

**AUTOMATED MULTIPLE WATER FILLING  
(AMWF) MACHINE**

**RUHAIRI BIN ABDUL RAHIM**

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA  
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BORANG PENGESAHAN STATUS LAPORAN  
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Saya RUHAIRI BIN ABDUL RAHIM mengaku membenarkan Laporan Projek Sarjana Muda ini disimpan di Perpustakaan dengan syarat-syarat kegunaan seperti berikut:

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Alamat Tetap: 89 LRG HILIR SBENG PERAK,  
05400 ALOR SETAR,  
KEDAH DARUL AMAN

Tarikh: 28/04/2009

Disahkan oleh:

  
(DOP DAN TANDATANGAN MENYELIA)

**KHAIRUDDIN BIN OSMAN**  
Pensyarah  
Fakulti Kejuruteraan Elektrik Dan Kejuruteraan Komputer  
Universiti Teknikal Malaysia Melaka (UTeM)  
Karung Bertundi No 1752  
Pejabat Pos Durian Tunggal  
76109 Durian Tunggal, Melaka

Tarikh: 28/04/2009

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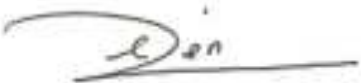
: RUHAIRI BIN ABDUL RAHIM

Date

: 24 MARCH 2009

"I hereby declare that I have read this report and in my opinion this report is sufficient in terms of the scope and quality for the award of Bachelor of Electronic Engineering (Industrial Electronics) With Honors."

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: .....

Supervisor's Name

: EN KHAIRUDDIN BIN OSMAN

Date

: 24 MARCH 2009

For my beloved mother, Husnaini Indrawati Binti Baharni and father, Abdul Rahim  
Bin Osman

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## ABSTRACT

This project was discussed about the design and implementation of automated multiple water filling machine using Programmable Logic Controller (PLC). This system suitable for liquid product that required exact amount of liquid and have 2 different flavor of liquid to be filled in the bottle such as drinking water (syrup and orange). This is a batch operation where a set amount of inputs to be process is received as a group, and an operation produces the finish product. Generally, the function of the machine is to fill the water automatically into bottles through a conveyor. So in this process, the bottle that will fill with this flavor water will mark with 2 color stickers where each color sticker will represent each flavor of water. The objective of this project was to be applied in drinking water industries and to automated the water filling process which can save time and cost. This project is the combination of PLC, and electrical DC motor system. This project is divided into 4 sections; the loading section, the conveyor section, path divider section and filling section, where the whole sections is controlled by PLC.

## ABSTRAK

Projek ini membincangkan rekabentuk dan pelaksanaan mesin pengisian cecair secara berganda menggunakan sistem Kawalan Logik Boleh Aturcara (PLC). Sistem ini sesuai untuk produk berasaskan kepada cecair yang memerlukan pengisian pada kadar yang tetap dan mempunyai 2 perasa berbeza untuk diisikan ke dalam botol seperti air minuman (sirap dan oren). Operasi secara berkumpulan ini melibatkan sejumlah bahan melalui proses diterima secara berkumpulan dan menghasilkan produk yang siap. Secara keseluruhannya mesin ini berfungsi mengisi air ke dalam botol secara automatik melalui alat penghantar barang-barang atau lebih dikenali sebagai konveyor. Melalui proses ini, setiap botol akan dilekatkan pelekat berwarna dimana warna pelekat ini mewakili perisa setiap air minuman yang dijalankan. Objektif projek ini untuk digunakan pada industri air minuman dan menjalankan proses pengisian air secara automatik yang akan menjimatkan masa dan kos. Projek ini adalah kombinasi PLC, sistem motor elektrik arus terus. Projek ini dibahagikan kepada 4 bahagian; bahagian pemuat, bahagian pembawa, bahagian pembahagi laluan, dan bahagian pengisi, dimana semua bahagian-bahagian ini dikawal oleh PLC.



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## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 Introduction**

This project is to design and develop the “Automated Multiple Water Filling Machine”. The purpose of this project is to apply filling system where this system can automatically filling 2 type of liquid into their bottle randomly by using PLC as a controller. The filling system will be using the filling concept Time Gravity Filler Selection Guide. This is a batch operation where a set amount of inputs to be process is received as a group, and an operation produces the finish product. This project is the combination of PLC, and electrical DC motor system. This project is divided into 4 sections; the loading section, the conveyor section (transfer section), filling section which divided into 2 sections A and B, and path divider section. The whole sections are controlled by the Keyence PLC. The mechanical part of the project consists of mechanical drawing, measuring, welding and fabricating process, while electrical part consists of electrical drawing; electrical wiring and programming. The software of the Keyence PLC theory includes the electrical and mechanical actuators for the hardware will be showing a good result to fulfill the objective of this project.

