UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF AN AUTOMATIC CAN CRUSHER USING PROGRAMMABLE LOGIC CONTROLLER AT FTK CANTEEN

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

by

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfilment of the requirements for the degree of Bachelor of Electronics Engineering Technology (Industrial Electronics) with Honours. The member of the supervisory is as follow:

……

(Mr. Ir. Nik Azran Bin Abdul Hadi)

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ABSTRAK

Penciptaan mesin pemampat tin dalam projek ini adalah untuk mengurangkan ruang penyimpanan yang besar oleh tin-tin aluminium kosong yang telah digunakan dalam pertubuhan komersial seperti restoran, kafeteria dan bar. Mesin pemampat yang biasanya dikendalikan secara manual dianggap tidak cekap kerana ia memerlukan tenaga manusia dan masa yang panjang dalam proses pemampatan. Mesin pemampat boleh ditakrifkan sebagai "Peranti yang digunakan untuk memampat tin aluminium supaya penyimpanan tin aluminium dalam tong kitar semula menjadi lebih mudah dan dapat menambahkan ruang penyimpanan dengan menjadikan tin-tin kosong flat". Matlamat projek ini adalah untuk mengurangkan isi padu tin aluminium kosong ke 70% dengan cara yang lebih berkesan, cepat dan tanpa tenaga serta kos yang efektif supaya ia sesuai digunakan dalam industri kecil. Proses secara automasi diimplementasikan dalam mesin pemampat tin ini kerana pengunaan mesin secara automasi sangat efektif dan berkesan yang tidak dapat dielakkan pada era modenisasi ini. Mesin pemampat yang dikendalikan secara automatik dikawal oleh Programmable Logic Controller (PLC) dengan bantuan sensor induktif dan capacitve, di mana ia digunakan untuk mengesan sama ada objek adalah logam atau bukan logam. Sistem ini boleh mengawal secara manual dengan menekan butang bermula dan henti ataupun mengunakan Human Machine Interface(HMI) untuk memaparkan bilangan yang boleh dimampatkan setiap hari. Mesin pemampat ini telah direka agar dapat memberikan penggunaan yang lebih praktikal dalam proses kitar semula bahan sisa aluminium dan dapat membantu dalam mengekalkan persekitaran alam yang mesra di dunia ini.

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ABSTRACT

The invention of a can crusher machine in this project is to reduce the wasted storage space occupy by the tremendous amount of used aluminium cans in the commercial establishment like restaurant, cafeteria and bar. Basically, can crusher machine is operated in manually which is very inefficiency where it highly required human effort and time in the can crushing process. A can crusher can be defined as "A device used for crushing the aluminium can for easier storage in recycling bins thereby giving extra space by flattening of can". The main aim of this project is to reduce the initial volume of empty aluminium cans down to 70% in more effective, faster and effortless way as well as low cost that is suitable to be used in small industry. An automation process is implemented in this can crusher machine due to the automation in the modern world is inevitable and highly effective to be used. The automatic can crusher machine is controlled by Programmable Logic Controller(PLC) with the aid of sensors of inductive and capacitve, where it is used to detect whether the object is metal or non-metal. Overall, the system can be control manually through the push start and stop button as well as using the Human Machine Interface (HMI) for displaying the number of can being crush per day. The design of the pneumatic can crusher machine provides a more practical usage in recycling aluminium wastes and meanwhile helps in maintaining eco-friendly environment in this world.

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DEDICATION

To my beloved parents,

All my lectures, especially, Mr. Ir. Nik Azran Bin Ab. Hadi
All my friends and relatives

Thousands of thanks and appreciates for their supports, encouragements and understands.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

PLC	-	Programmable Logic Controller
CPU	-	Central Processing Unit
I/O	-	Input / Output
AC	-	Alternating Current
DC	-	Direct Current
PSI	-	Pound per Square Inch
LED	-	Light Emitting Diode
PC	-	Personal Computer
CAD	-	Computer-aided Design
IPS	-	Inductive Proximity Sensor
IoT	-	Internet of Things
HMI	-	Human Machine Interface
LCD	-	Liquid Crystal Display

