ARM ROBOTIC SYSTEM BY USING LEGO MINDSTORMS

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Special dedication to my parents, family, friends and lecturers…

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ABSTRACT

An arm robotic system is used most in industrial. It was developed for help human to do work such as soldering that is used in electronic industry. An arm robotic used to do difficult work such as in automation industry and do work faster than human. There have many approaches in design and developing arm robotic system. However, this project is required design and develops an arm robotic system using Lego Mindstorms. This project also required to use Not Quite C (NQC) language to design and develop programming. This project involved with motorizes movement for degree of freedom (DOF) of the arm robotic and sensor detection. The arm robotic has three DOF which are grasp, low/raise the arm and rotation. The objectives of the project are develop arm robotic system using Lego Mindstorms as the requirement in the project, the arm can sorting object by object's color and design programming using NQC language. The main operation of the arm robotic is sorting object by its color. The arm robotic will take object and differentiate the object's color. Then the arm robot will put it in the box that is fixing.

ABSTRAK

Sistem tangan robot banyak digunakan didalam industri. Ia dibangunkan untuk membantu mansia melakukan kerja seperti pemeterian yang selalu digunakan di industri elektronik. Tangan robot digunakan untuk melakukan kerja-kerja yang sukar dilaksanakan oleh manusia dan ia juga melakukan kerja dengan pantas dan cepat. Banyak kaedah dan pendekatan yang ada untuk membangunkan sistem tangan robot. Walaubagaimanapun, projek ini dikehendaki membangunkan sistem tangan robot menggunakan Lego Mindstorms. Projek ini dikehendaki menggunakan bahasa *Not Quite C (NQC)* dalam membangunkan aturcara program. Projek ini banyak melibatkan pergerakan motor untuk menentukan *degree of freedom (DOF)* sesuatu tangan robot. Robot ini mempunyai tiga *DOF* iaitu untuk pusingan tangan, menaik/menurun tangan dan menggenggam tangan. Matlamat projek ini ialah robot ini mesti boleh mengasingkan sesuatu barang mengikut warna barang itu. Membangunkan aturcara program dengan menggunakan bahasa *NQC*. Operasi utama robot ini ialah mengasingkan barang dengan membezakan warna barang. Robot ini akan mengambil barang dan membezakan barang itu mengikut warna barang itu dan meletakkan barang itu ke dalam kotak yang mempunyai barang yang sama warna.

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LIST OF ABBREVIATION

DOF	-	Degree of Freedom
RCX	-	Robotic Command Explore
NQC	-	Not Quite C
LCD	-	Liquid Crystal Display
IR	-	Infrared
BWST	-	Body Weight Support on a Treadmill

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CHAPTER I

INTRODUCTION

This project required to design and develops arm robotic system based on LEGO Mindstorm. The project is emphasis more towards designing an arm robotic system using NQC. This project involved with more motorizes movement, sensor detection and machine vision that can be manipulated by programmer. The robot consists of subsystem such as rotation, raise/lower arm, grab/release object and sensor. This project used sensor to sort object and determine degree of rotation.

1.1 Objectives

- To develop an arm robotic system using LEGO Mindstorm.
- To develop an arm robotic system that can sorting object by its color.
- To design program by using NQC.

1.2 Scopes of Work

The project was an arm robotic system that can grabbed and released object. The robot can make rotation, grab and release object, raise and lower arm. The robot can grab an object such as ping pong ball, box and so on. The objects are not too big and not too small. It is also can put the object to another place around the robot standing. The arm can sort an object by its color.

1.3 Problems Statement

Many years before LEGO Mindstorms kits produced, arm robotic was built by using big gear, big motor, steel, pneumatic, hydraulic cylinder and so on. It needed welding for every joint and some part of arm. In designing arm robotic, they involved with some equation to calculate accuracy of movement. They also used software to make simulation of arm robotic in 3D image. They need to design and construct a controller of arm robotic. It quite difficult to built an arm robotic because it involved with iron material, big motor, welding process and so on. This arm robotic is stronger and not fragile. It can pick up weight and big object. The movement of arm robotic is more accurate [3].

