

## SUPERVISOR ENDORSEMENT

“I hereby declare that I have read through this report entitle “Injection Moulding Protection System Controller” and found that it has comply the partial fulfilment for awarding the degree of Bachelor of Electrical Engineering (Control, Instrumentation, and Automation )”.

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**INJECTION MOULDING PROTECTION SYSTEM CONTROLLER**

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**A report submitted in partial fulfilment of the requirements for the degree of  
Bachelor in Electrical Engineering (Control, Instrumentation, and Automation)**

**Faculty of Electrical Engineering  
UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**2016**

## DECLARATION

I declare that this report entitle “Injection Moulding Protection System Controller” 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 : YOGAVINOOTHON S/O VATHIVELLU

Date : .....

## **DEDICATION**

To my beloved father and mother,  
Vathivellu S/O Duraisamy & Rukumany D/O Sundaraju

## ACKNOWLEDGEMENT

First of all, I would like to thank almighty God for the strength and blessings. I would also like to express my deepest gratitude to my supervisor, DR. AHMAD ZAKI BIN HJ SHUKOR for guiding me throughout my final year project development. Knowledge and extra input given by them has highly motivated me to successfully complete this project. The information, suggestions and ideas given by them played huge role in developing a fully functional project.

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## ABSTRACT

Injection moulding machine is a machine produce varies type and size of plastic equipment's. Plastic industries using this injection moulding machine for 24 hours to increased their productivity. Injection moulding machine have a moulding in it. This moulding will print out the plastic equipment with the type and size that have been set in it. The moulding is the important element in the injection machine which is so expensive. Chiller is a system that the release heat from a liquid or a system that absorption refrigeration cycle. These mouldings need a chiller to cool the system because the moulding releases high temperature heat. The injection machine will be monitored by the workers 24 hours because if the chiller have problem and does not supply enough water or does not supply water cool enough, the moulding will be crack in high pressure heat. This will cause high budget to replace it. There are no protections to the injection moulding machine in the industries now. The result with this new injection moulding protection system controller, the injection moulding machine and the chiller can work 24 hours without any monitoring and risk. This injection moulding protection system controller will stop the heater in the injection moulding machine which give the heat to the moulding if the chiller have problem and does not supply enough water or does not supply water cool enough. This system also will give an email alert to the technicians or to the engineers through their smart phones if the system has problem. This injection moulding protection system controller also shut down the chiller after 2 minutes the heater had been shut down. This will save the waste energy that will be used by the chiller after the heater is off. In methodology, first the hardware sketch has been developed and with the sketch, the stimulation circuit is been design in EKTS software. Next, the hardware system been implement and adds on with the Arduino email software coding to send email alert. In results, the hardware system and the Arduino software with the email alert massage is been shown. The analysis of the system is also been shown in graph. As conclusion, all the objective have been fulfil in this project and the future work of this project is to develop an addition coding to allow the Arduino to received signal from the mobile phone to on the backup chiller if the chiller have problem.

