

**DESIGN AND TESTING OF AUTOMATION CONTROL FOR MINI GULA
MELAKA PRODUCTION SYSTEM USING ARDUINO**

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SUPERVISOR DECLARATION

“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 the degree of Bachelor of Mechanical Engineering (Design and Innovation)”

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Date :**JUNE 2015**

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**This report is submitted in fulfilment of the requirements for the degree of
Bachelor Degree of Mechanical Engineering (Design and Innovation)**

**Faculty of Mechanical Engineering
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JUNE 2015

DECLARATION

"I hereby declare that the work in this thesis which is Design And Testing of Automation Control for Mini Gula Melaka Production System Using Arduino is my own except for summaries and quotations which have been duly acknowledged. "

Signature :.....

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Date :**JUNE 2015**

DEDICATION

I would like to dedicate my thesis to my beloved mother, who gave me never ending affection, love, encouragement and pray of day and night throughout this Final Year Project (PSM).

ACKNOWLEDGEMENT

Praise to Allah SWT almighty for giving me the opportunity and strength to finish up my project. A special thank for my loving mother, Mrs. Che Hasnah Binti Che Ngah and my only brother, Tengku Ezwan Bin Tengku Mansor for never endless support and stunning advice. It would not have been possible without the full support and encouragement from my families and as well as my friends (Mohamad Tajuddin Bin Ramli and Mohamad Faiz Bin Mohamad Radzuan) who helped me a lot in finalizing this project within the limited time frame. My sincere thanks to all of them.

I also would like to express my special thanks of gratitude to my supervisor Dr.Shamsul Anuar Bin Shamsudin who gave me the golden opportunity to make this wonderful project on the topic “Design And Testing Automation Control for Mini Gula Melaka Production System Using Arduino” and which also helped me in doing a lot of Research. I came to know about so many new things, that I am really thankful to them.

ABSTRAK

Secara umumnya, kajian ini telah dijalankan pada pemprosesan Gula Melaka di Industri Kecil dan Sederhana (IKS). Penghasilan Gula Melaka secara keseluruhannya masih menggunakan kaedah tradisional dimana setiap proses dijalankan secara manual dan memerlukan tenaga buruh serta pengalaman yang mendalam. Setelah kajian dibuat, beberapa masalah yang dihadapi oleh pihak pengurusan dapat dikenalpasti. Antara pernyataan masalah tersebut adalah pengawalan suhu dimana penghasilan secara manual bergantung pada kelikatan cecair dalam proses tersebut. Di samping itu juga, masalah juga timbul dalam mencapai kuantiti yang diperlukan. Oleh kerana itu, sistem kawalan secara automatik diusulkan sebagai pendekatan untuk penambahbaikan sistem produksi Gula Melaka. Tambahan lagi, sistem kawalan ini membantu dalam mengurangkan tenaga pekerja disamping memudahkan dalam pengawalan suhu dan juga pergerakan pengacau sama ada dalam pergerakan perlahan ataupun laju tanpa mengubah kualiti tekstur Gula Melaka. Cadangan yang diusulkan ini mengambil kira penggunaan elektrik dan pengesan suhu ketika proses memasak. Sistem pengawalan automatik ini juga adalah mesra pengguna dan mempunyai factor keselamatan yang tinggi.

ABSTRACT

Generally, this research was being conducted in Gula Melaka production in Industri Kecil Dan Sederhana (IKS) company. Gula Melaka production overall still use the traditional methods where every process is carried out manually, which required labor force and need an expert. After doing some research, the problems that encountered in production management has been identified. The problem is where temperature regulation production manually depends on liquid viscosity. At the same time, the problem also occurs in achieving quantity needed. Therefore, automatic control system has been proposed as it will give some improvement to Gula Melaka production system. Furthermore, this control system helps to reduce labor mankind, besides it will ease the temperature control in the cooking process. Also, it can control the mixer speeds, whether in slow or fast progress whereas not change the quality of Gula Melaka. This idea is using the electric and temperature detector during the cooking process. This automatic control system is also user friendly and has high in factor of safety.

