UNIVERSITI TEKNIKAL MALAYSIA MELAKA

PROGAMMING OF AN AUTOMATED PICK AND PLACE ROBOT

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Robotics Automation) with Honours.

By

AZRAI BIN MUHAMMAD

FACULTY OF MANUFACTURING ENGINEERING

2010

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PSM

TAJUK:

'Programming An Automated Pick And Place Robot'

SESI PENGAJIAN:
2009/20010 Semester 2

Saya **AZRAI BIN MUHAMMAD**
mengaku membenarkan laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM / tesis adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM / tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. *Sila tandakan (√)

☐	SULIT	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia yang termaktub di dalam AKTA RAHSIA RASMI 1972)
☐	TERHAD	(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☑	TIDAK TERHAD	

_____ _____

5480-G Lorong Purnama,
Jalan Wakaf Mek Zainab,
15300 Kota Bharu,
Kelantan Darul Naim.

Cop Rasmi:

Tarikh: _____ Tarikh: _____

* Jika laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak organisasi berkenaan dengan menyatakan sekali sebab dan tempoh tesis ini perlu dikelaskan sebagai SULIT atau TERHAD.

DECLARATION

I hereby declared this report entitled **"Programming of an Automated Pick and Place Robot"** is the result of my own research except as cited in the references.

Signature	:	……..
Author's Name	:	……...…Azrai Bin Muhammad…….……..
Date	:	……..16 Mei 2010……

APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Robotics and Automation) with Honours. The members of the supervisory committee are as follow:

……

Supervisor

(En. Lokman Bin Abdullah)

Faculty of Manufacturing Engineering

(Official Stamp and Date)

ABSTRACT

Nowadays, robotics is one of the important parts in industry, especially in field of manufacturing. Robots are widely used in the manufacturing industry to replace human work. Robot used consists of a robot type of manual and automated robot. One of the most widely used now is Pick and Place Robot. This project title is *Programming An Automated Pick and Place Robot*. This report will focuses about programming an automated pick and place robot. The software used for programming robot is MPLab. MPLab Integrated Development Environment (IDE) is a free, integrated toolset for the development of embedded application employing Microchip's PIC and dsPIC microcontroller. The other software that used for this project is PICkit software. This software is used to transfer the programming coding from computer to the PIC. This software will uses with USB PIC Programmer UP00B. After programming from MPLAB is complete, the coding will export to PICkit, and from PICkit the data will transfer to the PIC. Among the most important electronics component is *Peripheral Interface Control (PIC)*. PIC is a device that can be programmed because it used flash read only memory for program storage. After programming is success, the next steps are analysis for this project. The first analysis is about the automated pick and place robot which is explanation about automatic robot movement. Then, second analysis is about the robot workspace where it includes about degree of freedom and end-effector robot. The last analysis is about the forward kinematics and inverse kinematics of robot manipulator where it will explained about robot position and orientation by using a graph. This analysis is based on coordinate transformation for the robot arm and end-effector. Overall for this project to programming an automated pick and place robot are successful.