## ABSTRAK

Mesin pengacuan suntikan ialah mesin yang hasilkan jenis dan saiz alat plastik berbeza. Industri plastik menggunakan mesin pengacuan suntikan ini selama 24 jam untuk menambah produktiviti mereka. Mesin pengacuan suntikan mempunyai satu pembentukan di dalamnya. Pembentukan ini akan mencetak alat plastik dengan jenis dan saiz yang telah ditentukan. Pendingin ialah satu sistem yang melepaskan haba dari cecair atau satu sistem kitaran pendinginan penyerapan itu. Pembentukan ini perlu sebuah pendingin bertenang sistem kerana pembentukan mengeluarkan haba suhu tinggi. Mesin suntikan akan dipantau oleh para pekerja itu 24 jam kerana jika pendingin mempunyai masalah dan tidak membekalkan air secukupnya atau tidak bekalan air cukup tenang, pembentukan akan retak dalam haba tekanan tinggi. Ini akan menyebabkan belanjawan yang tinggi menggantikannya. Pengawal sistem perlindungan pengacuan suntikan ini akan berhenti pemanas dalam mesin pengacuan suntikan yang memberi kehangatan kepada pembentukan jika pendingin mempunyai masalah dan tidak membekalkan air secukupnya atau tidak bekalan air cukup tenang. Sistem ini juga akan memberi satu emel berjaga-jaga kepada juruteknik atau kepada jurutera melalui telefon pintar mereka jika sistem mempunyai masalah. Pengawal sistem perlindungan pengacuan suntikan ini juga menutup pendingin selepas 2 minit pemanas telah ditutup. Ini akan menjimatkan membazir tenaga yang akan digunapakai pendingin selepas pemanas dibatalkan. Dalam kaedah, mula lakaran perkakasan telah dimajukan dan dengan lakaran, litar rangsangan telah direka dalam perisian EKTS. Berikutnya, sistem peralatan dilaksanakan dan ditambahkan dengan perisian e-mel Arduino pengekodan menghantar notifikasi emel. Dalam keputusan, sistem peralatan dan perisian Arduino dengan urutan berjaga-jaga e-mel telah ditunjukkan. Analisis sistem juga telah menunjukkan dalam graf. Sebagai kesimpulan, semua objektif telah memenuhi dalam projek ini dan kerja masa depan projek ini adalah untuk membangunkan tambahan dengan membenarkan Arduino memberi isyarat ke telefon bimbit untuk menukar pendingin simpanan jika pendingin mempunyai masalah.

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## CHAPTER 1

### INTRODUCTION

#### 1.1 Motivation

Figure 1.1 shows an Injection Moulding Machine that creates components by injection moulding process. Most generally used machines are hydraulically screw machines, even though electric machines are appearing and will be more important in the market in near future. The main units of a normal injection moulding machine are the clamping unit, the plasticizing unit, and the drive unit. The force unit provides energy to the plasticizing unit and clamping unit. Injection moulding machines are regularly categorized by using the maximum clamp pressure that the machine can generate. The clamping unit holds the mould. It is capable of closing, clamping, and opening the mould. The main components are the fixed and moving plates which the tie bars and the mechanism for opening, closing and clamping. The injection unit or plasticizing unit melts the plastic and injects it into the mould. The clamping force of typical injection moulding machines ranges from two hundred to hundred thousand KN. This is the force that pushes the two mould halves on identical time to avoid gap of the mould attributable to the interior pressure of the plastic soften within the mould. A chiller is a machine that released the oestrus from the liquidity and absorption refrigeration cycles per second. Concerns in intention and choice of hair-raiser include carrying out, efficiency, maintenance, and Cartesian product life cycle environmental impact. This liquid can then be circulated via a warmness exchanger to cool air or gadget as required. As an important by using ware, refrigeration creates waste heat that must be exhausted to ambient or, for greater performance, recovered for heating purposes [3].



Figure 1.1: Injection Moulding Machine [9]

## 1.2 Problem Statement

The mould is the important part in the injection moulding machine. If the chiller doesn't supply cool water to the machine, the moulding will be affected and will incur high cost to replace it. When all the hot runners and the machine are off, the workers forget to turn off the chiller and this causes the electricity bill to increase. Besides that if the machine stops when no water is supplied into the machine, the workers are unable to determine whether machine is working or not. This will cause the daily production to reduce.

## 1.3 Objective

The objectives to conduct these projects are:

1. To design a system that will make the heater stop when the water not cool enough or the water stops flowing to the machine and to design a system to send an email alert to mobile phone if the system have problem.
2. To design a system that will make the chiller to shut down after 2 minutes when the heater are off and to develop a bypass system that will make all system to run as usual if this new system have problem.
3. To analyse and verify the protection system of the injection moulding machine.

## **1.4 Scope**

This project is mainly concerned to develop the system at the injection section in the company. This system required 1x 1 meter to be fixed on the wall. A 3 phase supply for the chiller and for the heater and an Internet LAN supply are needed to run this system. This system will be used to control both injection moulding machine and the chiller. This project also needs a smartphone to receive the signal alert from the system.

