

**IOT BASED CHILD PART INVENTORY AND TRACKING  
SYSTEM IN INDUSTRY**

**MUHAMMAD SABRI BIN ROSLI**

**This report is submitted in partial fulfilment of the requirements  
for the degree of Bachelor of Electronic Engineering with Honours**

**Faculty of Electronic and Computer Engineering  
Universiti Teknikal Malaysia Melaka**

**2018**

**BORANG PENGESAHAN STATUS LAPORAN  
PROJEK SARJANA MUDA II**

Tajuk Projek : IoT Based Child Part Inventory and Tracking System  
in Industry  
Sesi Pengajian : 2018/2019

Saya MUHAMMAD SABRI BIN ROSLI mengaku membenarkan laporan Projek Sarjana Muda ini disimpan di Perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Laporan adalah hakmilik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan laporan ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tandakan (✓):

**SULIT\***

(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)

**TERHAD\***

(Mengandungi maklumat terhad yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan.

**TIDAK TERHAD**

Disahkan oleh:

  
(TANDATANGAN PENULIS)

Alamat Tetap: C-8232,  
Bukit Piatu,  
75150 Melaka,  
Melaka.

Tarikh : 14 Dec 2018

  
(COP DAN TANDATANGAN PENYELIA)


DR. SIVA KUMAR SUBRAMANIAM  
Senior Lecturer  
Faculty of Electronics and Computer Engineering  
Universiti Teknikal Malaysia Melaka (UTeM)  
Hang Tuah Jaya  
76100 Durian Tunggal, Melaka

Tarikh : 14 Dec 2018

\*CATATAN: Jika laporan ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali tempoh laporan ini perlu dikelaskan sebagai SULIT atau TERHAD.

## DECLARATION

I declare that this report entitled “IoT Based Child Part Inventory and Tracking System in Industry” is the result of my own work except for quotes as cited in the references.

Signature :  .....

Author : MUHAMMAD SABRI B. ROSLI

Date : 14 DEC 2018

## APPROVAL

I hereby declare that I have read this thesis and in my opinion, this thesis is sufficient in terms of scope and quality for the award of Bachelor of Electronic Engineering with Honours.

Signature

:



DR. SIVA KUMAR SUBRAMANIAM

Senior Lecturer

Faculty of Electronics and Computer Engineering

Universiti Teknikal Malaysia Melaka (UTeM)

Hang Tuah Jaya

76100 Durian Tunggal, Melaka

Supervisor Name

:

Date

:

14/12/2018

## **DEDICATION**

To my beloved parents and family member who has provided a variety of support regarding moral, financial and always be by my side when I am going through hard times to finish this my study including this project. It also dedicated to my supervisor and friend who give me advice, help, and support in completing this project and report.

## ABSTRACT

Managing inventory and tracking of child parts or raw materials used in a production process is a crucial component in an industrial shop floor. The child parts commonly located in a centralised store as inventory for the pre-planned production process. Tracking and recording the running number of parts incoming and outgoing of the store is a critical as well as a labour-intensive task in any industry. The store personnel is responsible for creating the inventory listing, storing, updating and tracking the child parts on demand by the production team for the continuous production process. Investigation of the existing child part inventory and tracking system is essential to manage efficiently, control & monitor all aspects of a store in any industry. A comprehensive data acquisition system in child part inventory into a cloud-based system enables a paperless system with minimum human intervention to oversee the entire incoming to outgoing process in the industry. The proposed system allows connectivity between the all-respective departments (PPC, TQM, Maintenance, etc.) to effectively request and systematically manage their daily resources based on pre-planned activities within one integrated system.



