DEVELOPMENT OF SMART LIBRARY SYSTEM USING RFID

DING YEN YEN

BACHELOR OF ELECTRICAL ENGINEERING (CONTROL, INSTRUMENTATION & AUTOMATION)

FACULTY OF ELECTRICAL ENGINEERING

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2016

"I hereby declare that I have read this project entitle "Development of Smart Library System using RFID" and that is has comply the partial fulfilment for awarding the degree of Bachelor of Electrical Engineering (Control, Instrumentation and Automation)".

Signature	:	……
Supervisor's Name	:	DR. MARIAM MD.GHAZALY
Date	:	……...

I declare that this report entitle “Development of Smart Library System using RFID” is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : …….

Name : DING YEN YEN

Date : …….

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to my supervisor, Dr. Mariam Md. Ghazaly for her guidance, continuous encouragement and constant support in making this research possible. I really appreciate her guidance from the initial to the final level that enabled me to develop an understanding of this research thoroughly. Without her advice and assistance it would be a lot tougher to completion. I also sincerely thanks for the time spent proofreading and correcting my mistakes.

My sincere thanks go to all lecturers and members of the staff of the Electrical Engineering Department, UTeM, who helped me in many ways and made my education journey at UTeM pleasant and unforgettable.

I acknowledge my sincere gratitude to my parents for their love, dream and sacrifice throughout my life. I am really thankful for their sacrifice, patience, and understanding that were inevitable to make this work possible. Their sacrifice had inspired me from the day I learned how to read and write until what I have become now. I cannot find the appropriate words that could properly describe my appreciation for their devotion, support and faith in my ability to achieve my dreams.

ABSTRACT

RFID is the newest and latest technology that has been used in library management system nowadays. With this research, the main aim is to develop the prototype of smart library system with additional features which is returning the books into the bookshelf in order to improve efficiency of the flow in library. RFID is radio frequency identification, readers and tags will communicate with each other through radio frequency. With RFID system, the operation system can be improved, operation cost will be decreased and the data of an item are useful for searching by users. The two design systems are about returning the book to the bookshelf in vertical motion and rotational motion. Two drawings are designing and comparing in order to make the best choice for the design for smart library system in the term of cost, space and number of flow of process. The technical problems and characteristics on the components which are going to use need to be consider and undergo the testing process when building the prototype, such as range of sensor to detect, performance of RFID, speed of DC motor and position of servo motor . The motor, such as DC motor and servo motor are going to use in the project. The control method, PWM control is applied for DC motor to determine the performance of speed of DC motor. The PID controller is designed for the servo motor with load and without load in order to improve the transient response. Ziegler-Nichols method is used for PID controller to perform the best accuracy of position of servo motor in the condition of clockwise direction. The components, such as IR sensor, DC motor, servo motor and RFID reader that used in the project will undergo a testing process to make sure the project runs successfully. The range for the IR sensor reflect on object is about 1 cm until 7cm. By using the PID, the servo motor can achieved the best accuracy of position but PI controller is not suitable for load condition due to PI controller causes unstable to the system. The prototype is developed with successful, but there have some technical problems occurred in hardware design. This research is useful and the technical problems need to be considered all the time and the corrective actions are needed to take when the hardware design is failed to run.

ABSTRAK

RFID adalah teknologi yang terbaru dan terkini yang telah digunakan dalam sistem pengurusan perpustakaan pada masa kini. Dengan kajian ini, tujuan utama adalah untuk membangunkan prototaip sistem perpustakaan pintar dengan memulangkan buku-buku ke rak buku untuk meningkatkan kecekapan aliran dalam perpustakaan. Dengan sistem RFID, sistem operasi boleh diperbaiki, kos operasi akan dikurangkan dan data item berguna untuk mencari oleh pengguna. Kedua-dua sistem reka bentuk akan kembali buku ke rak buku dalam gerakan tegak dan gerakan putaran. Dua lukisan bentuk dan membandingkan untuk membuat pilihan yang terbaik untuk reka bentuk untuk sistem perpustakaan pintar .Masalah teknikal dan ciri-ciri pada komponen yang akan menggunakan perlu mempertimbangkan dan menjalani proses ujian apabila membina prototaip, seperti pelbagai sensor untuk mengesan, prestasi RFID, kelajuan DC motor dan kedudukan motor servo. Motor, seperti DC motor dan motor servo akan menggunakan dalam projek itu. PID pengawal direka untuk motor servo dengan beban dan tanpa beban untuk meningkatkan sambutan fana. kaedah Ziegler-Nichols digunakan untuk pengawal PID untuk melaksanakan ketepatan terbaik kedudukan motor servo dalam keadaan mengikut arah jam. Komponen, seperti sensor IR, DC motor, motor servo dan pembaca RFID yang digunakan dalam projek ini akan melalui proses ujian untuk memastikan projek ini berjalan dengan jayanya. Julat untuk sensor IR merenung objek adalah dalam 1 cm sehingga 7 cm. Dengan menggunakan PID, motor servo boleh mencapai ketepatan yang terbaik kedudukan tetapi PI pengawal tidak sesuai untuk keadaan beban kerana PI pengawal menyebabkan tidak stabil kepada sistem. prototaip ini dibangunkan dengan berjaya, tetapi ada mempunyai beberapa masalah teknikal dalam reka bentuk perkakasan. Kajian ini adalah berguna dan masalah teknikal perlu dipertimbangkan sepanjang masa dan tindakan pembetulan yang diperlukan untuk mengambil apabila reka bentuk perkakasan itu menjalani gagal untuk menjalankan.