## **1.5 Project Background**

Injection Moulding Protection System Controller is a system that controls the heater and the chiller power supply to protect the injection moulding machine. If the flow switch does not detect the flow of the water from the chiller to the machine, this system will stop the heater from operating. Besides that, if the temperature of the water is above the set value, the machine will also be turned off. Other than that, this system also control the chiller by shutting it down if the heater is off for more than two minutes. Moreover, if the system shuts down the heater, the Arduino system will send an email to the engineers to inform about the malfunctions.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.0 Introduction**

This chapter present about some basic principle and theories in the project and review of previous journals about the Injection Moulding Machine, Chiller and the protection of the Injection Moulding Machine. In addition, the history of injection moulding machine and chiller also provided in this chapter. Besides that, this chapter also explained the types of injection moulding machine and chiller system that has been innovated and implemented through years. Last but not least, a detail explanation about Flow Switch, Thermostat, Arduino Uno Module with Wi-Fi Shield and Router are included in this chapter.

#### **2.1 Theory of basic principle of Injection Moulding Machine**

In this section basic principle such as types of Injection Moulding Machine and its usage are discussed. The theory involved in analysis of the protection system to the Injection Moulding Machine and chiller.

### **2.1.1 Study of Injection Moulding Machine**

An Injection Moulding machine is a chunk of system includes simple factors, the injection unit and the clamping unit. Injection moulding may be used with a selection of plastic resins. The procedure includes introducing raw materials in the form of granules into one of a heated cylinder, heating the substances in the heating chamber, and forcing the molten steel into a closed mould, in which the final solidification of the molten steel in shape of the configuration of the mould hollow space takes. The proceeding injection machine can be made from mild metallic and medium carbon steel. It may simplest be used for the production of small components such as key holder, bottle cap, tally, ruler, and clothes peg. The moderate metallic is used for the development of helping plates, hopper, mainframe, mould, and platens, handle, and tie bars. This is because they are no longer subjected to consistent warmness. It is without difficulty weld in a position, and has excellent workability but display poor reaction to warmth treatment. The selected resins for this method are polypropylene, ABS, and fluorocarbons, due to traits of problematic shapes can easily be produced. An advantage of small injection moulding technique encompass excellent surface finish of the product can be produced, less scrap and flashes are produced, and the procedure has highly low labour charges [3].

### **2.1.2 Operation**

Injection moulding machines can make the moulds to work fast in both a horizontal and vertical function. Figure 2.1 shows that most of the machines are horizontally oriented however vertical machines are utilized in some applications including insert moulding, permitting the gadget to take gain of gravity. A small quantity of vertical machines also does not need the mould to be fixed. The magnetic and hydraulic clamps are used when fast device adjustments are required. A lot of methods are proven to increase the gear to the platens, the maximum common place being guide clamps however hydraulic clamps and magnetic clamps are also used. The individual designing the mould chooses whether the mould uses

a cold runner system or a hot runner gadget to bring the plastic from the moulding to the cavities. The cold runners are simple channel carved through the mould. The plastic that fills the cold runner cools because the component cools and it will be released with the element as a sprue. A hot runner device is greater complex, regularly using cartridge warmers to maintain the plastic inside the runners warm because the part cools. After the component is ejected, the plastic left in a warm runner is injected into the next component [5].

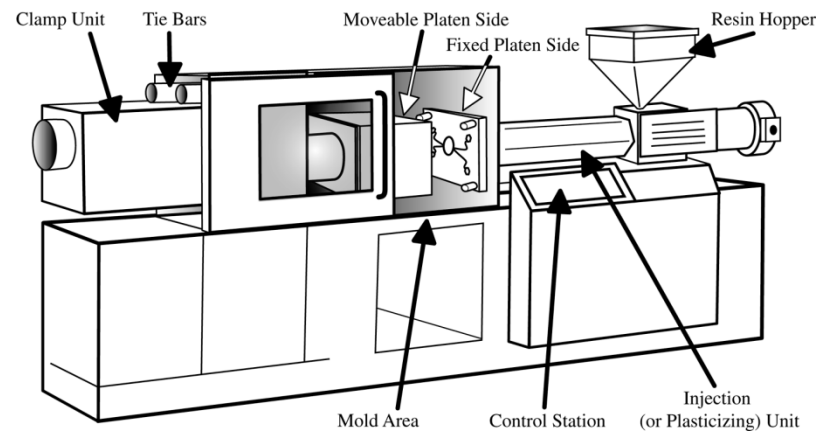


Figure 2.1: Moulding Machine Overview [5]

## 2.1.3 Types of injection moulding machines

### 2.1.3.1 Hydraulic

These types have been the simplest choice available to moulder until Nissei Plastic business Co LTD brought the primary all-electric injection moulding system in 1983. Hydraulic machines, despite the fact that now not nearly as particular, are the principal kind in maximum of the sector, with the exception of Japan [10].