ABSTRAK

Pada masa sekarang, robotik merupakan salah satu bahagian yang terpenting dalam industri, terutama sekali dalam industri pembuatan. Robot banyak digunakan dalam industri pembuatan untuk menggantikan kerja-kerja manusia. Robot yang digunakan adalah terdiri daripada robot jenis manual dan juga robot jenis automatik. Salah satu robot yang paling meluas digunakan pada zaman sekarang adalah robot angkat and letak Buku laporan bertajuk *Programming An Automated Pick And Place Robot.* Laporan ini memfokuskan tentang pengaturcaraan robot angkat dan letak. Perisian yang digunakan untuk pengaturcaraan robot adalah MPLab. MPLab Integrated Development Environment (IDE) adalah sebuah perisian untuk mengembangkan aplikasi yang terdapat dengan menggunakan Microchip PIC dan microcontroller dsPIC. Perisian yang lain yang digunakan adalah perisian PICkit. perisian ini digunakan untuk memindahakan program pengekodan dari computer ke PIC. Perisian ini akan digunakan dengan USB PIC Programmer UP00B. Setelah program dari MPLAB selesai, data akan dieksport ke PICkit dan dari PICkit data akan dipindahkan ke PIC. Diantara komponen elektronik yang paling penting untuk digunakan adalah *Peripheral Interface Control (PIC)*. PIC adalah peranti yang boleh diprogramkan kerana ia menggunakan pemancar pembaca memori hanya untuk menyimpan data. Setelah pengaturcaraan selesai, berikutnya adalah untuk membuat analisis tentang projek ini. Analisis pertama adalah tentang pergerakan robot secara automatik. Kemudian, analisis kedua adalah tentang ruang kerja robot dimana ia termasuk tentang darjah kebebasan dan hujung pemegang robot. Manakala, analisis yang terakhir pula adalah tentang pergerakan robot maju kehadapan dan juga pergerakan robot kembali ke posisi asal dengan menggunakan analisis grafik. Analisis ini didasarkan pada transformasi koordinat antara lengan-lengan robot dengan hujung pemegang robot. Secara keseluruhan untuk projek ini adalah berjaya.

DEDICATION

Specially dedicated to my beloved father Muhammad Bin Omar and my mom Che Rokiah Bt Mat who are very concern, understanding, patient, and supporting. Thanks for everything to my supervisor En. Lokman Bin Abdullah for his constructive guidance, encouragement and patient in fulfilling our aspiration in completing this project, to my brothers, my sisters and all my friends. I also would like to say thanks for everything. The work and success will never be achieved without all of you.

ACKNOWLEDGEMENTS

Alhamdulliah, I would like to express my thankfulness to Allah S.W.T because has given me all the strength that I need in fulfilling and completing my Projek Sarjana Muda and selawat is upon to the Prophet Muhammad S.A.W. I would like to thank my supervisor Encik Lokman Bin Abdullah for his constructive guidance encouragement and patient in fulfilling our aspiration in completing this project and also to my entire lecturers and technicians for their advice and motivation to development this project. I am especially thanks to my friends for their generosity in sharing information regarding to programming an automated pick and place robot.

Last but not least, I would like to thanks all my friends in UTeM who gave me supports ideas and information about the project. My especially thanks also goes to my parents for their support thought the course completing my project.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

PSM	-	Projek Sarjana Muda
DC	-	Direct Control
IDE	-	Intergrated Devemopment Enviroment
PIC	-	Peripheral Interface Control
CAD	-	Computer Aided Design
PC	-	Personal Computer
CPU	-	Central Processing Unit
RAM	-	Random Access Memory
ROM	-	Read Only Memory
A/D	-	Analog/Digital
I/O	-	Input/Output
USART	-	Universal Asynchronous Receiver Transmitter
SPI	-	Serial Peripheral Interface
PCB	-	Printed Circuit Board
LED	-	Light Emitted Diodes

CHAPTER 1
INTRODUCTION

1.1 Project Background

Nowadays, development of technologies especially in robotic are widely grown up. A variety design of robots has been develop in recent years in order to improve the design and their performance. A robot is a virtual or mechanical artificial agent. It is usually an electro-mechanical system which, by its appearances or movements, conveys a sense that it has intent or agency of its own. Today, commercial and industrial robots are in widespread use performing jobs more cheaply or with greater accuracy and reliability than humans. They are also employed for jobs which are too dirty, dangerous or dull to be suitable for humans. Typical applications of robots include welding, painting, ironing, assembly, pick and place, packaging and palletizing, product inspection and testing, all accomplished with high endurance, speed, and precision (Gunderson and Gunderson, 2009)

The application of robotic arm in the industry has provided a lot of aid toward the operator and it is also reduces human risk factor and accident rate. Thus, study on the robotic arm is keep on progressing and keep developing so that the robotic arm will be more user friendly. More possible, the robotic arm will able to act and react by itself, where needed to apply the Artificial Intelligent system on them. Through this, the production rate will increase and the product rejected rate will also decrease.

