



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**DEVELOPMENT OF SMART CLOTH DRYER
WARDROBE BASED ON AIR CIRCULATION EFFECT**

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Computer Engineering Technology (Computer Systems) with Honours.

by

NUR SYAHIRAH ZAKARIAH

B071510383

960405-06-5354

**FACULTY OF ELECTRICAL AND ELECTRONIC ENGINEERING
TECHNOLOGY**

2019

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: Development of Smart Cloth Dryer Wardrobe Based on Air Circulation Effect

Sesi Pengajian: 2019

Saya **NUR SYAHIRAH ZAKARIAH** mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (X)



SULIT*

Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972.

☐

TERHAD*

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

☒

TIDAK
TERHAD

Yang benar,

Disahkan oleh penyelia:

.....
NUR SYAHIRAH ZAKARIAH

.....
DR. SUHAILA BINTI MOHD NAJIB

Alamat Tetap:

Cop Rasmi Penyelia

X

X

X

Tarikh:

Tarikh:

*Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini

DECLARATION

I hereby, declared this report entitled Development of Smart Cloth Dryer Wardrobe Based on Air Circulation Effect is the results of my own research except as cited in references.

Signature:

Author : NUR SYAHIRAH ZAKARIAH

Date:

APPROVAL

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Computer Systems) with Honours. The member of the supervisory is as follow:

Signature:

Supervisor : DR. SUHAILA BINTI MOHD NAJIB

ABSTRAK

Tujuan projek ini adalah untuk mebangunkan sistem Almari Pengering Baju Pintar Berdasarkan Kesan Putaran Angin yang boleh di pantau dan dikawal melalui Bluetooth. Pada masa kini, di mana ia merupakan zaman pemanasan global, sukar untuk masyarakat menjemur pakaian mereka di luar kerana cuaca yang memudahkan mereka untuk jatuh sakit. Tambahan pula, pembangunan perumahan yang semakin pesat dengan struktur yang tidak bersesuaian menyukarkan lagi proses pengeringan atas beberapa faktor risiko yang perlu diambil kira. Oleh sebab itu, kebanyakan mereka mengambil jalan untuk menggunakan servis dobi semata-mata untuk mengeringkan baju walaupun ianya memerlukan kos yang tinggi untuk satu sesi pengirirngan. Maka dengan itu, projek teknologi pengering baju pintar ini telah dicadangkan agar dapat menyelesaikan masalah ini. Arduino Mega 2560 telah dipilih sebagai kontroler utama dalam projek yang dicadangkan ini untuk sistem integrasi. Sistem ini akan mengambil data suhu dan kelembapan baju yang dikerinkan menggunakan sensor DH22. Sistem pengering baju pintar ini juga boleh dipantau dan dikawal oleh pengguna mengguna telefon peintar mereka. Ini dilakukan menggunakan sambungan Bluetooth menerusi applikasi yang dimuat turun di telefon pintar. Projek ini dijamin sebaai mesra pengguna kerana sistem ini dapat dikawal oleh pengguna dalam jarak 10 meter dalam kawasan perumahan.

ABSTRACT

The purpose of this project is to develop a Smart Cloth Dryer Wardrobe Based on Air Circulation Effect which is empowered with the control and monitoring via Bluetooth. Nowadays, since it is an era of global warming, it is hard for people to dry their laundry outside since one can be vulnerable to sickness. Moreover, the rapid development of building construction that is not suitable for clothes hang drying is also one of the factors that most people nowadays goes to do laundry service to dry their clothes even it cost a lot. In order to solve these problems and to save cost in laundry, a technology to dry clothes inside the house is suggested. Therefore, a smart integrated dryer could be helpful for people who do laundry especially housewives, to multitask while waiting for their laundry dried inside the dryer. Arduino Mega has been chosen as the main controller in the proposed system. It will automatically check the humidity of the clothes to check its dryness which is using DHT22 humidity and temperature sensor. Subsequently, the system will provide a notification signal to user when the cloth is dried. The developed system can be controlled and monitored using android smartphone through wirelessly via Bluetooth connection. This system will definitely offer portability while providing efficiency and reliability which play a vital role for better drying process which of the system can be controlled using smartphone in the range of 10 meters.

