

**DESIGN OF MODULAR SMART PICK & PLACE  
AUTOMATION SYSTEM**

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**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

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AUTOMATION SYSTEM**

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**This report is submitted  
in fulfillment of the requirement for the degree of  
Bachelor of Mechanical Engineering (Design and Innovation)**

**Faculty of Mechanical Engineering**

**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

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## DECLARATION

I declare that this project report entitled “Design Of Modular Smart Pick And Place Automation System” is the result of my own work except as cited in the references.

Signature : .....

Name : Syahirah Binti Mohd Fadzil

Date : .....

## APPROVAL

I hereby declare that I have read this project report and in my opinion this report is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Design & Innovation).

Signature : .....

Name of Supervisor : Ir. Dr. Tan Chee Fai

Date : .....

## ABSTRACT

The main purpose of this project is to design and develop a smart modular pick and place automation system for training students in Vocational Technical School. The project primarily focus on development of the pick and place system within the best design characteristics such as easy to fabricate, cost effective, high performance with great a great grip and safe. The provision of pick and place system is simple design yet very effective that is it can grip a variety of shape and size of object. It is simple enough to be handle by students and easy to maintain. The size and weight of the pick and place system should be suitable for portability so that it can be moved around easily. There are a lot of pick and place system in the market. However, some equipment that is offered has not been completely satisfied. For example, some existing pick and place system are very large and complicated to handle, weighing hundreds of pounds and therefore expensive to purchase and maintained. Pick and place with efficient mechanism will be develop through this project and will meet the best engineering design where it can help in training student's skills.

## ABSTRAK

*Tujuan utama projek ini adalah untuk mereka cipta sistem automatik memilih dan meletakkan pintar yang inovatif untuk bersaing dengan pihak lain di pasaran. Projek ini terutamanya berfokus kepada pelajar teknik vokasional untuk melatih mereka dalam mengendalikan mesin dan alatan kejuruteraan. Matlamat mereka cipta sistem ini adalah mempunyai kriteria rekebentuk yang mudah namun canggih, mudah untuk difabrikasikan, mempunyai nilai estetik, harga terendah dan lain-lain. Penyediaan sistem automatik memilih dan meletakkan pintar ini sebagaimana disebutkan di atas adalah bersaiz kecil dan cukup sederhana untuk dikendalikan secara manual oleh pelajar pelajar yang belajar di sekolah teknik vokasional. Sebelumnya usaha telah banyak dilakukan untuk menyediakan sistem automatik memilih dan meletakkan ini. Namun, seperti peralatan yang telah dicadangkan masih lagi tidak memenuhi kehendak pengguna. Sebagai contoh, beberapa sistem ini yang ada sangat besar, dengan berat ratusan kilogram dan mahal serta sukar untuk mengendalikan penyelenggaraan. Sistem yang bermekanisme yang efisien akan dihasilkan melalui projek ini dan akan memenuhi keperluan pelanggan di mana boleh membantu pelajar pelajar menerapkan kemahiran mereka mengendalikan sistem ini dan dalam projek kejuruteraan mereka.*

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**LIST OF ABBREVIATIONS**

ADTEC	Advanced Technological Training Centre
BMI	British-Malaysian Institute
CAD	Computer Aided Design
CC	Community College
CIAST	The centre for Instructor and Advanced Skill Training
GMI	German-Malaysian Institute
IKM	Institut Kemahiran Mara
ITI	Industrial Training Institute
IKBN	Institute Kemahiran Belia Negara
IKBTN	Institute Kemahiran Belia Tinggi Negara
JMIT	Japan-Malaysian Technical Institute
KKTM	Kolej Kemahiran Tinggi Mara
PDS	Product design specification
Poly	Polytechnic
TVET	Technical and Vocational Education Training
UC	University College
U	University
HOQ	House of Quality

## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 BACKGROUND**

Modular is the basic term used that involves a module or modules for basic design construction. The most common or important characteristic of a modular is portable which can be used in various system. Meanwhile, the definition of “smart” in an automation system is the ability of a system to work through the process on its own without the guidance of a human. These robots learn from its environment and experience based on the knowledge, often works on highly repetitive task such as precision packing.

