



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**DESIGN AND ANALYSIS OF GRIPPER SYSTEM FOR A**

**MOBILE ROBOT**

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

by

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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 (Automotive Technology) with Honours. The member of the supervisory is as follow:

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## ABSTRAK

*Di pasaran, kebanyakan sistem pencincang digunakan untuk memotret objek. Projek ini terutamanya direka untuk mengendalikan pintu pusingan. Tujuan utama projek ini adalah untuk meneliti, merekabentuk dan menganalisis sistem perlawanan, yang direka dan dianalisis menggunakan perisian seperti Altair Hyperwork dan Catia V5. Kemudian, bahan jari adalah aluminium, dan bahan baut adalah keluli karbon tinggi. Menurut pengiraan, daya yang dikenakan pada jari boleh didapati. Di samping itu, sifat-sifat bahan tersebut adalah berdasarkan pustaka bahan perisian Inspire. Perbincangan juga akan disebutkan untuk membincangkan hasil analisis dan batasan sistem. Sistem perlawanan direka dengan jayanya. Seseengah cadangan untuk kerja masa depan akan direkodkan dalam Bab 5.*

## ABSTRACT

In marketplace, most of the gripper system is used for taking object. This project is mainly designed for rotating door knob. The main objective of this project is to study, design and analyze the gripper system and this project uses software such as Altair Hyperwork and Catia V5 for design and analysis. Then, the material of finger is Aluminium and the material of bolts is high carbon steel. Based on the calculation, the force that applied to the finger can be found. Besides that, the properties of the materials are based on the material library of Inspire software. The discussion will also be mentioned to discuss about the analysis result and limitation for this system. This gripper system is successfully designed. Some recommendation for future work will be recorded in Chapter 5.

## **DEDICATION**

To my beloved parents  
To my respected supervisor and all lectures  
And not forgetting to all my friends



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# CHAPTER 1

## INTRODUCTION

### 1.1 Background

Nowadays, the development of robots has become more advanced which brings plenty of convenience among human lives. Robots have been widely utilized for different field such as transportation and manufacturing. It is a reprogrammable and multifunctional controller to enable the movement of its material, parts, equipment or particular gadget by using various type of programme and command. Currently, commercial and mechanical robots are in common use due to its high efficiency in performance with higher precision and more dependent than human.

This final year project is a group project which is made up by 5 members. This project only focuses on mobile robot. Mobile robot is a robot that can move autonomous or remote operated and it also can replace as a human to complete a risk jobs. Mobile robots now are in broad used for some of these applications such as Explosive Ordnance Disposal (EOD), Chemical, Biological, Radiological, Nuclear and Explosive (CBRNE), special weapons and tactics (SWAT) and military police (MP) jobs.

Based on previous study, EOD also known as unmanned vehicles and they are mostly controlled by human operator from a long distance. In 1972, Major Robert John Wilson 'Pat' Patterson RAOC and his team at the Bomb Disposal School developed and deployed the first ever wheelbarrow. After that, Ammunition Technician used it in the war against Provisional Irish Republican Army bombs. A British soldier named

Lieutenant-Colonel Peter Miller had an idea of using electrically-powered wheelbarrow chassis to drag the suspect application for preventing people from hazardous area in the same year. However, it was failed to prove due to hard in maneuver.

In May 2016, Dallas parking garage was arise a shooting incident caused 5 police officers sacrificed, 7 others injuries included 2 civilians. This incident also caused very first time for American police to use EOD robot to kill Dallas Shooting Suspect. So, police Dallas sent a robot which is already installed an explosive to the suspect's location and then detonated the bomb to kill the suspect. Dallas polices chief said that they had no choice but only can use EOD robot to detonate bomb at the suspect's location to reduce the sacrifice of police officers. (Dave Gershgorn, 2016).

## **1.2 Problem Statement**

To design the mobile robot that can help military or law enforcement to operate the hazardous area. Most of the EOD robot does not have climb stair function. In this market, EOD robots can only grab and put down item but it cannot open the door due to lack of rotate function. Then, cost of EOD robot is quite expensive because there are many complex electronic systems, difficulty of manufacturing process, and sensor installed on them. If the cost of EOD robot is cheaper, police department can buy more EOD robot to reduce crime rate and operation period in a dangerous area. Hence, this project will solve the above problems with the analysis.

### **1.3 Objective**

In this project, there are three goals that need to be achieved, there are:

- To study the gripper system
- To design and analysis a gripper in mobile robot that can climb stair, open the door and enter the room.