## ABSTRAK

*Mengurus inventori dan mengesan bahagian kecil atau bahan mentah yang digunakan dalam proses pengeluaran adalah komponen penting dalam sebuah industri. Bahagian kecil biasanya terletak di stor berpusat sebagai inventori untuk proses pengeluaran pra-rancangan. Penjejakan dan rakaman bilangan bahagian yang masuk dan keluar dari stor adalah kritikal dan merupakan tugas yang intensif buruh dalam mana-mana industri. Kakitangan stor bertanggungjawab untuk membuat penyenaian inventori, menyimpan, mengemas kini dan menjejaki bahagian kecil yang diminta oleh pasukan pengeluaran untuk proses pengeluaran tanpa gangguan. Siasatan inventori dan sistem penjejakan bahagian kecil yang sedia ada adalah penting untuk menguruskan, mengawal dan memantau semua aspek stor dalam mana-mana industri dengan cekap. Sistem pengambilalihan data yang komprehensif dalam inventori bahagian kanak-kanak ke dalam sistem berasaskan awan membolehkan sistem tanpa kertas dengan meminimumkan campur tangan manusia untuk mengawasi keseluruhan proses masuk ke dalam keluar dalam industri. Sistem yang dicadangkan membolehkan penyambungan antara semua jabatan (PPC, TQM, Penyelenggaraan, dan lain-lain) yang membuatkan ia lebih berkesan serta boleh menguruskan sumber mereka dalam satu sistem bersepadu.*

## ACKNOWLEDGMENTS

First and foremost, I would like to take this opportunity to express my sincere acknowledgment to my respective supervisor Dr. Siva Kumar Subramaniam and Mr. Adie Bin Mohd Khafe from the Faculty of Electronics and Computer Engineering, Universiti Teknikal Malaysia Melaka (UTeM) for his essential supervision, support and encouragement towards the completion of this thesis.

Mainly, I would also like to express my deepest gratitude to Mr Mohd Firdaus and Mr Mahadi, the assistant engineer from the component store and microprocessor laboratory for their assistance and advice in all the data collection and analysis. I appreciate the help and cooperation gifted by staffs of Registrar Office who provide the necessary information for me.

Special thanks to all my colleagues, my beloved mother, father and siblings for their moral support in completing this bachelor degree. Lastly, thank you to everyone who had associated with the crucial parts of the realisation of this project



## TABLE OF CONTENTS

<b>Declaration</b>	
<b>Approval</b>	
<b>Dedication</b>	
<b>Abstract</b>	<b>i</b>
<b>Abstrak</b>	<b>ii</b>
<b>Acknowledgments</b>	<b>iii</b>
<b>Table of Contents</b>	<b>iv</b>
<b>List of Figures</b>	<b>ix</b>
<b>List of Tables</b>	<b>xii</b>
<b>List of Symbols and Abbreviations</b>	<b>xiii</b>
<b>List of Appendices</b>	<b>xv</b>
<b>CHAPTER 1 INTRODUCTION</b>	<b>1</b>
1.1 Background	1
1.2 Problem Statements	3
1.3 Project Objective	5
1.4 Scope of Project	5

	v	
1.5	Methodology Description	7
1.6	Report Structure	9
<b>CHAPTER 2 LITERATURE REVIEW</b>		<b>10</b>
2.1	Inventory	10
2.1.1	Types of Inventory	11
2.1.1.1	Raw Materials	11
2.1.1.2	Work-In-Progress Inventory	12
2.1.1.3	Finished Goods	12
2.2	Inventory Management	13
2.3	Inventory Management System	14
2.4	Inventory Tracking System	14
2.4.1	Barcode Technology	15
2.4.2	Radio Frequency Identification (RFID)	16
2.4.3	Comparison of Barcode System and RFID System	18
2.5	Internet of Things (IoT)	19
2.6	Previous Projects Which Related To This Project.	20
2.6.1	IOT Based Stock Verification System Using Raspberry PI, Barcode Scanner and Android Application[13]	20
2.6.2	A Web-based Inventory Control System using Cloud Architecture and Barcode Technology for Zambia Air Force [33]	21