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LIST OF NOMENCLATURE

AC	:	Alteranting Current
DC	:	Direct Current
FYP	:	Final Year Project
IKS	:	Industri Kecil Dan Sederhana
LCD	:	Liquid Crystal Display
PCB	:	Printed Circuit Board
PLC	:	Programmable Logic Controller
PWM	:	Pulse Width Modulation
RTD	:	Resistance Temperature Detectors
SMI	:	Small and Medium Indutry
SMIDEC	:	Perbadanan Pembangunan Industri Kecil dan Sederhana
SSR	:	Solid State Relays
USB	:	Universal Serial Bus

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CHAPTER 1

INTRODUCTION

This chapter, provides the project background which is entitled “Design and Testing of Automation Control for Palm Sugar Production System Using Arduino.” The problem statement, objectives and scope of this project are included.

1.1 BACKGROUND STUDY

Palm sugar is an organic sweetener with many benefits used interchangeably on a daily basis, whether as enhancers in cooking, baking or eaten directly. Palm sugar is well known in Asian and it's known as Gur in India, Jaggery in Sri Lanka, Gula Melaka in Malaysia or Gula Jawa in Indonesia. In Malaysia, palm sugar is also known as Gula Melaka that is produced traditionally from either coconut tree, Nipa palm, or also a Palmyra tree (Phaichamnan, 2010).

The Gula Melaka is made from fresh sweet palm juice called *Neera*. The process goes by tapping of the sweet, watery drips nectar from the palm tree buds that flows when the inflorescence. But the first thing is palm tree buds must be gently beaten with a mallet for a few days said (Karupatti, 2011). The small slice is then taken off at the end and the gourd is hung close to the cut. The sap is collected and to concentrate the nectar into solid it then was traditionally boiled down in huge woks. The syrup slowly evaporated and then stirred until a sticky sugar remains. This sugar can be extremely dense and very sticky even when it is soft. The sticky sugar is then

poured into bamboo sections or molds to form shapes. Mostly Gula Melaka is sold in cylinders as in Figure 1.1, block, rounded cakes or glass jars.



Figure 1.1: Palm sugar a.k.a Gula Melaka
(Gula Melaka: Cooking with Asian ingredients at home, 2011)

1.2 PROBLEM STATEMENT

Currently, the industry of Gula Melaka still relies heavily on manpower to fully operate the production system (Safwan, 2010). Automation control system can greatly help improve this situation by preserving the quality, besides it can fulfill the production requirement. Arduino is a common control technique in industrial but yet requires the better understanding to actually fully operate it in a production system. Thus, the skilled and knowledge in Arduino is needed to improve the production system of Gula Melaka which still produced in the traditional way.

1.3 OBJECTIVE OF THE PROJECT

The objectives of the project are:

1. To study and design control system using Arduino.
2. To develop automation control using Arduino in improving the production system of Gula Melaka.
3. To test the process as it is controlled using the Arduino code.

1.4 SCOPE OF STUDY

The scopes of this project are:

- To diagnose and improve the problem of the Gula Melaka production system.
- To use a common control tool such as Arduino.

1.5 ORGANIZATION OF THE THESIS

The remainder of this thesis is will be as follows. Chapter 2 covers the Gula Melaka production process. Chapter 3 touches methodology used that include the hardware and softwares getting up and programming. Chapter 4 discuss of a data analysis through the circuit design prototype while chapter 5 presents the results as this scheme is tested.

CHAPTER 2

LITERATURE REVIEW

In this chapter, it will briefly explain about Gula Melaka manufacturing process. It is also covers the overview about the control choices that are available. The review about analysis of control system also included.

2.1 SMALL AND MEDIUM INDUSTRY (SMI) GULA MELAKA PRODUCTION

In Malaysia, the number of workers in medium and small industry is assuming less than 10 people. The process of Gula Melaka production in the NRB Food Industry Company is manually done from the beginning process until it completes. As known, the Perbadanan Pembangunan Industri Kecil Dan Sederhana (SMIDEC) is an organization which responsible as advisor and provide some seminar to the entrepreneur of SMI (Corporation, 2009).

