DESIGN AND IMPLEMENTATION OF A WAREHOUSE ROBOT

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This report is submitted in partial fulfillment of requirements for the award of Bachelor of Electronic Engineering (Industrial Electronics) with honours

Fakulti Kejuruteraan Elektronik Dan Kejuruteraan Komputer
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DEDICATION

Dedicated to my beloved father and mother. Also to all my friends

ABSTRACT

A warehouse robot is an autonomous forklift mobile robot to perform loading and unloading jobs in a factory without human intervention. The robot is essentially a line following robot that follow a black line drawn on the floor. The robot is capable to locate loading location, retrieve and lift a load and transfer the load to designated unloading location. Infrared sensor is used for its line following function, to detect the loading and unloading station. The robot is driven using DC motors to control the movement of the wheels and the pickup mechanism. PIC microcontroller is used as the brain of the robot. One of most practical application has been in the area of material handling. The concept of this robot can be used to build an autonomous forklift to do loading and unloading routine in a factory without human intervention.

ABSTRAK

Robot warehouse adalah satu robot bergerak trak pencakar automatik yang menjalankan tugas mengangkat dan meletak barang dalam kilang tanpa jagaan manusia. Robot itu adalah penting sebagai pengikut garisan yang mengikut garisan hitam yang dilukis pada lantai. Robot itu berkeupayaan untuk mengenal pasti tempat meangangkat barang, mengangkat barang dan memindahkan barang itu ke tempat yang dikehendaki. Robot ini menggunakan pengesan infra merah berfungsi untuk mengikut garisan hitam, mengesan stesen pemuatan beban dan stesen pemunggahan beban. Robot ini menggunakan motor arus terus untuk pergerakan dan sistem pengangkatan barang. Robot ini juga menggunakan pengawal mikro PIC sebagai otaknya. Salah satu aplikasinya yang penting ialah dalam bidang pengangkutan bahan. Konsep robot ini boleh digunakan untuk membina trak pengangkut automatik bagi menjalankan tugas pengangkutan dalam kilang tanpa pengawasan manusia.

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CHAPTER I

INTRODUCTION

1.1 Introduction

This chapter will discuss on the robot history, robot definition, modern uses of robots, autonomous robot, automatic guided vehicle and warehouse robot. The problem statement, objectives of the project, scope of work and report structure will also be presented.

1.1.1 Robot History

The word "Robot" comes from the 1921 play "R.U.R." (Rossum's Universal Robots) by the Czech writer Karel Capek. The word "robotics" also comes from science fiction. It first appeared in the short story "Runaround" (1942) by Isaac Asimov. Three Laws of Robotics as shown below:

- Law Zero:

  A robot may not injure humanity, or, though inaction, allow humanity to come to harm.
- Law One:

A robot may not injure a human being, or, through inaction, allow a human being to come to harm, unless this would violate a higher order law.

- Law Two:

  A robot must obey orders given it by human beings, except where such orders would confict with a higher order law.

- Law Three:

  A robot must protect its own existence as long as such protection does not conflict with a higher order law.

1.1.2 Definition Of A Robot

According to The Robot Institute of America (1979) : "A reprogrammable, multifunctional manipulator designed to move materials, parts, tools, or specialized devices through various programmed motions for the performance of a variety of tasks."

According to the Webster dictionary: "An automatic device that performs functions normally ascribed to humans or a machine in the form of a human (Webster, 1993)."

1.1.3 Modern use Of Robots

Robots can be used for exploration when people are interested in places that are sometimes full of danger, like outer space, or the deep ocean. But when they can not go there themselves, they make robots that can go there. The robots are able to carry cameras and other instruments so that they can collect information and send it back to their human operators.

Robots are useful in industry. When doing a job, robots can do many things faster than humans. Robots do not need to be paid, eat, drink, or go to the bathroom

like people. They can do repetitive work that is absolutely boring to people and they will not stop, slow down, or fall to sleep like a human.