2.6.3	Radio Frequency Identification System for Asset Tracking and Inventory Management in Hospitals [42]	22
2.6.4	A Low-Cost Warehouse Inventory Management System using the Internet of Things and Open source Hardware [17]	23
2.6.5	An IIoT Quality Global Enterprise Inventory Management Model for Automation and Demand Forecasting Based on Cloud [4]	24
<b>CHAPTER 3 METHODOLOGY</b>		<b>25</b>
3.1	Flowchart for the Project	26
3.2	Main Process to Develop This Project	28
3.3	Data Collection Technique	29
3.3.1	Documents and Records	29
3.3.2	Interview	30
3.4	Hardware and Software Used in this Project	30
3.4.1	Raspberry Pi 3 Model B	30
3.4.2	Barcode Reader/Scanner	32
3.4.3	Microsoft Visual Studio 2017	33
3.4.4	MariaDB (Open Source Database)	34
3.5	Hardware and Software Design	35
3.5.1	Hardware Design	35
3.5.2	Software Design	36
3.5.2.1	Create Database in MariaDB	37

3.5.2.2	Develop Web App Using Visual Studio 2017	39
3.5.2.3	Connect Database in MariaDB with Web App	42
<b>CHAPTER 4 RESULTS AND DISCUSSION</b>		<b>44</b>
4.1	Analysis of Collected Data (Data of Components at FKEKK Component Store)	44
4.1.1	Incoming and Outgoing Components for the Year 2013-2017	45
4.1.2	Outgoing Components Sorted by Month for Last Five Year (2013-2017)	46
4.2	Web App of Child Part Inventory Management System	47
4.2.1	Web Page of Login and Registration	48
4.2.2	Component Page	49
4.2.2.1	Available Component Web Page for Admin and User (Staff/Student)	49
4.2.2.2	Web Page of Incoming & Outgoing Component	50
4.2.2.3	Web Page of Add New Component	51
4.2.2.4	Web Page of Update & Delete Component Information	52
4.2.3	Barcode Generator	53
4.2.4	Web Page of Reminder	53
4.3	Analysis of Response Time in Web App by using Wireshark	55
<b>CHAPTER 5 CONCLUSION AND FUTURE WORKS</b>		<b>58</b>
5.1	Conclusion	58

	viii
5.2 Future Work	60
<b>REFERENCES</b>	<b>61</b>
<b>APPENDICES</b>	<b>66</b>



## LIST OF FIGURES

Figure 1.1.1: Hierarchy of Mother and Child Part	2
Figure 1.4.1: Flow of system for this project	6
Figure 1.5.1: Flowchart of the methodology for this project	8
Figure 2.1.1: Relationship of finished product, work-in-progress and raw material	11
Figure 2.3.1: Evolution of inventory management system	14
Figure 2.4.1: Barcode labels	15
Figure 2.4.2: Types of RFID tags and its parts	16
Figure 2.4.3: Relationship of RFID readers and tags	17
Figure 2.6.1: Stock verification based on IoT [13]	20
Figure 2.6.2: Proposed Inventory Management Process [34]	21
Figure 2.6.3: Setup of the inventory management system in a hospital [43]	22
Figure 2.6.4: Block diagram of the system connection	23
Figure 2.6.5: Process of the system	24
Figure 3.1.1: Flowchart for the project	26
Figure 3.2.1: Block diagram of the main process	28
Figure 3.3.1: Block diagram of a process to get the documents and records	30
Figure 3.4.1: Raspberry Pi 3 Model B body configuration	31
Figure 3.4.2: Block diagram of a process to read barcode using a barcode reader	32

