# UNIVERSITI TEKNIKAL MALAYSIA MELAKA

# DESIGN AND DEVELOPMENT OF AUTOMATED WIRE CUTTER

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

by

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**BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA**

Tajuk: DESIGN AND DEVELOPMENT OF AUTOMATED WIRE CUTTER

Sesi Pengajian: 2019

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Signature: …………………………………

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# 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 (Process and Technology) with Honours. The member of the supervisory is as follow:

Signature: ………………………………………………….

Supervisor : MOHD HIDAYAT BIN AB RAHMAN

# ABSTRAK

Projek ini adalah projek pemotong dawai automatik yang telah direka dan dibangunkan. Pemotong ini adalah alat yang akan memotong wayar dengan menggunakan kuasa dari motor yang dipancarkan ke penyemperit melalui poros. Tujuan projek ini adalah untuk mengurangkan tenaga kerja apabila menggunakan wayar. Terdapat masa yang lebih lama diperlukan oleh pengguna wayar untuk mengukur dan memotong wayar. Satu tinjauan telah dijalankan untuk mengukuhkan pernyataan masalah dan mendapatkan kriteria pemotong dawai ini. Konsep pembangunan produk ini adalah untuk membangunkan produk baru. Terdapat tiga konsep reka bentuk yang dihasilkan dengan beberapa lakaran. Prototaip berfungsi dibangunkan untuk menunjukkan reka bentuk dan fungsi produk. Reka bentuk dengan dimensi telah dibina dengan menggunakan perisian SOLIDWORKS. Litar telah diprogramkan dengan menggunakan perisian Arduino kepada komponen Arduino Nano.

# ABSTRACT

In this project, an automated wire cutter was designed and developed. This cutter is a tool that will cut the wire by using the power from motor which being transmitted to the extruder through shaft. The aim of this project is to reduce the manpower when using wire. There was longer time required by a wire user to measure and cut the wire. A survey was conducted to strengthen the problem statement and get the criteria of this wire cutter. The concept development of this product is to develop a new product. There were three concepts of design generated with some sketches. A functional prototype was developed as to show the design and function of the product. The design with dimension was built by using SOLIDWORKS software. The circuit was programmed by using Arduino software to the Arduino Nano component.

**DEDICATION**

To my beloved family especially my father and mother, Abd Rahman bin Omar and Salmah binti Man, I would express my appreciation to my parents for their continuous support to me in performing this difficult task, and the journey does not end here.

To my supervisor, Mr. Mohd Hidayat bin Ab Rahman for being receptive and critical, and challenging me to be a better student.

To my friend, for their sacrifice, encouragement, and support towards project accomplishment.

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| | |
|---|---|
| **PVC** | Polyvinyl Chloride |
| **PE** | Polyethylene |
| **PUR** | Polyurethane |
| **PTFE** | Polytetrafluoroethylene |
| **FEP** | Fluorinated Ethylene |
| **SBR** | Styrene Butadiene Rubber |
| **PDD** | Product Design and Development |
| **QFD** | Quality Function Deployment |
| **PDPs** | Product Development Processes |
| **CO2** | Carbon Dioxide |
| **TRIZ** | Theory of Inventive Problem Solving |
| **ANP** | Analytic Network Process |
| **MRP** | Material Requirement Planning |
| **ERP** | Enterprise Resource Planning |
| **BOM** | Bill of Material |
| **LCD** | Liquid Crystal Display |
| **AM** | Additive Manufacturing |
| **ASTM** | American Society Testing and Material |
| **PCB** | Printed Circuit Board |
| **ABS** | Acrylonitrile Butadiene Styrene |
| **HOQ** | House of Quality |

# CHAPTER 1

# INTRODUCTION

This chapter will review the introduction, background of project, the problem statement, objective, project scope and product significant.

## 1.1 Introduction

A flexible metallic conductor made of copper, usually insulated and used for carrying electricity in a circuit. On the other word, wire is used for transmission of electricity or electrical signals which are come in many forms and many materials. There were two important points in need to be aware about wire; in transmission, electricity in long wire behaves very differently than in short wire used in design of devices, the use of wire in AC brings some problem such as skin effect and proximity effects. Copper and aluminium are the most popular material for electrical wire, they are not the best conductors, but they are abundant and cheap.

There are two large categories of insulating materials widely used to cover copper wire (and other) electrical conductors which is plastics, fluoropolymers and rubbers. The examples of plastic insulations are Polyvinyl Chloride (PVC), Polyethylene (PE) and Polyurethane (PUR). Examples of fluoropolymers are Polytetrafluoroethylene (PTFE) and Fluorinated Ethylene Propylene (FEP) while Neoprene (Polychloroprene and Styrene Butadiene Rubber (SBR) are for rubbers' type.

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There were many types of wire cutter, but all of this are used manually. Therefore, an automated wire cutter is design due to make it easy to use with the Product Design and Development approach. The purpose of this project is to calculate the wire length with quantity and this automated wire cutter will cut it. This product requires a role of wire being install at the nail. A setting for dimension and quantity should be key into the screen. An extruder will engulf the wire and cut the wire as ordered. This will save time especially at the electronic shop when selling the wire. This product consists of motor, driver, Arduino Nano, LCD display, tactile push buttons and wire cutter.

