TWO ROBOTS PUSHING A BEAM
(MOVEMENT AND COMMUNICATION)

MOHD FIRDAUS BIN ALUWE

This Report Is Submitted In Partial Fulfillment of Requirements for The Bachelor Degree of Electronic Engineering (Computer Engineering)

Faculty of Electronic Engineering and Computer Engineering
Universiti Teknikal Malaysia Melaka

APRIL 2007

UNIVERSTI TEKNIKAL MALAYSIA MELAKA
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN
PROJEK SARJANA MUDA II

Tajuk Projek : TWO ROBOTS PUSHING A BEAM (MOVEMENT & COMMUNICATION)

Sesi Pengajian : APRIL 2007

Saya MOHD FIRDAUS BIN ALUWE
(HURUF BESAR)

mengaku membenarkan Laporan Projek Sarjana Muda ini disimpan di Perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Laporan adalah hakmilik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan laporan ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tandakan (√) :

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

(TANDATANGAN PENULIS)

Alamat Tetap: T-04-U-05
JALAN PIES
PRESINT 16
62150 PUTRAJAYA

Tarikh: 4/5/07

Disahkan oleh:

(COP DAN TANDATANGAN PENYELIA)
ANIS SUHAILA BT MOHD ZAIN
Pensyarah
Fakulti Kej Elektronik dan Kej Komputer (FKEKK),
Universiti Teknikal Malaysia Melaka (UTeM),
Karung Berkunci 1200,
Ayer Keroh, 75450 Melaka

Tarikh: 4 May 07

"I hereby verify that I have read this report and I find it sufficient in terms of quality and scope to be awarded with the Bachelor's Degree in Electronic Engineering (Computer Engineering)"

Signature : .....

Supervisor Name : Pn Anis Suhaila Bin Md Zain

Date : 4 Mei 07

Dedicated to:

My beloved family, my supervisor, UTeM"s lecturer, lab technician, LEGO robot's team, and all my friends for their understanding and support.

ACKNOWLEDGEMENT

First of all, I would like to thank Allah the All Mighty, which with his bless, I manage to complete this thesis.

I would like to express my greatest gratitude and sincere thanks to my supervisor, Pn. Anis Suhaila Binti Mohd Zain, for accepting me as her project student and for her valuable ideas, advice and help in the supervision and discussions of this Final Year Project. In fact, she gave me guidance when obstacles arise throughout this period of time. Once again, I thank her for her tolerance and endeavors.

I am especially grateful to my parent and members of my family, for all their support and understanding along my study. Lastly, my grateful goes to all my colleagues who give me guidance and help in completing this project.

ABSTRAK

Projek tahun akhir ini adalah merupakan aplikasi dalam bidang kejuruteraan komputer. Objektif projek ini adalah untuk mencari sesuatu objek dalam kawasan yang ditetepkan dengan menggunakan pengesan warna atau pengesan cahaya, serta bersedia di hadapan garisan objek dan seterusnya menolak objek tersebut ke satu kawasan yang lain. Projek ini terbahagi kepada dua bahagian iaitu pambangunan perisian dan rekabentuk perkakasan. Bagi proses pembangunan perisian, perisian Bricx Command Center yang ditulis menggunakan bahasa NQC digunakan untuk memprogramkan pergerakan robot, peranti pengesan serta komunikasi antara kedua-dua ribot. Bagi rekabentuk robot, kedua-dua robot dibina dengan menggunakan perkakasan LEGO yang dikawal oleh pengawal RCX serta menggunakan peranti pengesan yang juga turut disediakan bersama-sama. Aplikasi kepada projek ini adalah ia boleh digunakan di pelabuhan untuk proses mencari serta penyusunan kontena. Selain itu ia juga dapat digunakn oleh pihak tentera sebagai robot untuk mencari serta memusnahkan periuk api.

