UNIVERSITI TEKNIKAL MALAYSIA MELAKA

ANALYSIS ON CORNERING PERFORMANCE OF PLC BASED MOBILE ROBOT NAVIGATION SYSTEM

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

by

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DECLARATION

I hereby, declared this report entitled " Analysis Cornering Performance of Plc Based Mobile Robot Navigation System" is the results of my own research except as cited in references

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfilment of the requirements for the Degree of Bachelor of Manufacturing Engineering (Robotics And automation) with Honours. The member of the supervisory committee is as follow:

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(Dr. Fairul Azni Bin Jafar)

ABSTRACT

Mobile robot is defined as a programmed machine that is skilled of movement in any controlled environment. They have capabilities to move around in their environments and are not fixed to one physical location as categorized as fixed robot. The example of mobile robot such as mobile robot navigation, mobile robot at the space and so on. Although the robot has been created with a good design and control, it still have a problem. The problem that always faced by the robot like, speed, program, sensor and also avoidance obstacles of the objects. Thus, it motivates to analysis the one of the problem of the mobile robot navigation system which is the problem during make a cornering.

To analyze the project, a navigation experiment will be test on u shape path and experiment will repeat with two different program. The experiment results are presented in graph in order to know the cornering performance of the mobile robot.

The first experiment in this research which are the experiment with transistor and without transistor. Second experiment to analyze the effect of the program on the navigation of mobile robot. The programs have developed into two which are the program with reverse action and the program without reverse action. Each of this experiment will be repeated three times to get better results. For the first experiment, the navigation with transistor is better than without transistor. And for the second experiment, the program without reverse action give a good results during make a cornering.

ABSTRAK

Robot mudah alih ialah didefinisikan sebagai sebuah mesin diprogramkan yang mahir pergerakan di mana-mana persekitaran terkawal. Mereka mempunyai kebolehan bergerak-gerak dalam persekitaran mereka dan tidak ditetapkan bagi satu lokasi fizikal seperti yang dikategorikan sebagai robot tetap.

Contoh robot mudah alih seperti pelayaran robot mudah alih, robot mudah alih di ruang dan sebagainya. Walaupun robot telah mewujudkan dengan satu perancangan baik dan mengawal, ia masih lagi satu masalah. Masalah yang sering menghadapi oleh robot seperti kelajuan, sistem, penderia dan juga halangan-halangan pengelakan objek. Maka, ia mendorong kepada analisis salah satu masalah sistem pandu arah robot mudah alih yang merupakan masalah semasa membuat satu membelok

Untuk analisis projek, eksperimen pelayaran akan diuji di laluan bentuk u dan eksperimen akan berulang dengan tiga perkakasan berbeza. Keputusan eksperimen akan mewakili di graf supaya tahu prestasi takik keliling robot mudah alih.

Dua experiment akan dijalankan dalam kajian ini iaitu untuk experiment pertama, pergerakan robot dengan menggunakan transistor dan tanpa transistor. Experiment kedua yang dijalankan adalah untuk menganalisis keberkesanan program. Dalam kajian ini program telah terbahagi kepada dua iaitu program tanpa proses pengunduran dan dengan pengunduran. Experimen akan dijalankan sebanyak tiga kali bagi mendapatkan keputusan yang terbaik. Bagi experimen yang pertama, keputusan yang menunjukkan lebih baik adalah pengemudian dengan menngunakan transistor. Dan bagi experiment kedua, pengemudian dengan menggunakan proses tanpa penguduran adalah lebih baik.

DEDICATION

Especially dedicated to my beloved parents, Hasbullah bin Mat Yaman and Azmah binti Sapii and to my supervisor, Dr.Fairul Azni bin Jafar, and all my friends who have encouraged, guided, and inspired me throughout the study process.

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LIST OF ABBREVIATIONS

AGV - Automated Guided Vehicle

FKP - Fakulti Kejuruteraan Pembuatan

FYP - Final Year Project

WMR - Wheeled Mobile Robot

GPS - Global Positioning System

MDARS - Mobile Detection Assessment and Response System

PLC – Programmable Logic Controller

CHAPTER 1
INTRODUCTION

This chapter will explain the background of the project, the details of the problem statement and motivation, the objectives, the scopes, report structure and the report configuration of the project entitled "Analysis on Cornering Performance of PLC Based Mobile Robot Navigation System".