1.2 Robot Programming

Since the early years of robotics, industrial robots have been programmed on text based on programming language. Gruver et al. (Gruver et al. 1984) provides the list and the general overview of the industrial and research robot programming languages available. More sophisticated robot programming language, such as ABB's Rapid (Rapid 1994), is in common use but they require specialized knowledge of the language and the programs have limited portability. Up to date, teach pendants, connected to a robot controller used to direct and program a robot, have been the most common mode of interaction, although there have been attempts to provide interactive programming framework on text based interface (Jayaraman and Deisenroth 1987).

As software capabilities improved, the ability to do off-line programming proved to be a significant step forward. Interfaces to manipulator systems made further progress with the introduction of user friendly programming paradigms for sensor-based manipulation (Morrow and Khosla 1997). The current state-of-the-art in manipulator interaction is based on iconic programming (Gertz and Khosla 1994) and/or programming by human demonstration (Ikeuchi and Suehiro 1994). Task experts have extensive knowledge and experience with respect to the task, but may only have limited expertise in robotics. To enable novice users to interact with the robot, the interface needs to be intuitive and have the ability to interpret the vague specifications of the user. An example of such a system is the gesture-based programming interface developed by Voyles and Khosla (Voyles et al. 1997). The robot system observes the operator unobtrusively while she is demonstrating the task. The observations can be based on vision, range sensing, data gloves, or tactile sensing. In addition to using gesture-based interaction for direct control of robots, it can also be used for robot programming. The system is able to model high level task specifications but not the sensor feedback during contact. Voyles et al. (Voyles et al. 1999) proposed a gesture-based programming paradigm where the system is assumed to have a set of basic skills from which the system can compose programs. Programming based on observed human demonstration is including Gesture Based Programming, Programming by Demonstration, or Learning by Observation.

1.3 Objectives

The main objective of this project is to programming an automated pick and place robot. Among the other objectives want to achieve are follows:

a) To use MPLAB IDE for programming An Automated Pick and Place Robot.
b) To design new robot task by using MPLAB IDE from manual robot to automatically robot.
c) To analyze the forward kinematics and inverse kinematics for an automated pick and place robot.

1.4 Problem Statement

For the past year, a pick and place robot had been built and available in the laboratory. But the pick and place robot only can move manually. The robot had been programmed only for manual task. To program this robot need to understand the software features to make sure that programming will be done are success. Besides, the working time efficiency will also be calculated to know the data for the robot. The problems that needs to concern are: electronics component also have a little problems where the DC motor had been used are burn and need to replace with the new DC motor.

a) Unsuitable software used.
   - Programming Language complicated to understand
b) Types of PIC
   - Need to find the suitable PIC for automatic pick and place robot.
c) Programming Algorithm.
   - Robot only programmed for manual task only and not for automatic robot.
d) Unsuitable Robot Features.
   - Need to change the broken part and upgrade several parts.

1.5 Project Scope

Project scopes are very important in order to help in the development and the progress of the project. This project will be focus on the programming an automated pick and place robot by using PIC microcontroller and MP LAB IDE as a software in order to perform its specified task. Not only those, scope also help in deciding the path and secure the flow of the project. To develop this project, it has to select the suitable PIC to make a programming. Then, the robot will program to function brilliantly to move the object from one place to another by automatic operation.