### **1.4 Scope**

- Design a gripper.
- House of quality of the gripper.
- Analyse and get the result of the gripper.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Introduction

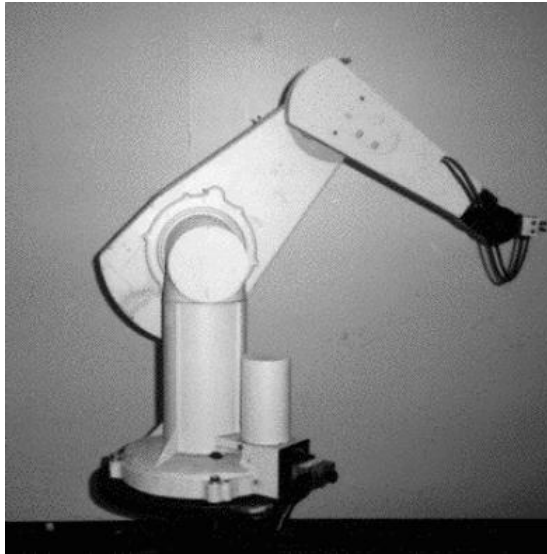
A robot is a reprogrammable and multifunctional controller intended to move material, parts, instruments or particular gadgets. Besides that, robot also can move by itself, and its movement and performance can be effect by programming.

Currently, commercial and mechanical robots are in common use, because their working performance are more efficient with higher precision and more dependent than people. They are additionally adopted for occupations that are excessively grimy, risky or exhausting, making it impossible to be handled by people. Robots are generally adopted as a part of earth and space investigation, weaponry, surgery, lab research and large scale manufacturing of purchaser and modern products.

#### 2.2 Manipulators robot

Manipulator robot is a robot that can work in a compelled workspace, it has outright estimations of position might possibly need to see their general surroundings. The most well-known manipulator robot adopted as a part of industry today is the robot arm. These arms are utilized to weld, bundle, paint, position and collect a large group of items that we adoption daily. Fundamentally a robot arm is a progression of linkages that are associated such that a servo engine can be utilized to control each joint. The

controlling computer, the cerebrum of the robot, is customized to control the different engines on the robot in a way that enables it to perform particular jobs.



**Figure 2.1: robot arm(Kumar, 1998)**

Figure 2.1 is an example of robot arm. The robot arm can be in various diverse ways. The size and shape of this arm is basic to the robotic engineering of the robot. The arm is the piece of the robot that positions the last grabber arm or spray head for their pre-programmed business. In the event that the outline of the arm is too substantial or little this positioning may not be conceivable. Numerous arms similar the human arm, containing shoulders, elbows wrists and hands.

### **2.3 Mobile robotics**

After the robots are broadly adopted, human were create mobile robotics. Mobile robots, additionally point out to as Unmanned Ground Vehicle (UGVs), are as of now in broad use in some of these applications. Explosive Ordnance Disposal (EOD) and mine clearance jobs are the most conspicuous of today's applications. Lately, there

have been desire to join robot innovation in various different kinds of tasks too. The prospects that might be accomplished can be classified into three kinds, there are recovering people in dangerous, destructive or dull operations; encouraging missions generally unreasonable for people; permitting more effective job execution or lower cost(Carl Lundberg, 2007). Besides that, mobile robots are the robot that can be to move, fly, swim or walk. It have to answer three fundamental inquiries, there are where am I, where am I going and how would I arrive. To answer these fundamental inquiries, there must to begin with made estimation, model the surrounding, restrict itself, design a way to its objective. Other than that, design a mobile robotics that can work in unconstrained conditions. It also need outer detecting (example sensor) to decide position and to evade impediments. (Williams and Dissanayake, 2006).

### 2.3.1 Vanguard MK2



**Figure 2.2: Vanguard MK2(EOD and Equipment, 2004)**

Allen-Vanguard keeps on planning and supply cutting edge technical with its coming generation EOD robot, figure 2.2 shows Vanguard MK2. This lightweight, compact, strategic EOD robot keeps up perfection of value with its extra highlights and enhanced usefulness. The Vanguard MK2 to beat new ground up mission bolster over all dangerous obligation situations. With rising requirement for remote robotic reaction to progressively complex risk circumstances, the Vanguard MK2 is create to work with Allen-Vanguard's extensive scope of items for readiness, reaction and treatment of Chemical, Biological, Radiological, Nuclear and Explosive ( CBRNE) risks.

The MK2 is the latest edition of the Vanguard robot voted the best performing and most relevant structure in a main function assessment of contending system directed by Battelle, for the Technical Support Working Group (TSWG) of the National Institute of Justice. A duplicate of the NIJ report can be made accessible on demand. The MK2 joins the improvements suggested by Battelle making it a main resource for bomb squads and law enforcement helper. Vanguard keeps on working with TSWG to guarantee the Vanguard MK2 meets all present and future robotic specification distinguished for CBRNE, EOD/IEDD and First Reaction Groups. The MK@ has expanded ground speed, longer mission period, enhanced roughness, dual autonomous firing circuits and is still generally a large portion of the cost of the following most able robot on the market.

The MK2 have other improvements and standard components, there are two-way digital audio; 10 time zoom of camera; incorporated RS-232 port for extra detecting and detection equipment for CBRNE jobs and concurrent adopt of different features. Besides that, MK2 also provide a claw-wrist that can rotate 0° until 300° and it