TABLE OF CONTENTS

LIST OF TABLE

LIST OF FIGURE

LIST OF ABBREVIATIONS

RFID	-	Radio Frequency Identification
PID	-	Proportional–Integral–Derivative
PWM	-	Pulse Width Modulation
PID	-	Proportional-integral-derivative
P	-	Proportional
Z-N	-	Ziegler-Nichols

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Overview

This chapter will cover the introduction, motivation, problem statement, objective and scope of the research on implementation of smart library system using RFID.

1.2 Introduction

Library is the place where storing the information resources and it provides borrowing service for the library members. The 1st libraries discovered in temple room, located at Sumer with the proving of earliest style of writing. [1] Nowadays, the number of books is increasing in library from time to time in order to affect the people are wasting the time to search the books. Because of many books are arranging in bookshelf, misplaced of books will occur. Automation is growing rapidly recently and it is in order to solve the problem occurred in library which is mentioned. Before the automated returning book system is designed for library, the first thing need to consider is what type of Automatic Identification and Data Capture which called as AIDC is going to use. AIDC is the method to identify and specify the information for the objects. Generally, AIDC is divided into 2 types which are printed and encoded. For AIDC in library, the most common use is barcode and RFID. An analysis will be done for the comparison between RFID system and barcode system. Picking the suitable components for the phase design and analysing the characteristics on the

components is important when developing a system. Researching on the past studies which is related to the topic is necessary to build an automation system in library. Experiment for the components used is going to setup and running along in the research to make sure the system build successful.

1.3 Motivation

RFID is a smart technology that is widely used in the world. For example, RFID is used in supermarket at case and pallet levels such as Wal-Mart, Best-Buy and Target in order to reduce the cost associated with this technology nowadays [2]. RFID is also provides great potential for library system such as broadening access and security. The data of a product can be identified through RFID, it make the mostly industries consider RFID first for tagging their product which can be tracked easily. From the Figure 1.1, the RFID is growing rapidly from the early year. RFID will take over barcode system in one day. Passive RFID technology has greater potential in the future if compared with active RFID due to the price is very cheap. RFID is chosen because it can improve the efficiency in management, production line and industry.

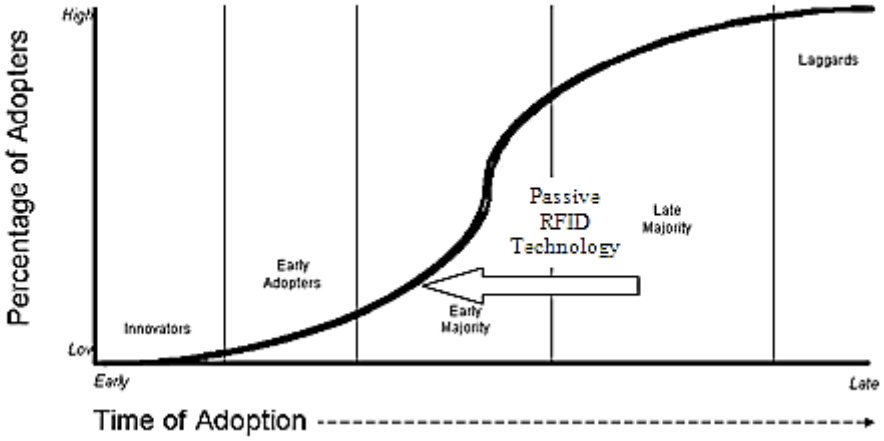

Figure 1.1: Diffusion in RFID Technology (Rogers, 1962)

Automation is useful and growing rapidly recently. For example, some of the restaurant in Japan are applying automation with conveyor belt sushi. The research had mentioned that automation is able to increase the efficiency of library system. [3] Automation is providing great potential and bring convenience to people around the world. Because of too much books on library, the higher and larger of bookshelf is needed to occupy the number of books. A chair and ladder is needed to pick up or put back the books into the bookshelf. With the smart automation, the injuries case can be reduced or prevented. The injuries case happened which is mentioned in The Brown Daily Herald. [4] Alexandra Ulmer had mentioned that Pereira who is a library technician is needed to a surgery on shoulder and elbow after he had serviced 28 years for the shelving books at Brown with the proven by lawyer. Therefore, this research will determine the possibility of applying automation in library management system.