Figure 3.4.3: Tool in Microsoft Visual Studio	33
Figure 3.4.4: Table of information in MariaDB	34
Figure 3.5.1: Connection of Raspberry Pi and Wireless Barcode Reader	35
Figure 3.5.2: Driver of raspberry pi not recognised RF receiver in the USB port	36
Figure 3.5.3: RF receiver detect by raspberry pi	36
Figure 3.5.4: Session Manager of MariaDB	37
Figure 3.5.5: Database and table in the MariaDB	38
Figure 3.5.6: Table setting in MariaDB	38
Figure 3.5.7: Create a new project in Visual Studio 2017	39
Figure 3.5.8: Example of master page layout in web form	40
Figure 3.5.9: Codebehind of web form	41
Figure 3.5.10: Add extension of MySQL connector	42
Figure 3.5.11: Configuration of MariaDB database in the web.config	43
Figure 4.1.1: Graph of outgoing components sorted by month	46
Figure 4.2.1: Child Part Inventory Management System	47
Figure 4.2.2: Login Page	48
Figure 4.2.3: Web page of the available component for admin	49
Figure 4.2.4: Incoming and outgoing component page	50
Figure 4.2.5: Error message show up after barcode detected in the database	51
Figure 4.2.6: Web page of add new component	52
Figure 4.2.7: Error in delete component information from the database	52
Figure 4.2.8: Barcode generator	53
Figure 4.2.9: Reminder for pre0order level	54

Figure 4.2.10: Reminder for expiry date	54
Figure 4.3.1: Live capture in Wireshark	55
Figure 4.3.2: Graph of response time	57

## LIST OF TABLES

Table 2.4.1: Comparison of Barcode system and RFID system [49], [50]	18
Table 4.1.1: Number of Incoming and Outgoing Components	45
Table 4.3.1: Response time of a web page	56

## LIST OF SYMBOLS AND ABBREVIATIONS

IoT	:	Internet of Things
RFID	:	Radio-Frequency Identification
NFC	:	Near-Field Communication
Wi-Fi	:	Wireless Fidelity
USB	:	Universal Serial Bus
PC	:	Personal Computer
LAN	:	Local-Area Network
FKEKK	:	Faculty of Electronic and Computer Engineering
UTeM	:	Universiti Teknikal Malaysia Melaka
FYP	:	Final Year Project
PCB	:	Printed Circuit Board
1D	:	One Dimension
2D	:	Two Dimension
3D	:	Three Dimension
CCD	:	Charged Coupled Device
CCTV	:	Closed Circuit TV
ZAF	:	Zambia Air Force
PLC	:	Programmable Logic Controller
GUI	:	Graphical User Interface



CPU	Central Processing Unit
RF	Radio Frequency
HTML	Hyper Text Markup Language

## LIST OF APPENDICES

- Appendix A: Kad Kawalan Stok
- Appendix B: Borang Permohonan Komponen
- Appendix C: Information of Components in Excel
- Appendix D: Barcode Reader Datasheet
- Appendix E: Raspberry Datasheet
- Appendix F: HTML for Login Page
- Appendix G: C# for Login Page
- Appendix H: Gantt Chart

# CHAPTER 1

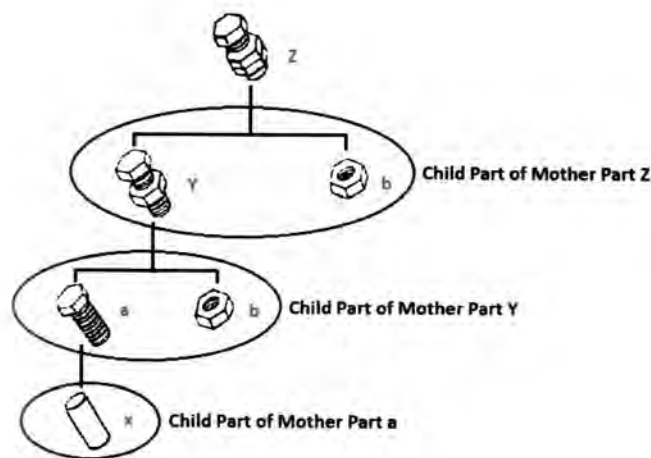
## INTRODUCTION

This chapter provides an introduction to this project. The contents of this chapter is a project overview, problem statement, project objective, project scope, a brief description of the methodology and thesis outline of IoT based child part inventory and tracking system in the industry.

