagi melaksanakan proses pembayaran. Oleh itu, Cart-o-Matic dilengkapi bersama sistem RFID dan GPS dengan tujuan untuk memberikan pengalaman membeli belah dengan efisien kepada setiap pengguna. Cart-o-Matic ini juga direka untuk mengurangkan masa yang diambil untuk pengguna membuat bayaran di kaunter bayaran. Cart-o-Matic ini akan menggunakan sistem RFID untuk mengenalpasti barangan yang dimasukkan kedalam troli, sistem GPS untuk mengesan kedudukan troli dan yang paling penting ialah integrasi dianantara mikropengawal dengan pangkalan data pusat membeli-belah tersebut dengan kaedah IoT untuk mengurangkan masa beratur di kaunter pembayaran. Kesimpulannya, penghasilan Cart-o-Matic membuktikan bahawa barangan yang dikesan melalui RFID sistem akan dipamerkan informasinya pada aplikasi Android untuk memudahkan dan memberikan pengalaman yang menyenangkan dalam proses membeli belah bagi para pengguna. Manakala, pada masa yang sama, jumlah bill yang perlu dibayar oleh pengguna akan siap untuk dikeluarkan di kaunter pembayaran sejurus sahaja pengguna ingin melaksanakan proses pembayaran dimana masa yang diperlukan untuk proses pembayaran telah dikurangkan. Selain itu, Cart-o-Matic telah membuktikan keberkesannya dalam menjejak troli yang hilang bagi mengurangkan dan mengelakkan kerugian pihak pusat beli belah.

ABSTRACT

Shopping mall or supermarket is where people bought in their daily life necessities. In this new era of technology, there is an emerging demand for efficient shopping experience and quick payment methods. Quite often, customers are not aware of the items they took in and they may exceed their budget for those who even put the line. Some even do not have the time to queue up for their payment. Due to this situation, Cart-o-Matic are equipped with RFID and GPS system to make shopping easier and worry-less for the customers who came with certain budget. Cart-o-Matic is also introduced to reduce the time taken for the customer to perform their payment. The Cart-o-Matic will be using the RFID system to identify the items in cart, GPS system to relocate the cart and most importantly the integration of microcontroller with the database of shopping mall using IoT to reduce the time queuing up for payment. In a nutshell, the Cart-o-Matic proves that scanned items along its details will be listed on the Android application to provide a better shopping experience whereas at the billing counter, the total bill will be ready as the customers are about to perform the payment which reduces the time taken to queue for payment. Apart from that, the Cart-o-Matic proves capable in relocating any missing cart to avoid any losses from the shopping mall's party.

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LIST OF SYMBOLS

A	-	Current
V	-	Voltage

LIST OF ABBREVIATIONS

RFID	Radio-frequency identification
IoT	Internet of things
UID	Unique identifiers
ID	Identifications
LCD	Liquid crystal display
QR	Quick response
GUI	Graphical user interface
GSM	Global system for mobile communication
GPS	Global positioning system
Mbps	Megabits per second
Kbps	Kilobits per second
Mhz	Megahertz
NMEA	National Marine Electronics Association
HEX	Hexadecimal
IDX	Index file extension
LIB	Library
URL	Uniform Resource Locator
MRI	Magnetic resonance imaging
UART	Universal Asynchronous Receiver Transmitter
TTL	Time to live
USB	Universal Serial Bus

CHAPTER 1

INTRODUCTION

1.1 Background

Shopping nowadays has become a weekly routine for families to restock their house groceries and other daily needs. In order to give the satisfaction of shopping to the customers, the first rule is to provide shopping carts for them to carry along the needed items. That has been what every shopping mall been doing nowadays. However, there is a lot of room to improve on the shopping system and the shopping cart itself since the era of embedded system implementation has evolved tremendously.

Embedded system briefly as described by (Heath and Steve, 2003) is a microprocessor-based system that is designed to control or manipulate a function or range of functions. With the evolving of embedded system designs, many were used in daily application such as digital watches, hybrid vehicles, and magnetic resonance imaging (MRI). Relative to the revolution of shopping carts, a specific design of an embedded system could be implemented in the shopping cart to increase the shopping experience of the customers.

Arduino microcontroller is one of the vital parts used in designing an embedded system. Arduino basically is an open source programmable circuit board that is designed to be integrated with a wide variety of makerspace projects be it simple or complex as stated by (Wigmore, 2014). The Arduino includes few facilities to communicate with a computer as one, for example, the ATmega328 (single-chip microcontroller) provides universal

asynchronous receiver/ transmitter (UART) time to live (TTL) of 5V serial communication and then an ATmega16U2 on the board channels the serial communication over the universal serial bus (USB) to the software on the computer. With the collection of data obtained from the Arduino, a better system could be designed to improve the performance of the current system.