## 1.2 Objectives of the Project

The project is aimed to meet the following objectives:

- To design and implement automated multiple water filling machine
- To learn the concept of electrical DC motor system
- To apply selector conveyor concept
- To implement hardware installation, wiring, mechanical mounting
- To learn troubleshooting and analyzing
- To learn PLC programming

## 1.3 Problem Statements

This machine is designed to filling 2 type of liquid to their bottle randomly in a single machine. This project will reduce the usage of man power because all of the work will be done by machine. Human held filling process will cause inexact volume of liquid into the bottle. So using automated system will set the volume of the liquid exactly the same for each bottle. If all the process is done manually, it will cost lot of time to complete the task. This machine will also reduce the human error while doing this process manually. It also can be used as a training kit to describe the function of dc motor.

## 1.4 Scope of the Project

All projects have their own scope or limitation as a guideline throughout the completion of the project. The project scope for implementation this project is:

- i. Design filling system for 2 type of flavor water in one machine randomly
- ii. Divided into 4 sections;
  - Loading section
  - Conveyor section

- Filling section
  - Path divider section
- iii. Design filling system using gravity filling concept.
  - iv. Selector conveyor concept
  - v. Control by PLC
  - vi. The programming or software development and implementation consists of Keyence Programmer for Keyence PLC.

### **1.5** Report Overview

This report consists 5 chapters where each chapter filled with detail of scope and description.

- Chapter 1  
Review about Automated Multiple Water Filling (AMWF) Machine such as introduction, objectives, problem statement and scope of project.
- Chapter 2  
This chapter discuss about the literature review, theory of component using and project comparison between pervious projects.
- Chapter 3  
Describe about project methodology used in this project, project process flow and project layout.
- Chapter 4  
These chapters describe about result such as preliminary result and expected result. On this chapter also write about discussion about this project.
- Chapter 5  
This chapter was clarifying about recommendation and conclusion about this project.

## CHAPTER 2

### LITERITURE REVIEW

This chapter will explain and discuss about source or article that related to the project. It is consist of the products that have been appeared in the market nowadays. This chapter is also contained the theory of the components, equipments and programming languages that is used in the project.

#### 2.1 First Review

For the first review is from Automatic Gravity Filler GI 2100 [8] which can be refer on figure 2.1

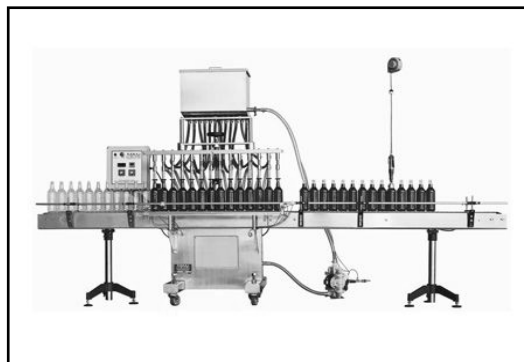


Figure 2.1 Filling machine

### **2.1.1 Construction features**

304 Stainless steel heavy duty stainless steel welded C frame. It has 20 Gallon stainless steel overflow tank and stainless steel cover for overflow tank. It also consist 20 Gallon feeding tank with float valve and stainless steel cover for feeding tank. The 20 hose are made with 304 stainless steel feeding manifold. All contact parts are stainless steel, sanitary, Teflon, viton and hoses. The machine is mounted on 4 heavy duty casters. The machine is leveled by 1 inch 304 stainless steel leveling screws.

### **2.1.2 Control Panel Features**

The machine was controlled by Omron PLC for all logic functions, special modifications on programs available for special adaptations. Front panel filling time adjustment through Omron Timer. Front panel conveyor speed control for machine sold with conveyor. Front panel mounted bottle counter. Front panel Start and Emergency STOP for easy access. Front panel nozzle code for changing nozzle quantities. The fiber optic sensors are set by Omron standard for container gating. It was expandable to 20 nozzles to increase speed.

### **2.1.3 Main Component Features**

This machine uses 40 Gallon per minute double diaphragm pump for feeding tank supply. Hardened Stainless steel calibrated shafts with linear bearings for nozzle rack movement smoothness and durability. It has 8 inch stroke air cylinder with magnetic sensors for nozzle up and down movement. Hand wheel and shaft mounted stoppers for height and stroke adjustment.