### 1.1 Background

Inventory represents items, goods, and materials stored in certain places as stocks by persons or organisations for specific purposes [1]–[3]. Sharma [3] and Jayaram [4] state that the inventory held or stored by the company in its premises categorised into three types of goods namely raw materials, in-process products, and finished goods.

Item defined as a raw material, hardware, object, or grouping of parts, components, etc [5]. Item divided into two parts: child part/item and mother part/item or parent part/item. The type of inventory used for this project is a raw material, or more accurate is a child parts. Sometimes, mother parts also categorised as a raw material in industry. Mother parts is a result of the assembly of two or more child parts and can be a child part when it assembled with other child parts. Figure 1.1.1 shows the difference between a child part and the mother part.



**Figure 1.1.1: Hierarchy of Mother and Child Part**

To manage and handle child parts in inventory is very difficult as it is small and numerous. The child part stored or held in the inventory store before supplied it to the production department. The production operation will be disrupted if the section of inventory does not supply the child part to them. Therefore, the inventory management system plays a vital role in order to make sure production operate smoothly [6].

With the technology that grows now, the inventory management system can use new technology such as RFID, NFC, QR code and Barcode to improve the efficiency rate of the system [7]. The technology is growing according to the revolution of an industry that is happening now, which also known as Industry 4.0 [8]. The fourth revolution of industry based on a cyber-physical system that includes internet of thing (IoT), cloud computing, system integration, etc [8], [9]. The machine, devices, sensor, and people able connected through the IoT platform.

This project focuses on managing and monitoring data in real time, developing a system to warn an employee if the inventory reaches the threshold set by the company and designing web-based for the inventory management system. The process of project development can be referred to in Chapter 3 and Chapter 4 for the result.

## **1.2 Problem Statements**

The inventory management system is the essential system for manufacturing companies, warehouses, pharmacies and so on [3], [6], [10]. Some criteria must be met to determine the efficiency of the company's production operations. Good criteria in inventory management systems are systems that able to store, track, predict and organise the stocks systematically [11].

Currently, the inventory management system used by the component store at FKEKK UTeM is a semi-automatic system. The store has more than one thousand component drawers, and some of the drawers have two different components. The component's information such as incoming, outgoing and number of stock manually recorded and organised in the Excel software. According to Mr Mohd Firdaus who is



an assistant engineer in FKEKK component store, recording, updating, counting and tracking processes use much time and need more worker.

Tejan [12] has shown the task in inventory management system such as tracking, listing, storing, and updating the parts/items consume longer time in order to complete it by manually. Danawade et al. [13] stated that handling inventory by using a manual and semi-automatic system is a labour-intensive task in any industry as well as increase the expenses of system operation [14]. This clarification confirms the statement given by Mr Mohd Firdaus. Moreover, human error can happen when human handling a manual or semi-automatic system [15], [16].

Therefore, the current inventory management system can be improved using the tracking system and the IoT platform to control incoming and outgoing stocks. Time to tracking the location of materials as well as labour for recording, updating and storing data can be reduced when using this system. Hence, not updating the incoming and outgoing items in real time may make the stocks not sufficient for production to operate [12], [14]. Consequently, company loss is inevitable from happening and the situation comes worse when the material needs a long time to arrive after ordered by the company.

By using the internet of thing (IoT), the inventory can update the outbound and inbound material in real time. With the web that builds in the system, the employer and employees can monitor and organise the information of material. Therefore, can solve the poor communication among employees in a manual inventory management system that can make the process of system sluggish and less efficient [17]. However, the given solution cannot solve some of the problems or can raise other problem. The scope of work will discuss the limitation of this project.