Besides Arduino, the main feature that every industry is keen on nowadays is the development and implementation of the Internet of Things (IoT). The IoT is a specified system of interrelated computing devices, digital machines, objects, etc that are included of unique identifiers (UIDs) and the ability to move on data over a network without the need of any human-to-computer nor human-to-human interaction. By applying IoT in a system, data could be transfer securely to its cloud at a fast rate and it is reachable for the authorized party anywhere as long there is an internet connection. In this case of the project, the data of items in the cart can be transferred throughout the shopping mall's system effortlessly.

This project is proposedly to be in use of Arduino as its vital component along with radio-frequency identification (RFID) tag and reader, global positioning system (GPS) module, NodeMCU, etc in designing a specified embedded system of the smart shopping cart. An alarm system is also to be included in the parts of the designed system. As additional, an Android application is to be integrated with the smart shopping cart's system as a part of the features with the purpose of increasing the customer's satisfaction while shopping.

Hence, this project is focused on to overcome the problems faced by the shopping mall's part in order to gained satisfaction and good reputation from its customers. However, the shopping cart only works for the shopping mall that has been integrated with itself. The shopping cart would not function as detailed in another shopping mall that has not been integrated with its system.

1.2 Objectives

The objectives of this project entail three main aims which are:

1. To develop a shopping cart equipped with RFID and GPS system.
2. To build an Android application for monitoring the shopping cart's activities.
3. To analyse the performance of Cart-o-Matic's designed system.

1.3 Problem Statement

With the emerging demand for the efficient shopping experience and quick methods of payment, shopping malls in Malaysia need to take a step ahead in inventing new technology for their shopping system. It may take a while to adopt new changes but the outcome of having the new technology in each shopping malls may benefit both the customer and the shopping mall's side.

The setbacks of using the current method of shopping are due to the high time consuming and unpleasant shopping experience for both the customer and manpower of shopping mall to proceed from having items in the cart to the payment at the counter. Customers who came in with a specific budget will need to be aware of the items they took and once they lost count of the total bill, they will need to find a scanner and scan each item which is really, an unpleasant shopping experience for them. Proceeding to the counter for payment, the worker will need to scan each item the customer took which also goes back to have consumed a long period. Additional, due to few unethical actions, there have been several losses to be count for the shopping mall's side as few shopping carts went missing day by day.

Thus, it is compulsory to design and acquire a shopping cart equipped with RFID and GPS system along with a display of item where customers need only to scan the RFID tag of the items they took and have them in the display whereas the GPS is to allocate the shopping cart if they ever went missing. A database connected from the shopping cart and the counter of payment is needed to overcome the setbacks of implementing current shopping method. An Android application that redirects the customer to their favourite items also could increase the customer's satisfaction in shopping.

Hence, the developed system offered by this project is aimed at:

1. Provide a satisfying shopping experience for the customers.
2. Save time for both customer and workers of the shopping mall at the payment counter.
3. Reduce the number of shopping cart losses

1.4 Scope

This project is delimited to:

1. The shopping cart will only work in a system that has integrated with the cart's system.
2. The shopping cart uses ESP8266 to connect between the microcontroller and the Android application.
3. The shopping cart used is based on the microcontroller of NodeMCU itself.

The limitation of smart shopping cart design is focused on improving the current system of shopping method. The smart cart will be limited to read items with a registered RFID tag only. The designed Android application will only display the user's previous item which is listed according to its quantity bought into. The cloud where all the data stored is only accessible to the shopping mall's part.

1.5 Report Outline

This report includes five chapters. A surface overview of Cart-o-Matic – Smart Shopping Cart Using RFID & GPS System with IoT are portrayed in Chapter 1. The problem statement, objectives and scope of the project are also included in Chapter 1. Chapter 2 will be included with the part of Literature Review where an overview of the designs and development of the Cart-o-Matic is presented. In Chapter 2, the timeline of development regarding the Cart-o-Matic will be explained. Chapter 3 are to illustrate the methodology of this project which comprises of hardware and software development. The RFID system will be the input signal alongside with GPS system. The Arduino Software (IDE) will be used to program the Arduino specifically. Android application will be the monitor for output display whereas the data are transferred throughout a cloud using NodeMCU. Chapter 4 is to be focused on the results obtained on behalf of this project which is analysed on the completion of the Cart-o-Matic. Chapter 5 lastly will mark out the conclusions and recommendations for future work.