The pick and place automation system is a kind of robot that is used in the industrial world. Nowadays, more robots are used to replace human in the industry. This is because robots can give a much better accurate and efficient work outputs. Moreover, they are very helpful and useful in handling dangerous, dirty or even repetitive dull works. In terms of cost, it is much cheaper compare to human labor in a long term. This is because robots can work overnight without even stopping or get tired. Pick and place automation system is widely used in manufacturing, assembly and packing, mass production of consumer and industrial goods.

Meanwhile, automation is termed use for different control system such as numerical control, programmable logic control or other industrial control systems. This is applicable with computer applications or information technology such as Computer Aided Design or Computer Aided Machining to manipulate all the industrial machinery process. Therefore,

reducing manpower requirement. Automation is very important especially in rise of technology the in the world economy and daily application. Thus, automation needs to be improved along the way according to customer's requirement.

## **1.2 PROBLEM STATEMENT**

During the Tenth Plan, mainstreaming and broadening access to quality technical and Vocational Education and Training (TVET) were undertaken to address industry needs for skilled workers. Measures were also undertaken to improve public perception towards TVET. These efforts resulted in the percentage of school leavers pursuing TVET after Sijil Peperiksaan Malaysia (SPM), increasing from 25% in 2010 to 38% in 2013. Transforming TVET is one of the game changers in the Eleventh Plan to meet the demand of industry and contribute towards economic growth in view of globalization, knowledge economy, technology advances and global labor mobility. To adapt to TVET, and industrial based training system is needed to train the necessary skills for the TVET student. A modular automation training system that focus on smart pick and place is proposed.

## **1.3 OBJECTIVE**

In the manufacturing industries, smart pick and place automation system is design to help human accomplished difficult task and made the job much easier and decrease the time of production.

The objective of this project is to develop a modular pick and place system that is simple, safe, durable and high effective for training students in the technical college.



## 1.4 SCOPE OF PROJECT

In order to complete this project, scopes are required to assist and guide the development of this project. The scope should be identified and planned to achieve the objective of the project successfully on time.

The scopes of this project are:

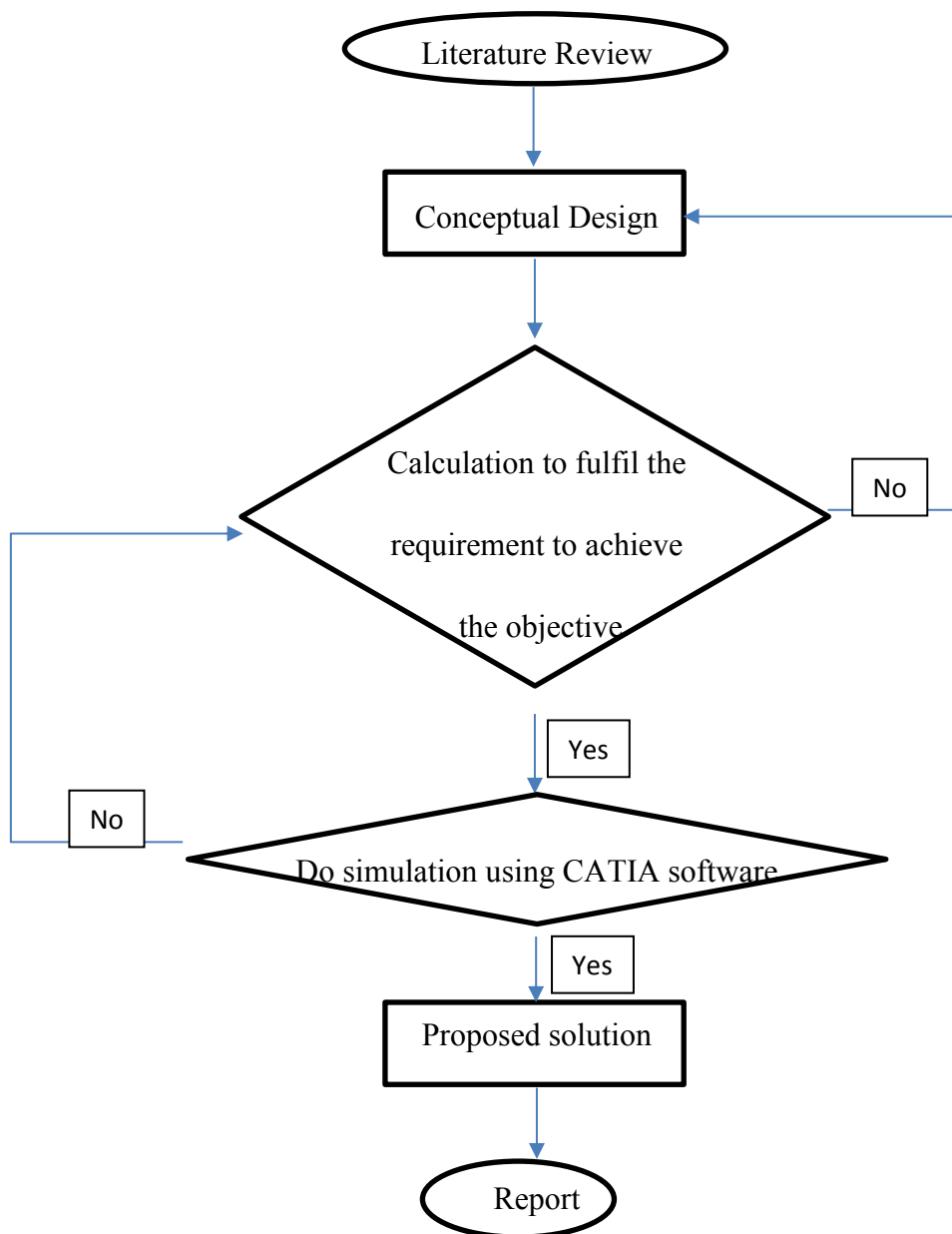
1. Designing the mechanical parts of the pick and place automation system within the criteria of training purpose, easy to fabricate and cost effective.
2. The provision of pick and place automation system is a table size machine and is simple to be handle by students.
3. To apply the design and analysis using engineering software, CATIA V5R19 and ANSYS Structural Analysis.

## 1.5 GENERAL METHODOLOGY

The actions that need to be carried out to achieve the objectives in this project are listed below.

1. Literature review Journals, articles, or any materials regarding the project will be reviewed.
2. The suitable design for smart modular automation pick and place system will be proposed.
3. If the design process of the pick and place system has passed, the calculation process will take place to determine whether the design has fulfilled the requirement needed in the objective.
4. The simulation of the mechanism will be done using CATIA software. The maximum force and the movement of the pick and place system will be tested in the software.
5. The result that was tested will be recorded and be placed to make comparison to further improve the system.
6. Report writing will be done at the end of the project.

The methodology of this study is summarized in the flow chart as shown in **Figure 1.1**.



**Figure 1.1:** Flow chart of General Methodology

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Introduction

This chapter discusses about the basic type of pick and place automation system together with their advantages and disadvantages. Not to mention, a little explanation on TVET system in Malaysia. Other than that, the type of end effector are also discussed in this chapter. From the basic configuration, there are a few aspects to be taken note so that the type of robot is suitable for the user. Tanya M. Anandan (2013), stated that the bigger size of the robot is not always better because of some reasons. Therefore, some aspects needs to be research first before buying a certain pick and place system. Besides that, the degree of freedom of robots are also discussed to further apply to the next step on developing a pick and place system. Lastly, the existing pick and place system and their cost in the market are also shown in this chapter.

## 2.2 TVET system in Malaysia

According to Prof. Dr. Jailani et al (2013) the Technical & Vocational Education Training system can be in both private or public institution which provide basic skill training that can be apply through application of mathematics and science. There are five level of qualification which is Certificate, Diploma, Degree, Master and Doctoral. In Malaysia, TVET can be applied by any students at an early age, that is after students have finished their PT3. TVET can gain students by brushing up their basic training skill to a high level mathematics and science. Below are examples of technical and vocation provider in Malaysia for government and private sector.