1.6 Stages of the Report

The report will conducted in few chapters for the report details regarding the project. Starting with introduction for chapter one, where this chapter includes of background, objectives, problems statement, and project scope. All the entire element becomes as an initial step before go through this project. For the chapter two, this report discuss about literature review related with programming an automated pick and place robot such as general about pick and place robot, history about robot programming, principles of software to used, explanation about Peripheral Interface Control (PIC), about the programming language, and a little about electronics component likes motor. After that, this report goes through to the chapter three. In this chapter, it will consist of methodology of this project where process flow chart that describes what have been done to complete this project. This chapter is explaining the way how to achieve the objective of Programming an automatic pick and place robot. Then, chapter four will continue with design and development. This chapter will show how the programming has been done to achieve the objective. Programming language used in this project will be explain and a simple step for programming will be show. For the chapter five, the result and discussion will be made for the result. The discussion based on robot analysis, where all the results will analyze. And the last chapter is chapter six. Chapter six is about conclusion where it includes all chapters and being concluded as finalize of the project. All this chapters are very important in determining the successful of this project.

1.7 Gantt Chart

1.7.1 PSM 1

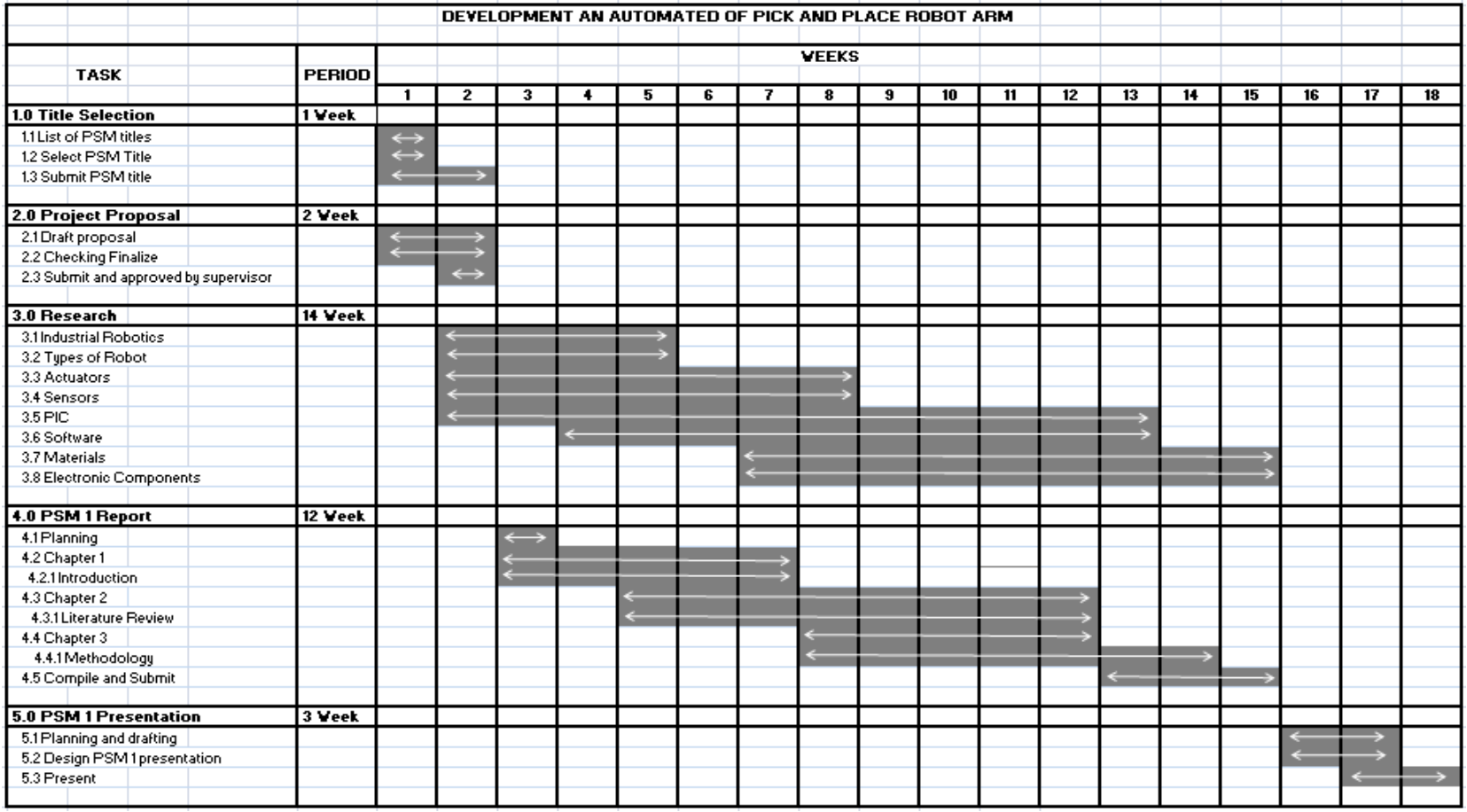

Figure 3.2: Gantt Chart for PSM 1

1.7.2 PSM 2

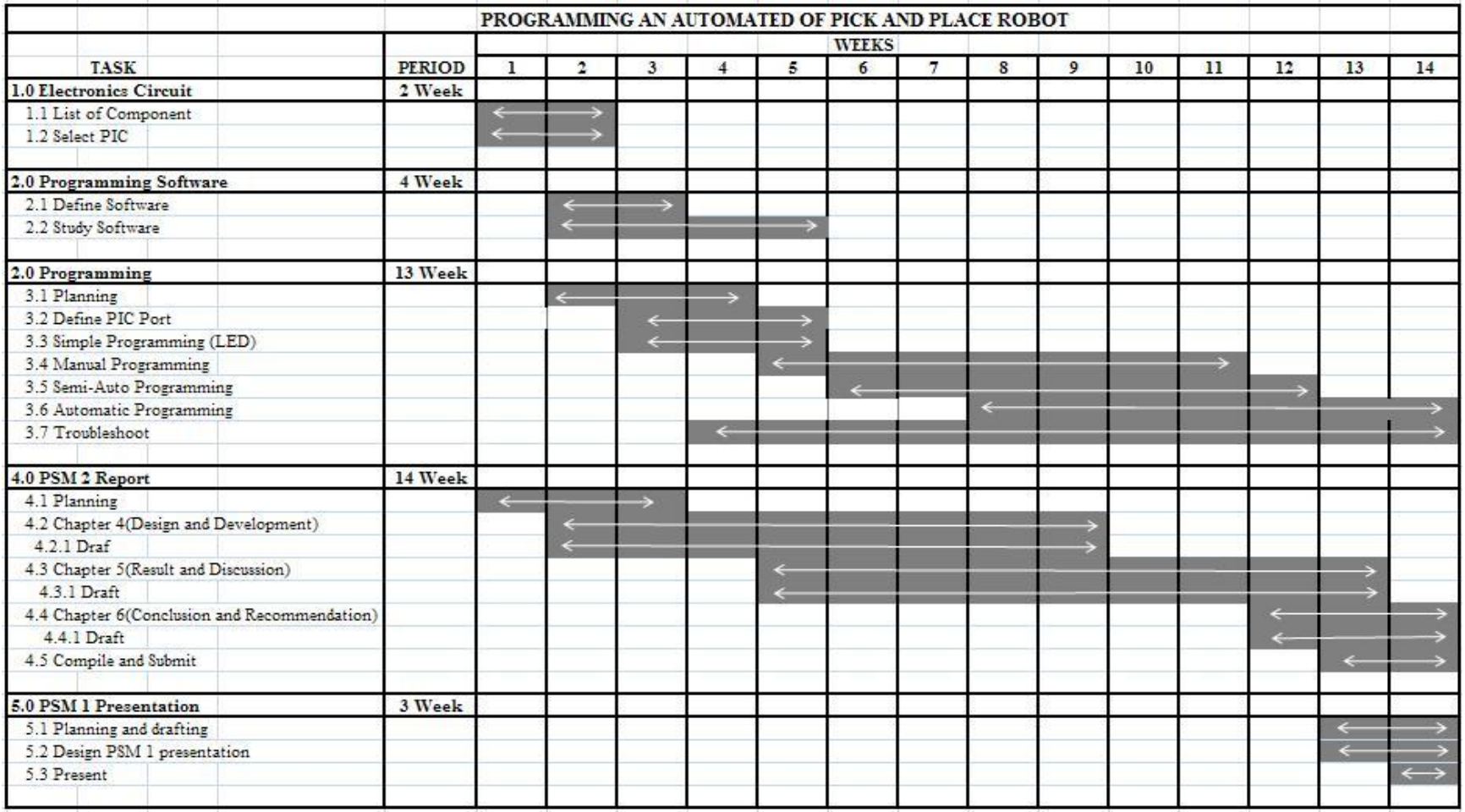

Figure 3.2: Gantt Chart for PSM 2