ABSTRACT

This final year project basically the application of computer engineering. The objective of this project is to finding an object in a room, while given its approximate location, aligning beside the object using color & light estimation, and moving the object to a second location. The project is divided into two parts, software development and hardware design. For software development, the Bricx Command Center which is writen in NQC programming language is used to develop program for the movement of the car, as well as the sensor and the communication between the robots. For the hardware design, the robots was built by using LEGO bricks that controlled by using lego RCX controller, and used lego sensors. The application of this project can be applied at the port for serching a contenants and it also can be applied in military as the robots to find the mines.

TABLE OF CONTENTS

LIST OF TABLE

LIST OF FIGURES

LIST OF ABBREVIATIONS

AC	-	ALTERNATING CURRENT
AI	-	ARTIFICIAL INTELLIHENCE
CLI	-	CALLER LOCATION IDENTIFICATION
IDEs	-	INTEGRATED DEVELOPMENT ENVIRONMENTS
IR	-	INFRARED
LCD	-	LIQUID CRYSTAL DISPLAY
MIT	-	MASSACHUSETTS INSTITUTE OF TECHNOLOGY
NQC	-	NOT QUITE C
PC	-	PERSONAL COMPUTER
PRGM	-	PROGRAM
RAM	-	RANDOM ACCESS MEMORY
RCX	-	ROBOTICS COMMAND EXPLORER
RIS	-	ROBOTICS INVENTION SYSTEM
ROM	-	READ ONLY MEMORY
USB	-	UNIVERSAL SERIAL BUS

LIST OF APPENDIX

CHAPTER 1

INTRODUCTION

Chapter 1 starts with the background of the project and the importance of the project. It is followed by objectives, scope of the project, and problem statement of the project. The overview method of project is presented in fifth part and lastly summary of the thesis is described.

1.1 BACKGROUND OF THE PROJECT

Two Robots Pushing a Beam

The project dealt with finding an object in a room, while given its approximate location, aligning beside the object using color and light estimation, and moving the object to a second location. All was done using robots which were built with Lego bricks and controlled using Lego RCX controller, and used Lego sensor. This project is programmed by using nqc programming.

Application of this project can be apply at a port for searching a cotenants and it also can be apply in military as a weapon to find and destroy mines.

1.2 OBJECTIVES

The objectives of the project are:

i) To design a robot that can move in certain area.
ii) To design the robot that recognizes the color of the surface.
iii) To design the robots that can push the object.
iv) To design both of the robots can push the object together.
v) To design the movement of the robot become more faster.

1.3 SCOPE OF PROJECTS

This final year project basically the application of computer engineering. The project is divided into two parts, software development and hardware design. The software development will be implementing in computer to Lego Mindstorm by using a Lego infrared transmission tower. In this project I use NQC programming language because it easy to understand and its more efficient. I also use the light sensors to control the movement of the robots. These sensors have limitation to 3ft x 4ft sq area and this robot only can recognize a few types of colors.

1.4 PROBLEM STATEMENT

i) The robot movement is unlimited to certain area.
ii) Difficult to recognize which beam should be pushed.
iii) The movement of these robots is quite slow.
iv) Lack of making NQC programming algorithms.

1.5 METHOD OF THE PROJECT

Several steps are taken through in completing this design. Firstly, some studies are made to understand the overall specification of the project. Reading on the past journals and books is done to gain the knowledge for achieving the objectives.

By referring the information and data obtained through the study, the overall functional block diagram of the programming design for the robot is sketched using the top-down level design. This is a design technique that starts with the highest level of an idea to block diagram and works its way down the single component in block diagram. From that, the block diagram of the program algorithms for the RCX controller is developed by using NQC programming. The NQC program is checked it syntax to ensure error free. The full block diagram (flow chart) will be shown and explained in the chapter 3.

After that, the program is simulated and tested to verify the functionality of the design. Lastly, the designs are synthesized its area and time testing for each algorithms is used. Note that, some iteration processes are performed during NQC programming, syntax checking, simulation and synthesized in meeting the task.