DEDICATION

To my beloved mother and father who are always there for me

To my beloved family

To my lecturer and supervisor, for their guidance and encouragement

Dr. Suhaila Binti Mohd Najib

To my friends, for their unconditionally support.

ACKNOWLEDGEMENTS

I would like to take this opportunity to express my deepest grateful appreciation to all wonderful people have continuously giving me support, advices, knowledge, understanding and contribution towards the successful completion of this Final Year Project. In particular, I wish to express my sincere appreciation to my supervisor, Dr. Suhaila binti Mohd Najib for encouragement, guidance, critics, advices, suggestion and motivation on developing this project. In addition, contributed towards my understanding and thoughts. Finally, I would like to express my sincerest gratitude and deepest thankfulness to my parent for their love, support and encouragement that they had given to me.

TABLE OF CONTENTS

	PAGE
TABLE OF CONTENTS	x
LIST OF TABLES	xv
LIST OF FIGURES	xvi
LIST OF APPENDICES	xx
LIST OF ABBREVIATIONS	xxi
1 INTRODUCTION	1
1.1 Introduction	1
1.2 Project Background	1
1.3 Problem Statement	3
1.4 Aim and Objectives	4
1.5 Project Scope and Limitations	5
1.6 Project Significance	6
1.6.1 Portable	6
1.6.2 User Friendly	7
1.6.3 Quality Control	7
1.6.4 Convenient	8
2 LITERATURE REVIEW	9

2.1	Introduction	9
2.2	History of Automatic Dryer System	9
2.3	Previous Development of Automatic Dyer	11
2.3.1	Arduino based Automatic Clothes Dryer System	11
2.3.2	Arduino-Based Temperature Controlled Rice Grain Dryer with Moisture Content Analyser	13
2.3.3	Continuous Airflow Rate Control in A Recirculating Batch Grain Dryer	15
2.3.4	Design, Simulation and Implementation of a Microcontroller based Seed Dryer Machine for Farm Produce Interfaced with Computer System	16
2.3.5	Controlling the Boiler Temperature of Tea Leaves by using Android Application and Arduino UNO	18
2.3.6	Design and Development of a Hybrid Solar-Electric Dryer for Sliced Vegetable Crop	20
2.3.7	Sequence Control of Grain Dryer Machine using PLC	22
2.3.8	Open Access Modelling of Drying Process and Energy Consumption of Onion Slices in a Hybrid Crop Dryer	24
2.3.9	Design of Temperature Controlled Solar Dryer	26
2.3.10	Development of Rice Grain Dryer using Arduino	27

2.3.11	Point of Use Thermoelectric Powered Automated Irrigation System for an Intensive Shallow Bottom Heat System Using Waste Geothermal Hot Water and Steam Condensate in Iceland	28
2.3.12	Development of Hanger and Clothes Dryer	30
2.3.13	Design and Experimental Study on Automatic Cloth Retrieval and Drying System	32
2.4	Comparison of Automatic Dryer by Using Sensor, Microcontroller and Heating Element	35
2.5	Summary	38
3	METHODOLOGY	43
3.1	Introduction	43
3.2	Project Overview	43
3.3	Flowchart	44
3.4	Hardware Development	46
3.4.1	Arduino Mega 2560	46
3.4.2	HC-05 Bluetooth module	48
3.4.3	DC Motor	49
3.4.4	Temperature Sensor	50
3.4.5	DC Fan	51
3.4.6	Solid State Relay (SSR)	53
3.5	Software Development	54

3.5.1	Arduino IDE	54
3.5.2	MIT App Inventor	55
3.6	Component Implementation on Board	56
3.7	Software implementation	57
3.7.1	Arduino IDE Development	57
3.7.2	MIT App Inventor 2 Development	61
3.7.3	3-Dimensional Design	64
3.8	Summary	66
4	RESULT & DISCUSSION	67
4.1	Introduction	67
4.2	Project Development	67
4.2.1	Smart Dryer Hardware Operation	67
4.2.2	Android Application Operation	71
4.3	Results Analysis & Discussion	75
4.4	Summary	78
5	CONCLUSION & FUTURE WORK	79
5.1	Introductions	79
5.2	Conclusion	79
5.3	Recommendation for Future Work	79