### **2.1.4 Standard Features**

Nozzle spacing is fully adjustable through top screw. Container height can be adjusted from 1 to 16 inches high. Meanwhile the nozzle stroke can be adjusted from 0

to 8 inches. Entry and exit bottle gating cylinders adjustable, sideways, up and down and inside and outside. Air filter regulator, safety lockout valve and valve activated by float on tank are mounted on the pump. Spacing and additional bottle control obtained by flow controls mounted on air gating cylinders.

### 2.1.5 Requirements

- 110 Volts
- 60Hz
- 15 Amps
- 10 CFM at 80 psi.

## 2.2 Second Review

For second review is from thesis DESIGN & IMPLEMENTATION OF AUTOMATED FILLING AND CAPPING MACHINE USING PLC [5], from MOHD ASNAWI. The picture of his project can be refer on figure 2.2

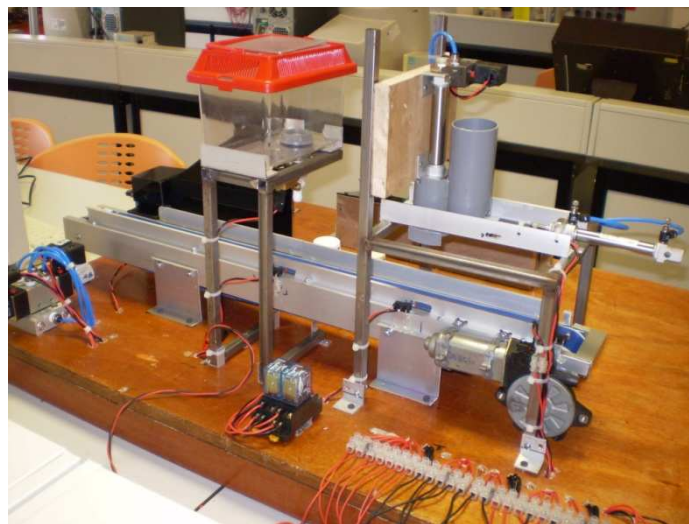


Figure 2.2 Automated Filling and Capping Machine

This machine is divided into four sections; the loading section, the conveyor section, filling section, capping section and the whole sections is controlled by the Omron CQM1-H PLC.

### **2.2.1 Construction features**

The frame and base for the machine was constructed by using metal for give the toughness. It was built by using fabrication and welding techniques. This machine has 1 water tank over conveyor. The measurement of the tank is 9cm height, 20cm wide and 6cm deep which will cover the capacity 1080mL of water. It can full up to 8 bottles of 125mL in one time.

### **2.2.2 Main Controller Features**

The Machine was controlled by Omron CQM1-H PLC and use pneumatic system for loading part and capping part.

### **2.2.3 Main Component Features**

#### **2.2.3.1 Loading Section**

The loading section was designed to store the empty bottle before the process was started. Use pneumatic system and cylinder was use as stopper. The slider is designed lean about 40 degrees so that the bottle will slide down according to gravity principle after the cylinder return to its initial position. The loading magazine can store up to 5 bottles of 125mL at one time.

#### **2.2.3.2 Filling Section**

The filling tank was design on top of the bottle while filling process because the liquid easily flow through to the bottom according to gravity principle. The measurement of the tank was 9cm height, 20cm wide and 6cm deep which will cover the capacity 1080mL of water. With this amount of water, it can full up to 8 bottles of 125mL. The total time for the valve to open and full one bottle

of 125mL was 6 minutes and 10 seconds. This section use feed valve to flow the water into bottle.

### **2.2.3.3 Capping Section**

The capping section use pneumatic system and cylinder as a pusher to push cap to bottle.

### **2.2.3.4 Conveyor**

The conveyor part, it will use dc motor to move the conveyor forward. It will stop according to the sensor or the limit switch position.

## **2.2.4 Standard Features**

### **2.2.4.1 Electrical DC Motor**

DC motor was used to move the conveyor which is transferring the product between stations. This motor will operate at the voltage of 12 VDC, with the starting current 1.2A and running current of 0.85A.

### **2.2.4.2 Pneumatic System Equipment**

- **Directional Control Valves**

This system used 3/2 way single acting and 5/2 way double acting directional control valve. The 3/2 way single acting directional control valve is from AMISCO model EV1 7/9. Then, the 5/2 way double acting directional control valve is from CHELIC SV-6202. This whole pneumatic system is operates at 24 VDC and the pressure applied is at range 1.5 to 3.0 Bar.