1.5.1 'C' and 'NQC' Programming

This programming language is used to implement the motion of the robot such as moving forward, backward, turning and so on. It also used to find some object by recognize the object color and push the object to specific location. There would be object or maze around the robot so has to set out proof algorithm that would move the robot without crush or stuck with the objects. All these behavior will be applying first by using the programming language of LEGO RCX programmable controller. The program from computer will be transferred to the robots by using the infrared tower that connected from computer to robot.

1.5.2 Sensors

The Light sensor was determined to be the best methods used for sensing the object because it has an ability to detect a color, specifically the brightness of the surface. By using this sensor, the robots can find the location of the object.

1.5.3 Hardware Design

The hardware design of the robot monitoring system included construction by LEGO Mindstorm parts. The hardware included two wheels for moving the robot. When building the body robot, the body must have enough sensors to make sure the robot did not crush the object.

1.5.4 Software

Software like firmware used before implement the programming code into the RCX because this software will erase all previous programs inside the RCX. The Brick COM software used to create the 'C' or 'nqc' program algorithms for the robot.

1.6 SUMMARY OF THE THESIS

This thesis consists of five chapters what describes in detail and clearly about this project. Chapter one is an introduction of the entire of the project. They are including with importance of this project and motivation of the projects. Besides, the problem statement, objective, scope and overview method of project are discussed in this chapter.

Chapter two will discuss about the study and all the information that are related to this project. Each the fact and data are gathered through the different source of references in order to choose the best algorithm to implement in this project.

Chapter three will be explaining the methodology of implemented in this project in detail. The design of the robots, workspace and how the light sensors detect the colour will be explained in this chapter. Introduction to NQC programming and the flowchart of the programming algorithm also will be presented in this chapter.

The results obtained on this project are given in chapter four. Analysis on the functionality and fault of the program is described. The finding of the project and its problem faced during the developing process will be discussed in this chapter. The alternative that been choose to overcome the problem also will be explained in this chapter.

Chapter five of this thesis will conclude the whole project development and some suggestion to improve the project are given.

CHAPTER 2

LITERATURE REVIEW

In this chapter, its will explains about theory and concept of the entire project. The purpose of this chapter is to determine the perspective and the method used for developing the project. This chapter also will become the reference of the theory to solve the problem within the project. Literature review on past journals is done to understand the all hardware material and programming algorithms for the project.

2.1 HISTORY OF ROBOT LEGO MINDSTORM

Lego Mindstorms has been nearly 15 years in the making. It comes through collaboration between LEGO and the Massachusetts Institute of Technology (MIT). An MIT research scientist, helped develop much of the microprocessor technology ultimately used in Mindstorms, and it was MIT's vision to stuff a computer inside a LEGO brick. A pioneer in artificial intelligence and the creator of the LEGO programming language, worked with LEGO to put his Logo into LEGO bricks.

The Lego Mindstorm is incorporated with sensors such as light sensors, touch switches and heat sensors. All input and output ports is connected and managed by the RCX controller. Here, RCX controller will receive a program created in Bricx Command Center or RoboLab using infra-red transmission. The program then is stored inside its own memory and can be executed directly from the controller.

2.1.1 LEGO MINDSTORM

First launched in 1998, LEGO MINDSTORMS for Schools (LMfS) and ROBOLAB™, each year have helped countless students grasp science, technology, engineering, and math concepts with hands-on, naturally motivating building sets, programming software, and curriculum relevant activity materials. LEGO MINDSTORMS Education is ideal for use in after-school club environments and robotics competitions, where student have time to explore and invent their own robotics solutions and where they can reap the benefits of professional support. Inside the LEGO MINDSTORM package:

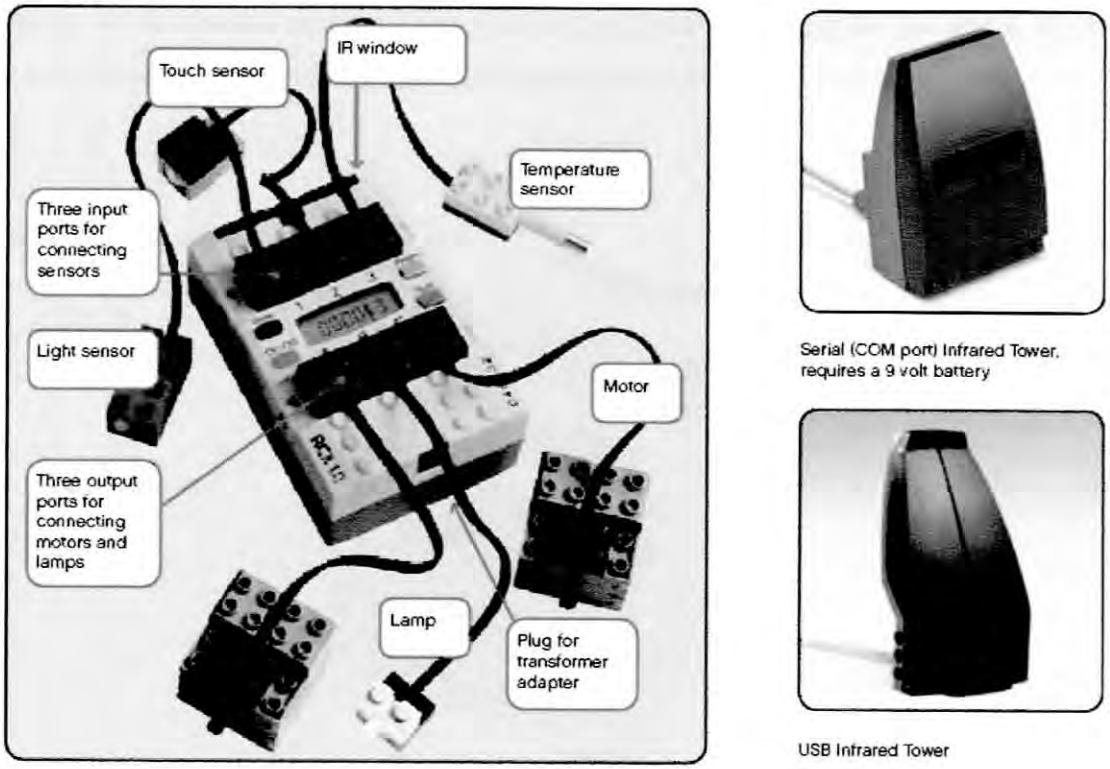

Figure 2.1 Set of Lego package

2.2 RCX COMMAND CENTER

The first generation of Lego Mindstorms was built around a brick known as the RCX. It contains a Renesas H8/300 microcontroller as its internal CPU. Embedded into the RCX is a microcontroller, a Hitachi H8/3292, with a CPU, called the H8/300 CPU Core. This CPU runs the control program. Through the H8/3292 based device controllers the control program access RCX input/output devices like buttons, a speaker, and a special purpose Liquid Crystal Display (LCD). Furthermore, sensors like a touch sensor or a temperature sensor can be connected to the RCX input ports providing sensor input to the control program and the control program can activate actuators like motors connected to the RCX output ports. Stimuli from the environment a car bumping into an obstacle can be registered by a sensor, e.g. a touch sensor, and transformed into input

values for the control program. The resulting response is turning the car and it can be accomplished by the control program through values output to actuators, e.g. a motor.

Figure 2.2 RCX programmable brick

The RCX is equipped with the following input/output devices:

Input devices:

i) Four buttons labeled Run, OnOff, View, Prgm
ii) Three input ports labeled 1,2,3
iii) Battery voltage level
iv) Timers
v) Infrared receiver