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter will discuss and describes about programming pick and place robot, and focuses on the data collecting from various resources for the project includes, chronology of robot, electronics component, software, and planning.

2.1 Robot

Robot is a virtual or mechanical artificial agent. The robot is built with the capability of performing a various types of human task. It is a mechanical device that is capable of being programmed to do task automatically (Murphy, 2000). Once it programmed, the capable human operator do not need of operating the machine because the robot only needs supervision from time to time and not the whole time. Most robots are built that resembles an anthropomorphic (human-like) appearance (Sandler, 1998). It is a special combination of motors, solenoids, wires and assorted electronic odd ends. It is a mechanical that is integrated with electrical components. Most robots now days have five important capabilities which are:

a) To move from one point to another point.
b) To be able to handle any sort of object.
c) To able to program
d) Built multifunctional.
e) Practical and efficient for different environments.

The relationship between the three commonly robot primitives are Sense, Plan and Act. The function of a robot can be divided into three general categories. For the function Sense category, the information are taking from the robot's sensor and producing an output useful by other functions (Murphy, 2000). If the function is taking in information and producing one or more tasks for the robots to perform, that function is in Plan category. Functions which produce output commands to motor actuator are in Act category. Table 2.1 shows the three robot primitives in terms of input and outputs.

Table 2.1: Robot Primitives defined in terms of inputs and outputs

ROBOT PRIMITIVES	INPUT	OUTPUT