1.4 Problem Statement

There are some technical problem on RFID, which the tag is not detected by the reader [2]. When the tag is moving on conveyor belt, the reader performance will be affected by speed of conveyor belt. The tags also will be influenced by the arrangement of tag on the item surface. The aim of the study evaluate result of various type of the variable, speed of conveyor belt, tag placement and the distance between unit tag and RFID reader and antennas that will affect the readability of RFID tag. Another one is regarding IR sensor due to IR sensor is divided into many types, every IR sensor has their own detecting range for the obstacles. IR sensor has the different detection range for the obstacle due to the colour of the obstacle and the voltage supply to the sensor. The aim of the research is carried out an experiment to determine distance of reflective object in different of colour with the difference values of input voltage to the sensor. The design of the conveyor belt for the sensor to detect the object will based on the results get from the experiment setup. The speed of conveyor belt will be affected by the weight of the item, the length of belt and frictional forces of the belts. To make sure the system is running smoothly, control of speed for conveyor belt system is necessary. The research had mentioned that servo motor is losing control and position without the close loop system. [4] A controller is needed to design to control the position of servo motor with accurately.

1.5 Objective

The main purpose of introducing this project is to design an intelligent smart library system based on RFID Technology with automated system which is returning books to bookshelves and determine the possibility of applying automation system in library for improving the efficiency for library management system. In order to achieve the purpose of the project and to solve the problem occur, the objectives are to design a prototype that able to apply microcontroller technology. The objectives have been listed below must be achieved in completing this project.

a) To design small prototype of smart library system with automated book return system.

b) To examine the performance of RFID tag with different placement.

c) To determine the distance of IR line tracking sensor to reflective object in 5 colours- red, orange, yellow, green and blue with the range of input voltage

d) To analyse the transient response of position for servo motor using PID controller.

1.6 Scope

To achieve the objectives, the scope of project as followed. Two drawings will be designed and analysed to order to make the choices on the design for smart library system. Implementation of a smart library system which is more focused on the conveyor belt system for returning the books to proper area of bookshelf by using Arduino Mega 2560 as a controller with RFID technology for provide more efficient management. The type of DC geared motor which is going to use is SPG 50-60K. The experiment for DC motor is only included open loop system for PWM analysis. The close loop system for PWM analysis of DC motor is not covered for the research. While the IR line tracking sensor is going to apply is model of IR Line Tracking Sensor (Single Bit). For PID to control the accuracy of 6 positions for Tower Pro MG995 in clockwise direction is using Ziegler-Nichols Tuning Rules.

1.7 Organization of the Project

This report will be conducted into five chapters and each of the chapter stated as below. Chapter 1 is regarding about Introduction. This chapter will cover the overview of the project such as general information, motivation, problem statement, objective and scope. Chapter 2 is about Literature Review. This chapter will discuss project background and the past studies related to the project research from the journal and conference paper. Chapter 3 is discussing about Research Methodology. All relevant experiments and techniques that used in the project will discuss in chapter 3. The flowchart for the system design with explanation will show in this chapter. Chapter 4 is about Results& Discussions. The result of the project from the experiment will record and interpret in chapter 4.Chapter 4 is also will analyse and discuss the data which get through the experiment. Chapter 5 is talking about conclusion. This chapter discuss the conclusion and recommendation for the project.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

This chapter is about the literature review for the case study which is related to the research. Project background for the research is included in this chapter. The theory on automatic identification and data capture, barcode, RFID, object detection system and system which is to control the DC motor and DC servo motor are included in this chapter.

2.2 Project Background

RFID which stands for Radio Frequency Identification system was created and invented in the years of 1948, but it was not used for the commercial application until the year of 1980[2]. Antenna, transceiver is called as reader, transponder is also as a tag are components in RFID system. Through RFID system, readers and tags will communicate with each other through radio frequency. RFID is widely used in worldwide today because it can be used to identify and track the item either in shopping, library, industry and various place by radio waves. Issues like misplaced and missing item are common problem that occurred in library nowadays. 1995 study shows that 12 percent of all library books in Ohio were missing [6].Based on the research, Singapore libraries are applying RFID Technology as management system in library [7]. To make the system to be more efficient, the automated