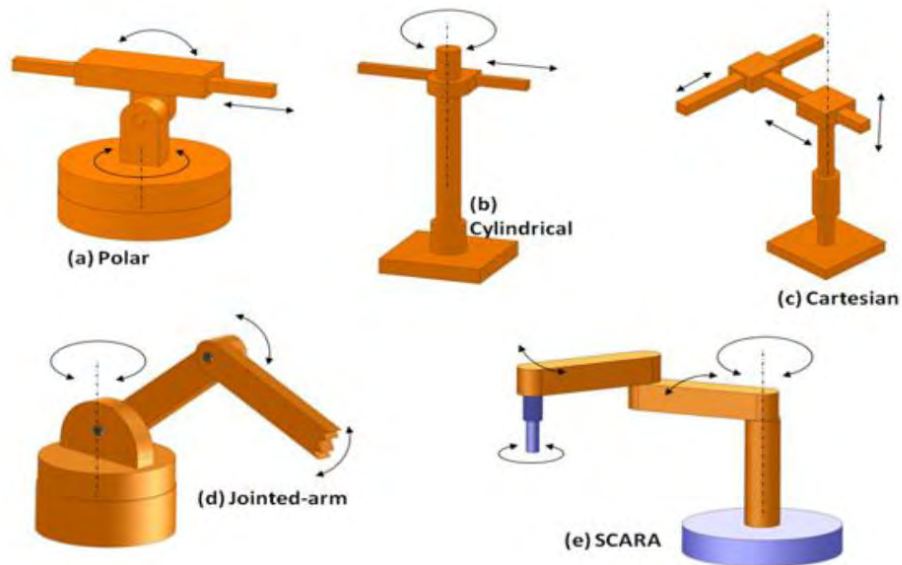
	Level of study				
	Certificate	Diploma	First Degree	Masters	PhD
<b>Government :</b> Ministry of Higher Education	CC, Poly	Poly, UC, U	UC, U	UC, U	UC, U
Ministry of Human Resource	ITI, CIAST, JIMIT, ADTEC				
Ministry of Youth and Sports	IKBN, IKBTN				
Majlis Amanah Rakyat	IKM, IKTM, GMI, BMI, MFI, MSI,				

	MIAT				
<b>Private</b>		UNIKL, KLIUC, MMU, UTP, UNITEN, UNISEL	UNIKL, KLIUC, MMU, UTP, UNITEN, UNISEL		

**Table 2.1** : Examples of Technical and Vocational Education and Training Level providers in Malaysia (Source: Prof. Dr. Jailani et al 2013)

### 2.3 Type of configuration of pick and place system

According to A.Modi and M.Patel (2015), there are three broad class of industrial automation which are fixed automation, programmable automation and flexible automation. For robots, the movement can be divided into two general categories which are arm and body motions, and wrist motions. The term “degree of freedom” is referred when the individual joint motion associate with these two categories. Most of the robot is equipped with 4 to 6 degrees of freedom. The basic structure of robots can be seen in **Figure 2**. There are polar, cylindrical, Cartesian, jointed-arm and SCARA configuration.



**Figure 2.1:** The five basic robot anatomies. (Source: A.Modi and M.Patel, 2015)

The robots are connected through many manipulator joints that are rigid called links. In the industrial robot, the joints used often involves in a relative motion of the adjoining links that is either linear or rotational. Linear joints involve sliding or translational motion of the connecting links.

### 2.3.1 Polar configuration

According to R. Shiilling (2013), the polar configuration which also known as spherical configuration, has a concept design similar to the military tank. The robot will move vertically from a pivot point in the middle and can rotate around the axis perpendicular base. Another rod, as the wrist or gripper, will extend and retract to reach for things. According to The Anatomy of Industrial Robot (2011), the advantage of this design is that it is capable of reaching long extended things horizontally. It can do more job than the Cartesian and the cylindrical configurations. Besides that, this design is very simple despite being able to lift heavy weight. Meanwhile, the disadvantage is that the vertical movement is very low and limited. The most common applications of polar configuration are die casting, injection molding, forging, glass handling, material transfer, stacking and unstacking.



**Figure 2.2:** UNIMATE Polar configuration robot (Source: Robotics Bible, 2011)