Other usage of robots is in medicine. Sometimes when operating, doctors have to use a robot instead. A human would not be able to make a hole exactly one 100th of a inch wide and long. When making medicines, robots can do the job much faster and more accurately than a human can. Also, a robot can be more delicate than a human. Some doctors and engineers are also developing prosthetic (bionic) limbs that use robotic mechanisms. Dr. David Gow, of the Prosthetics Research and Development Team at Princess Margaret Rose Orthopaedic Hospital, made the first bionic arm called the Edinburgh Modular Arm System (EMAS) in 1998.

Robots also can be used in military and police. Police need certain types of robots for bomb-disposal and for bringing video cameras and microphones into dangerous areas, where a human policeman might get hurt or killed. The military also uses robots for locating and destroying mines on land and in water, entering enemy bases to gather information, spying on enemy troops

At first, robots where just for entertainment, but as better technology became available, real robots were created. Many robots are still seen on T.V. (Star Trek - The Next Generation) and in the movies (The Day the Earth Stood Still, Forbidden Planet, Lost in Space, Blade Runner, Star Wars). These imaginary robots do a lot of things that the real ones can not do. Some robots in movies are made to attack people, but in real life they cannot really hurt people at all because they are not in control of themselves.

1.2 Problem Statement

Forklift is used in warehouse for material handling. However, the forklift needs man power to drive. This will increase the operation cost. The process is not dependable and productive because workers cannot works 24 hours per day. Therefore, extra workers had to be hired for shift. Besides this, the percentage of

manual forklift product handling defect also quite high because it is hard for the workers to control the forklift motion with the repetitive accuracy. The rate of accident happens for manual forklift handling also quite high. Furthermore, it is also dangerous for human to manipulate chemical material that is hazardous to human health. Therefore, an autonomous forklift robot is essential to perform such task in this situation.

1.3 Objectives

i. Construct a line following robot.
ii. Function to load and unload pallet in designated area.

1.4 Scopes Of Work

The scope of work in this project is stated below:

i. Combination of a line following robot and manipulator robot.
ii. PIC Microcontroller is used and selected according to the total needs of I/O port.
iii. PICBASIC Pro is used as the programming language for PIC microcontroller.
iv. The maximum weight that can be lifted by the robot is 2kg.

1.5 Report Structure

This thesis is a documentary to deliver the idea generated, the concepts applied, the activities done, and the final year project product produced. The thesis consists of seven chapters. Below is the description of each chapter in the thesis.

In Chapter 1, the history, definition and modern usage of robots is discussed. . Furthermore, the problem statement, objective of project and scopes of work will also be presented.

Chapter 2 is the literature review about the theoretical concepts applied in constructing the warehouse robot. This chapter discussed how a line following robot and a forklift robot works. The ways to combine both concept of the robot to become a warehouse robot is also included. Besides this, this chapter also explains the way to choose the suitable PIC microcontroller, sensor, motor and pickup mechanism.

In Chapter 3, the methodology, the design flow and construction of the project is introduced. It gives brief description about each procedure in completing the project. This chapter includes a list of tools and approaches used in the project.

Chapter 4 covered the result from all the designing, testing and troubleshooting process. It contains the overview of the development of the hardware. It includes the design and construction of the complete robot, the PIC microcontroller board, the sensor board, the motor board, the pickup mechanism, the track and the load. It also involved testing and troubleshooting of the board constructed. Problem analysis is also included where the problem encountered during the whole designing and constructing process and the solution to overcome to problem are discussed. .

Chapter 5 is the conclusion of the Final Year Project. It also includes the application of the project and the recommendation that can be implemented in the future.

CHAPTER II

LITERARUTE REVIEW

2.1 Introduction

There are a number of microcontrollers, motors and sensors in the market with vary specification. Therefore, literature review is done in this chapter to make a review between the various types of microcontrollers, motors and sensors. This is very important as a guide line to choose the most suitable of microcontroller, motor and sensor to be used in this project.

2.2 Autonomous Robot

Autonomous robots are robots which can perform desired tasks in unstructured environments without continuous human guidance. Autonomous vehicles have been designed and implemented to perform a wide variety of tasks, from delivering medical sample in a hospital to sweeping and clearing unexploded ordnance from a mine-field. One of the most practical and popular applications for autonomous vehicles has been in the area of material handling. The use of autonomous material handling vehicles is now common in the high volume