5.4	Project Potential	80
REFERENCES		81
APPENDICES		85

LIST OF TABLES

TABLE	TITLE	PAGE
2.1	Comparison of past automatic dryer.	35
3.1	Specification of Arduino Mega 47	49
3.2	Specification of 12V DC motor.	50
3.3	Technical Specification of DHT22 (Liu, 2015).	51
4.1	Time for clothes to dry.	75
4.2	Data analysis of clothes humidity based on time.	76

LIST OF FIGURES

FIGURE	TITLE	PAGE
1.1	Project Significance diagram.	6
2.1	Example of earliest dryer.	10
2.2	Block diagram of an automatic clothes dryer wardrobe system (Putra, 2016).	13
2.3	System Flow of the temperature controlled rice grain dryer (Lagrazon and Ignacio, 2014).	15
2.4	Seed Dryer Machine (Ezeofor et al., 2015).	18
2.5	Block diagram of the batch dryer tea (Boopathy and Ramkumar, 2016).	20
2.6	General view of the hybrid dryer system (Nwakuba et al., 2017).	21
2.7	Sectional view of the hybrid dryer (Nwakuba et al., 2017).	22
2.8	Block diagram of grain drying machine (Singh et al., 2012).	23
2.9	Isometric drawing front view of the hybrid electric-gas dryer (Nwakuba et al., 2017).	25
2.10	Circuitry of Dynamo Fans (Bagh et al., 2015).	27

2.11	Block diagram of the Arduino based grain dryer (Hasnan, 2017).	28
2.12	Irrigation Controller Hardware (Foley <i>et al.</i> , 2015).	30
2.13	Block Diagram of automated dryer system (Feriska and Triyanto, 2017).	31
2.14	Prototype of automated clothes dryer rack (Feriska and Triyanto, 2017).	32
2.15	Block Diagram of the automated clothes retrieval (Kumar <i>et al.</i> , 2017).	33
2.16	Assembly drawing of the automated clothes retrieval (Kumar <i>et al.</i> , 2017).	34
3.1	Block diagram of smart dryer system.	44
3.2	Flowchart of the Smart Dryer Wardrobe.	45
3.3	Image of Arduino Mega 2560 (Wei <i>et al.</i> , 2014).	47
3.4	HC-05 Bluetooth module ('HC-05 Bluetooth Module User 's Manual V1 . 0', 2015).	48
3.5	Image of DC motor.	49
3.6	Temperature and Humidity Sensor DHT22 (Liu, 2015)	51
3.7	Image of 12V DC Fan	52

3.8	Image of Single channel SSR.	53
3.9	Open Source Software Arduino IDE.	55
3.10	MIT App Inventor Software.	56
3.11	Circuit implementation.	57
3.12	Arduino Mega microcontroller coding.	58
3.13	Arduino Mega display output from sensor input and bluetooth communication.	59
3.14	Arduino Mega control on and of system via Bluetooth application.	60
3.15	MIT App Inventor application interface design.	61
3.16	MIT App inventor coding block for bluetooth connection.	62
3.17	MIT App inventor coding block for dryer notification system.	63
3.18	MIT App inventor coding block for control of the system through the application.	64
3.19	Inside view of the dryer.	65
3.20	Outside view of the dryer.	65
4.1	Prototype of the Smart Dryer.	68
4.2	Inside view of the Dryer Wardrobe.	69

4.3	Main circuit of the dryer.	70
4.4	Polyster made cloth.	70
4.5	Cotton made cloth.	71
4.6	Icon of the system Android application.	72
4.7	Bluetooth of Android Smartphone.	72
4.8	Main screen of the application before connected to any Bluetooth address.	73
4.9	List of available Bluetooth connection.	74
4.10	The main screen of application after Bluetooth is connected.	74
4.11	Line Chart for humidity versus time analysis.	77