Planning and arrangement in the production business depend on how the industry deals with the marketing strategy that is carried out. If high demand is required for a good strategy to fulfil all requests, it can be made by modifying the working hours or increasing the number of workers. Besides that, it can make a change from Gula Melaka production system aspect which is done by semi automation or fully automatic by designing a control system that can ease SMI. In order to fill the request from the NRB Food Industries Company, Malacca, this automation system for the Gula Melaka production system is proposed.

2.2 GULA MELAKA MANUFACTURING PROCESS

Gula Melaka is a sweetener that made of sweet water that comes from nectar flower buds of the palm. It will be boiled in huge woks for a while before it turns hard into the mold. Gula Melaka is naturally sweet and contained a few vitamins and nutrition, which are needed in the human body (Asia Botanicals Sdn. Bhd, 2014). It also can replace the additional sweetener in every food dish as human daily routine.

Gula Melaka that exists in the current market is like cylinder form and round block. The making process is not an easy task because of it having several stages before it launch to the market. The steps are including process of cooking, pouring, cooling and lastly packaging (K.A. Azlan, 2015).

2.2.1 Process of Cooking

Sweet watery Neera from palm tree will be heated to the extreme temperature range around 110°C to 130 °C and it exceeds the level of normal boiling point. To control the fire and temperature, this manually cooking method used charcoal. The temperature will be increased and reduced depending on the expertise in looking the viscosity change.

Beside sweet Neera, other ingredients also added such as water, coconut milk and pandan leaves. A pandan leaf was used as aroma booster and prevents the sugar from quickly spoiled. In the cooking process, it requires a range of 2 hours and half to 3 hours depend on the quantity used. The process needs to be consistent in order to prevent the sticky sugar from quickly harden.

2.2.2 Process of Pouring

After finishing cooking, the sticky sugar being poured into the mold manually. The Gula Melaka mold is made of bamboo and wooden. It is because by

using those materials, the sugar will harden and separated easily. This process needs to be done faster as the sugar start hardens.

2.2.3 Process of Cooling

This process is to change a sticky sugar into a solid one and basically, less time is required. The sugar hardened when the warm temperature started to decrease from 100°C to 30°C - 40°C and time taken is only 30 minutes. The process commonly made in 27°C - 30°C between room temperature.

2.2.4 Process of Packaging

The last process of Gula Melaka manufacturing is packaging. For this process, the Gula Melaka which had been taken out of the mold will be packed into the plastic. It then will be sealed and put in the box.

2.3 MICROCONTROLLER APPLICATIONS

In order to achieve the temperature needed, a data processing program had been designed by combining the microcontroller software system to accept the command. The computer programming system is to control the program which kept on storage card. The data sent is from the external input section which will be changed and then, it will send to the output data.

Controller system is the most sophisticated which enables the converter to adapt it into temperature control. The system involved is classified as a 8 bit number with data language in controlling all the requests nowadays (Manas Kumar Parai, 2013). This microcontroller will control the temperature and the speed of the mixer by using the language C which has already combined. More than that, this system will control the output from the temperature sensor to show on the screen touch used.

2.3.1 Programmable Logic Controller (PLC)

PLC is a digital computer which used to control machines and process. It is a programmable, reliable and usable and at the same time can withstand a harsh industrial environment (Hackwort, 2013). Often, the system will produce correct action by using logic commands and done through by connecting to a computer or a programming panel.

There are many advantages of PLC control systems such as the response time is quite faster, and can handle complicated system. Also PLC as shown in Figure 2.1 is sophisticated instruction sets available and easy to repair or expand.



Figure 2.1: Programming Logic Controller
(LENZE, 2015)

2.3.2 Arduino Mega

Arduino Mega as shown in Figure 2.2 is a one kind of microcontroller board and it contains everything that needed to support the microcontroller. Arduino mega has 54 digital input and output pins and the 14 from the pins can be used as PWM outputs. It is also gives 16 analog inputs, USB port which designed for integrating with Android devices (www.sainsmart.com, 2013).