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CHAPTER 1
INTRODUCTION

1.0 Introduction

Nowadays, beverage cans such as carbonated soft drinks, alcoholic beverages, juices and also energy drinks are made up of aluminum or tin-plated sheet. It is undeniable that people use aluminium so frequently because there is 75% of worldwide production of beverage cans made up of aluminium. Thus, it is necessary to recycle aluminium as recycling is important in today's world to save our limited natural resources and help in preserving the environment. In addition, recycling aluminium not only can helps to keep the lanfills clear, but it also can help to save energy. In producing a new aluminium beverage cans by using a recycled aluminium, it uses 95% less energy and the greenhouse gases emission is reduced to 95% compare with making a new can from new materials. (Khanapure *et al.*, 2015)

This project is about design and fabricate of a can crusher machine that operate automatically with the aids of the sensor by using a proper controller and the power source to crush the aluminium cans thereby reduce 70% of its initial volume so that it can overcome the storage problem people face for the recycling purpose.

Programmable Logic Controller(PLC) is an industrial computer that receives inputs from input devices and interpret the inputs and generate output to control peripheral output devices. The input devices which is either analog or digital are received from sensors or machine in the form of voltage and current. Programmable Logic Controller(PLC) is a controller that is able to interpret and convert the stimulus to the CPU thereby a set of instructions for the actuators to operate

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according to the output sequence can be executed accurately in industrial environment. (Kiran *et al.*, 2013)

Pneumatic system are classified under "Fluid Power Control" as it transmits the power through pressurised gas or liquid. Control valves are used to control the flow direction, pressure and flowrate of the compressed air so that it can works well with the actuator for the power control application. The main reason for the extensively used of pneumatic system in fluid power control application especially in sequential and repetitive operations is that the simplicity, economical and it provide an outstanding advantages in terms of safety in pneumatic system. (Bharth *et al.*, 2016)

1.1 Problem Statement

Beverages such as cold drinks and soft drinks are normally available in aluminium can nowadays. This is because the beverages come in small aluminium can are made up in light weight material which is easier to be recycle with lower cost. According to an aluminium association, Americans throw away 25,000,000 aluminum beverage can every hour. The disposal of numerous number of empty leftover aluminium can waste in increasing scale should deal with it properly because the aluminium is one of the important recycling material to be recycled as it is 100% renewable in order to prevent aluminium waste pollution as well as maintaining an eco-friendly environment. (Veena and Kadadevaramath, 2016)

There is various type of can crusher machine that can crush the empty leftover aluminium can. Crushing the aluminium can by using large crushers is not suitable to be used in small scale industry due to the machine cost is high. In addition, the existing can crusher available which is operate in manually such as hand or foot operated crusher is ineffective as today the technology already improves to a new level.

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Another problem arises when using the existing manual can crusher in the small scale industry as this is a time-consuming process and ultimately leads to the reduction of production rate to reduce the initial volume of the aluminium can. On the other hand, in order to deal with the large number of the empty leftover aluminium cans, it require a greater force thereby will cause human fatigue.

Beverage in aluminium cans are frequently consumed in commercial establishment such as restaurant, cafeteria and bar recently. The empty leftover aluminium can cause the garbage bags to fill up quickly as it takes up a lot of storage space when people is trying to collect and recycle them. Thus, storage is often a problem as the empty leftover aluminium can consume too much spaces and the total volume of the beverage waste of aluminium cans increases. This will indirectly cause high transportation cost for moving such huge number of cans to the recycle centre. (Kshirsagar and Ninawe, 2014)

1.2 Objective

The intention behind this project is to design and fabricate a crusher machine which can achieve the following objectives:

- To design and fabricate of an automatic can crusher machine.
- To utilize the Programmable Logic Controller (PLC) as a main mechanism with pneumatic system.
- To reduce the crushing force, time and human fatigue.
- To reduce 70% of its initial volume of the aluminium cans that save space for recycling purpose.