### **2.1.3.2 Mechanical**

This type machines use the toggle system for constructing up tonnage at the clamp side of the gadget. Tonnage is needed on all machines so that the clamp facet of the device will not open due to the injection strain. If the tool 1/2 opens up it will create flash within the plastic product [12].

### **2.1.3.3 Electric**

The electrical press, also called electric machine technology (EMT), reduces operation prices by way of cutting power consumption and also addresses a number of the environmental issues surrounding the hydraulic press. Electric powered presses have been shown to be quieter, quicker, and have a better accuracy however the machines are extra steeply-priced. Hybrid injection moulding machines declare to take benefit of the exceptional functions of each hydraulic and electric powered system, however in fact use almost the identical amount of power to perform as a well-known hydraulic [10].

### **2.1.4 Moulding**

The mould used to manufacture polymer optics can be notion of as a sophisticated triple dimensional puzzle that has two primary capabilities. One is the cavity information in conjunction with the middle pins and the second is the body that houses the cavities and inserts. The complexity of the mould is broadly speaking pushed through the complexity of the detail being moulded. One of the key advantages of using polymer optics is the capacity to combine optical and mechanical capabilities into one platform. Relying upon the nature of the mechanical capabilities being taken into consideration the mould itself will take on additional complexity.

### 2.1. 4.1 Moulding design

Figure 2.2 shows the moulding that has primary additives, the injection mould (plate A) and the ejector mould (plate B). Both these components also are called moulder and mould maker. Plastic resin enters the mould through a spruce or gate in the injection mould. The bushing is to seal tightly against the nozzle of the injection barrel of the moulding machine and to permit molten plastic to glide from the barrel into the mould, also referred to as the hollow space. The spruce bushing directs the molten plastic to the hollow space photographs via channels which might be machined into the faces of both the plates. These channels permit plastic to run alongside them, so they're referred to as runners. The molten plastic flows through the runner and enters one or greater specialised gates and into the cavity.

To permit for of the moulded detail from the mould, the mould characteristic have no longer overhang each other in the route that the mould opens besides elements of the mould are designed to move among overhangs while the mould opens. Mould is commonly designed simply so the moulded detail reliably stays at the ejector (B) thing of the mould while it opens, and draws the runner and the spree out of the (A) side together with the additives. The part then falls freely whilst ejected from the (B) aspect. Tunnel gates, known as submarine or mould gates, are located below the parting line or mould floor. A gap is machined into the ground of the mould at the parting line. The moulded detail is chopped (thru the mould) from the runner equipment on ejection from the mould [6].

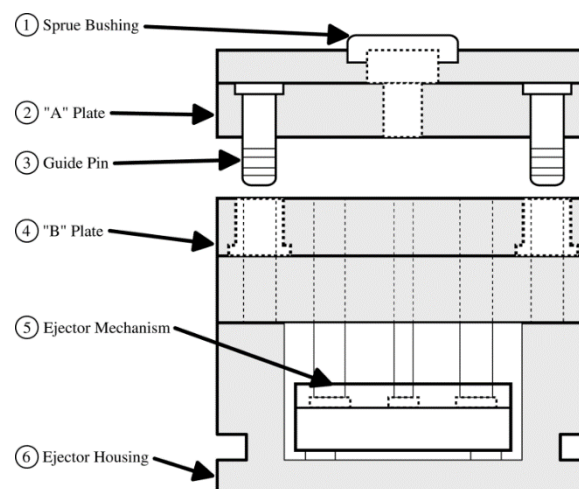


Figure 2.2: Moulding [6]