When LEGO Mindstorms was produced around year 1998, many people used LEGO Mindstorms in built their robot. With LEGO Mindstorms, the arm robotic could be design and develop easier. This is because, LEGO Mindstorms produces a lot of kits brick with sensor, motor, RCX "programmable brick" as controller and graphical software (RoboLab). Do not need to design and construct controller because LEGO Mindstorms has controller which is RCX that can control arm robotic by transfer programming into RCX via IR tower. Welding process do not need in built arm robotic. Only joined every bricks by own creativity to produce arm robotic. However, design arm robotic using LEGO Mindstorms have advantages and disadvantages.

Advantages :

- Easily to built arm robotic system
- Do not need built controller of arm robotic
- Do not need welding process

Disadvantage :

- Not strong and fragile
- Arm robotic movement not accurate
- Can not pick up weight and big object

CHAPTER II

LITERATURES REVIEW

2.1 Introduction of Robotic

Robotics is the science and technology of robots, including design, manufacture, and application. Other definition, robotic is the engineering discipline dealing with the design, construction and operation of robot in automation. Robotics requires a working knowledge of electronics, mechanics, and software [11].

A robot is a mechanical or virtual, artificial agent. A robot is usually an electro-mechanical system, which, by its appearance or movements, conveys a sense that it has intent or agency of its own. The word *robot* can refer to both physical robots and virtual software agents, but the latter are often referred to as *bots*.

A robot also can be defined as a programmable, self-controlled device consisting of electronic, electrical, or mechanical units. More generally, it is a machine that functions in place of a living agent. Robots are especially desirable for certain work functions because, unlike humans, they never get tired; they can endure physical conditions that are uncomfortable or even dangerous; they can operate in airless

conditions; they do not get bored by repetition; and they cannot be distracted from the task at hand.

A typical robot must have several of the following properties:

- Is not has been artificially created.
- Can sense its environment . Can detect objects or things like heat and light and convert the object information into symbols that computers understand.
- Can manipulate things in its environment.
- Has some degree of intelligence, or ability to make choices based on the environment, or automatic control / preprogrammed sequence.
- Is programmable. It has brain that contains instructions called algorithms to control the robot.
- Can move with one or more axes of rotation or translation.
- Can make dexterous coordinated movements.
- Appears to have intent or agency (reification, anthropomorphisation or Pathetic fallacy).

2.1.1 Mechanical

All robots share the features of a mechanical, movable structure under some form of control. The structure of a robot is usually mostly mechanical and can be called a kinematic chain (its functionality being akin to the skeleton of a body). The chain is formed of links (its bones), actuators (its muscles) and joints which can allow one or more degrees of freedom. Most contemporary robots use open serial chains in which each link connects the one before to the one after it. These robots are called serial robots and often resemble the human arm. Some robots use closed parallel kinematic chains. Other structures, such as those that mimic the mechanical structure of humans, various animals and insects, are comparatively rare. However, the development and use of such structures in robots is an active area of research. Robots used as manipulators have an

end effector mounted on the last link. This end effector can be anything from a welding device to a mechanical hand used to manipulate the environment.

The mechanical structure of a robot must be controlled to perform tasks. The control of a robot involves three distinct phases called robotic paradigms (perception, processing and action). Sensors give information about the environment or the robot itself (e.g. the position of its joints or its end effector). Using strategies from the field of control theory, this information is processed to calculate the appropriate signals to the actuators (motors) which move the mechanical structure. The control of a robot involves various aspects such as path planning, pattern recognition, obstacle avoidance, etc. More complex and adaptable control strategies can be referred to as artificial intelligence.

2.1.1.1 Robotic Paradigms

A robotic paradigm can be described by the relationship between the 3 primitives of robotics: Sense, Plan, and Act. It can also be described by the way sensory data is processed and distributed through the system. The types of paradigms are:

1) Hierarchical Paradigms

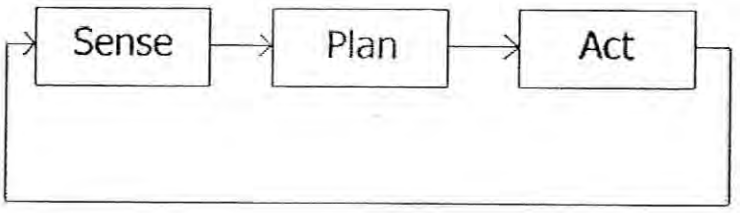

Figure 2.1: Hierarchical paradigms

- The robot operates in a top-down fashion, heavy on planning.