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
Appendix A	Arduino Coding	85
Appendix B	MIT App Inventor Coding	87
Appendix C	Gantt Chart	88

LIST OF ABBREVIATIONS

LED	Light Emitting Diode
AC	Alternating Current
PWM	Pulse Width Modulation
PC	Personal Computer
ADC	Analog Digital Converter
SCADA	Supervisory Control and Data Acquisition
USB	Universal Serial Bus
PLC	Programmable Logic Controller
RTD	Resistance Temperature Detectors
DC	Direct Current
LDR	Light Dependent Resistor
IDE	Integrated Development Environment
SPP	Serial Port Profile
SSR	Solid State Relay
MIT	Massachusetts Institute of Technology

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter is an overview of the whole project where it will briefly discuss about project background, problem statement, and the objective of this project. This is chapter is a chapter that act as a guide in preparing the entire project. The scope of this chapter basically explain why this project was chosen to be developed.

1.2 Project Background

Nowadays, technology has become a part of society daily life where people depends a lot on it to assist them in making tasks easier and faster in their life. The existence of technology in daily life application has make things become convenient and effectively efficient. Therefore, most people follow the evolution of machinery for everyday life applications. Furthermore, most mobile phones nowadays are ‘smart phone’, which offers more advanced communication such as connectivity than regular cell phone (Kamelia *et al.*, 2014). This make current technology more advance since people can control or monitor their hardware application from mobile phone.

One of the machinery application that has continue to advance in this new technology era is dryer machine. Nowadays, many people use dryer to dry their laundry or clothes instead of dried it under the sun as people nowadays are more

complied with their busy lifestyle. Moreover, it is not that safe anymore to be under the hot scorching sun as global warming has increased over the year. Besides, the unpredictable and inconsistent weather is also an important factor that need to be considered for clothes to be dried outside. Especially in the urban where the condition of the area has restricted air flow and limited exposition to sunlight (Malave *et al.*, 2017). Therefore, many people now use clothes dryer to dried up their laundry.

There are many drying system that has been designed and developed, which are used in various fields for various purpose. The drying system is widely used in agriculture to dried food or agricultural product, while there is also drying system that is used in industries to dry soil or water. Despite different method and products on how the system is used, the system operation for most of the dryer is mostly the same. The dryer system is used to detect moisture content with various ways and sensor, then there are many type of drying components is used. The drying components is the most significant component in the system dryer as it is required to produce and dissipate heat for drying process. The process of drying consists of evaporation state and dehydration state.

The current technology of drying wardrobe is still unheard of in Malaysia despite it is widely used in Europe and more developed and advanced country. The dryer system that exist nowadays however still have its weakness or limit that not up to par with current technology. Most of the current technology dryer took long time to dry the clothes which is inefficient and unpractical for daily life. Therefore, this project is proposed to develop and upgrade the current drying system to make it more user friendly and convenient to be used.

1.3 Problem Statement

These days, where global warming had increased steadily, and daily life is fully occupied by busy lifestyle, people can hardly organize themselves as the workload is increasing. They have a difficult time to split their management between personal life and their work. Especially for moms who need to manage children, busy working people, or full-time student who have to attend class from morning to evening, their schedules are packed all day.

Even though they can do laundry as usual and dry the clothes outside and leave it until they came back home, there is no guarantee that it will dry up due to inconsistent weather and urban area complication. Sometimes, there were days where it was scorching hot sun and then suddenly rain heavily. There is a lot of dangerous factor that might need to be considered when hanging laundry outside thus making them always anxious. Apart from that, sometimes people who are busy tends to wash their laundry at night and requires their clothes tomorrow in the morning. This leaves people with occupied schedule a fast drying process for the clothes especially those who are frequently travelled and has short amount of clothing supplies.

From these factors that it is hard to dry laundry outside, many of drying system has been developed ease the drying process. Nevertheless, despite most of washing machine nowadays has tumble dry function, the tumble dry is only significance to dry the clothes by squeezing the water out of from clothes makes the clothes are not fully dried. Besides, there is also dryer machine using heat pump which it can only be found in self-laundry service where user need to spend quite a lot of money for