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1.3 Scope of Work

A fully automatic can crusher machine is needed to implement in the commercial establishment like cafeteria, bars and restaurant because there is numerous leftover empty aluminium cans need to deal with every day. Programmable Logic Controller (PLC) is used to control the output sequence of the process with the use of CX-programmer software. Double acting cylinder based on the principle of pneumatic system is used to push and crush the empty aluminium can. The design and the simulation of the pneumatic schematic circuit can be done in the comprehensive software called FluidSIM before combining it to hardware. Pneumatic can crusher machine are powered by air pressure. This device is fitted with a pneumatic cylinder that pumps air with a tremendous force to set the crushing device into motion, which then falls onto the can. So, it can crush the empty aluminium can effortlessly by flattening it to 70% of its initial volume. An inductive and capacitive sensor are uses to determine whether the existence of the object is either metal or non-metal thereby determine whether the object needed to be crush. If the inductive sensor does not detect the object as a metal, the double acting cylinder will push the empty aluminium can to the rejection chamber. Initially, a standard size of cans is considered but with further modification the machine would be able to accept cans of various size and even plastic bottles.

1.4 Report Layout

This thesis generally explain about the design and improvement of the can crusher machine. There will be five chapters that will explain more about this project.

Chapter 1 explain about the introduction of the can crusher machine and the objectives of the project. Besides that, the problem statement and scope of the project are explaining and discuss briefly in this chapter.

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Chapter 2 compiles the literature review, generally on the existing projects and components that used in this project. This part concentrates on the theory of all aspects of the can crusher machine including working principle and mechanism of the can crusher machine. Sources from journals, books, thesis and website that covering all the information related to the title of the project are considered as a reference.

Chapter 3 describes the methodology of the project on the design and simulation part. This part focus on the procedure to execute the project from the primary design until the end. Strategy and time management are presented in this part. The project's planning like Gantt chart also presented in this chapter.

Chapter 4 describes the expected result from this project and ensures the objectives of the project is achieved.

Chapter 5 concludes all chapters from chapter 1 to chapter 5. The conclusion of the whole project and recommendation will be concluded in this part.

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CHAPTER 2
LITERATURE REVIEW

2.0 Introduction

The goal of this project is to design and fabricate an automatic can crusher using Programmable Logic Controller (PLC) with the aid of sensors that can differentiate the object with pneumatic system to maintain an eco-friendly environment. Thus, a good understanding on the knowledge of the design and fabricate is required for the development of the can crusher machine. Therefore, a research on various previous work are studied to obtain all the information related to the topic. Besides, a comparison of various work is done based on the information obtained which are essentially valuable in the construction and specification of this final year project paper. The theory and a brief explanation on can crusher, pneumatic, Programmable Logic Controller (PLC) and the sensor used are also presented in this chapter.

2.1 Type of Crusher

A crusher is a machine designed to reduce large solid material object into a smaller volume or pieces. Crusher reduces the size or change the form of waste material so they can more easily disposed or recycles. (Qais *et al.*, 2015) Basically, the numerous existing type of the can crusher machine is used to reduce the initial volume of the can.

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2.1.1 Manual Can Crusher Machine

Manual can crusher machine is simple in term of design and easy to be used. In addition, this type of machine does not require the supply of electricity to operate. Thus, the cost for this type of crusher is low with a portable and manually operated mechanism. Due to the manual can crusher requires human power to operator, thus, the operator gets fatigue after some time especially when deals with numerous number of leftover aluminium can. It is definitely a laborious work by crushing the can manually. For recycling of these cans, manual operation which carried out in industries is a time consuming process and ultimately it leads to the reduction of production rate.(Husain and Sheikh, 2014)

Figure 2.1: Hand operated Can Crusher Machine

2.1.2 Pneumatic Can Crusher Machine

Pneumatic system uses compressed air to transmit and control power energy. Basically, the working fluid is air where the air is compressed above atmospheric pressure. This stored pressure potential is changed over to a reasonable mechanical work in a proper controlled sequence by utilizing control valves and actuators. The pneumatically operated can crusher machine require an air compressor as a supply of power energy in crushing

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