SENSE	Sensor data	Sensed information
PLAN	Information (sensed and/or cognitive)	Directives
ACT	Sensed information or directives	Actuator commands

2.2 Chronology

Table 2.2: The Chronology of Robot (Isom, 2005)

YEAR	DESCRIPTION
1946	George Dovel patents a playback device for controlling machine
1950	Alan Turing publishes Computing Machinery and Intelligence in which he proposes a test to determine whether or not a machine has gained the power to think for itself. It becomes known as the "Turing Test".
1951	In France, Raymond Goertz designs the first tel operated articulated arm for the Atomic Energy Commission.
1954	George Devol and Joe Engleberger design the first programmable robot "arm" and use the term Universal Automation for the first time. Thus planting the seed for the name of his future company – Unimation.
1956	Marvin Minsky and John McCarthy organize a conference in Dartmouth, Massachusetts,US. The conference coins the phrase "artificial intelligence".
1957	Servomechanisms Laboratory at MIT demonstrates one of the first practical application to computer-assisted manufacturing
1962	The first industrial arm robot – the Unimate – is introduced.
1964	C&D Robotics founded.
1965	DENDRAL is the first expert system or program designed to execute the accumulated knowledge of subject experts.
1968	The octopus-like wall mounted tentacle Arm is developed by Marvin Minsky.
1969	Victor Scheinman, a Mechanical Engineering student working in the Stanford Artificial Intelligence Lab (SAIL) creates the Stanford Arm.
1970	Shakey from SRI, Menlo Park USA, can see and avoid obstacles. Shakey is introduced as the first mobile robot controlled by artificial intelligence. It is produced by SRI International.
1974	Victor Scheinman forms his own company and starts marketing the Silver Arm. It is capable of assembling small parts together using touch sensors.