## 1.2     Background

A wire cutter is created to reduce the time used when cutting the wire. The cutter functions when the power from power supply is transmitted through motor to the cutter and cut the wire. It consists of one tool which is spring wire cutter used in the mechanism.

This project consisting questionnaire which will be spread to the public as to get the required criteria in some aspect for the cable cutter. In addition, the surveys will be done as evidence to strengthen the objective of this project. There is few software applied in this project such as SOLIDWORKS 2016 and Arduino.

## 1.3     Problem Statement

K. Li said as risk factors for hand or wrist injury problems, unnatural postures and repetitive forceful exertion were identified. These factors can be reduced through

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the design or restructuring of the power or non-power hand tool used (Li, 2002). Some of the users always face the problem fingers stuck or pinched in between the handles. This will presence injuries to the user of wire cutter. A lot of ergonomic design to avoid this problem was applied to the wire cutter but there still require other step before cut the wire.

In producing a circuit, wires are required to connect the circuit. Due to produce a neatly circuit, a dimension should be considered for the length of wire. Therefore, an additional step of measuring the wire with quantity is required before cut and use it. In addition, the properties of wire itself which always roll over or twist making the user difficult to measure it. There would be extra time needed to cut the wire by using the ordinary manual cutter.

## 1.4    Objective

Wire cutter can presence some risk to the user and produce long time to cut. By creating this product, the time used to get the wires with the quantity and dimension preferred will be reduced by this product. The objectives of this project are:

i.      To determine the criteria of wire cutter using survey.

ii.     To design a wire cutter by using SOLIDWORKS.

iii.    To fabricate a wire cutter prototype.

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## 1.5	Scope of Project

This product is design due to the customer requirement who use wire to complete their circuit. Therefore, a survey was conducted participated by 30 respondents. The survey aimed to get the point of view and idea of the developed product. The version of software used to design the product is SOLIDWORKS 2016. Some features that used in this software are extruded boss, extruded cut, fillet and mate. Other than that, Arduino software was used in this project. A developed of functional prototype was built as to review the design of the product. The prototype used several types of mechanism such as extruder, motor and wire cutter. PDD approach was used in this project involving QFD, concept development and others.

## 1.6	Significant of Product

Wire cutters are widely used to cut the copper, brass, iron, aluminium, and steel wire. Most wire cutters have handles that are sealed to ensure that users are not shocked by the wires at which they are operate. Some of electronic shop consist lot of wire bundles which will give tendency of it to be twisted and hard to be cut when selling. There also needed for the electronic technician in the lab to connect the circuit and complete it.

There was lot of wire used in electronic media industry from huge to small size. This require an accurate measurement to produce bundle of wires in production line. Apart from that, the manufacturing of wire involving the costly material. There should be an automated tool instead of using human effort which will increase the cost of payroll per month.

# CHAPTER 2

# LITERARETURE REVIEW

This chapter shows the review of previous primary and secondary sources regarding to the project needs.

## 2.1    Introduction

Wire cutter is the main tool for the electrical person. There were some issues when using the existing cutter such as finger pinched between handle and measuring step required to get the wire. Therefore, an improvement should be done as to avoid all those things above. As said by Yoshikawa, project strategy normally includes two phases which are analytical research by theory and experiment and constructive research by design. The actors in society use the results aiming at producing innovation and when it accomplish successful, it will spread and diffuse into them (Yoshikawa, 2012).

An automated wire cutter is a cutter functioned automatically when the dimension and quantity is load to the screen. A torque is produced by a motor which is drive a driven to move the cutter. The cutter is cut the wire and return to its' natural position as a spring is applied between the handle. This cutter is attached to a spring and driven so that both can be controlled by a motor. There were two motors required in this product.

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## 2.2 Product Design Development

Wei Chan said the concept selection is the most critical aspect and the climax in the product design and development. The concept selection method is based on various factors, including orders received, building and evaluating prototypes, discussion among executives, market demand, trial and error and the market's standard deviation. The concept selection of this project is categorized as discussion among executives which similarly to meeting to the supervisor and discuss what the product should be and how it should be developed.

There are five specific dimensions which ultimately relate to profit that are commonly used to access the performance of a product development effort. (1) Product Quality: How good is the product resulting from the development effort? (2) Product Cost: What is the manufacturing cost of the product? (3) Development Time: How quickly did the team complete the product development effort? (4) Development Cost: How much did the firm have to spend to develop the product? (5) Development Capability: Are the team and the firm better able to develop future products as a result of their experience with a product development project?

In this journal, they also describe about the methodology. (1) Research design- a qualitative study, which sets out to understand better and acquire insight into the phenomenon of interest and construct explanations or theory. (2) Respondents-sampling is crucial in this type of project because it is extremely costly and time-consuming to project a large population. (3)   3 Instrumentation- Interviewing is an important technique for qualitative research because it enables the

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