1.1 Background

Mobile robot is a type of robot that has ability to move around and is not fixed at only one position. It can move from one position to other position depends on the physical geometry and environment. Mobile robot will acts like a human and can performed the human tasks.

In order for mobile robot to work successfully in human living environment, they need to have skills which allow them to perform tasks similar to the human being. One of the skills which could be considered as most important for mobile robot is navigation. Navigation is ability of the robot to move in an environment. There are various types of mobile robot navigation one of the examples like manual remote. This type of mobile robot is control by driver by using joystick or other control instruments.

Mobile robot navigation is where a robot capable to navigate to a position in its environment. It will guide its own position and determine their respective positions in the frame of reference and then plan the way towards few target location. In order for robot to navigate to a position or move through real – world it needs the mechanism includes locomotion sensing, localization, and motion planning. A good

representation is a massive important factor to the robot in a navigation system. The representations stated are the map of the environment and the capable to read the task. Those important tasks will encourage the precise result in navigation system. Mobile robot navigation systems have been creating as a function to navigate the position. This task will make human job become easier.

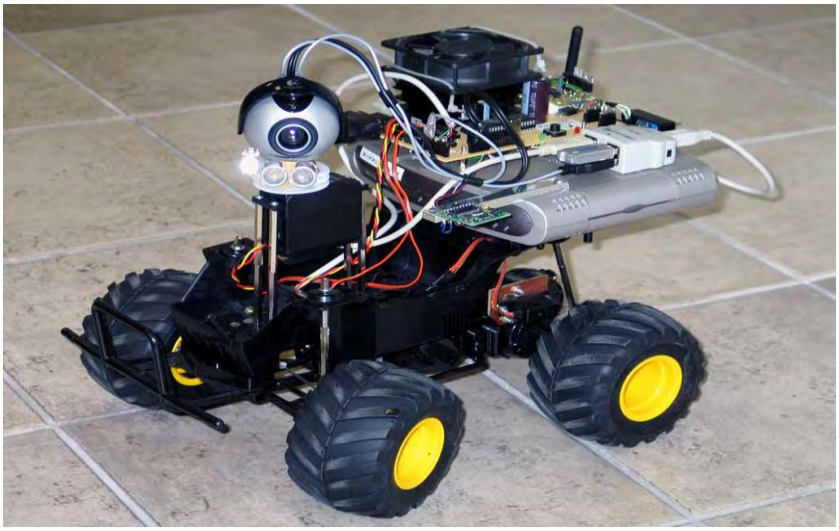

Figure 1.1: Mobile robot of vision system for landmarks detection.
(Source: http://www.neurotechnology.com/robotics.html).

Navigation can be classified as a combination of three core competencies which are self-localisation, path planning, map-building and map interpretation. Definition of the navigation is comprised of three categories which are Global Navigation, Local Navigation, and Personal Navigation. These three categories have different ability to determine the position. Global navigation has the ability to determine the position of an absolute or map-referenced, and to move to the desired destination. While in Local Navigation, the ability to determine a position compared with objects either the objects is stationary or moving in the environment, and to interact with properly and Personal Navigation involving realizing the various parts that make up the self, in relation to each other and the object handle.

Line-following robots, Automated Guided Vehicles (AGVs) are the best example of mobile robot that used line following navigation system. In order to navigate the system, an automated guided vehicle or automatic guided vehicle (AGV) is a mobile robot that follows the colour line or wires in the floor, or uses vision, magnets, or

lasers. AGVs have expressed hallway or area where it is or where they can navigate. For the guidance to mobile robot move successfully in the line, the AGVs use magnetic tape, buried guide wires, or painted stripes that have been draw on the ground. These vehicles have some disadvantages which are not freely programmable and cannot change their path in response to external sensory input (e.g., obstacle avoidance). However, the interested reader may find a survey of guidance techniques for AGVs in (Everett, 1995).

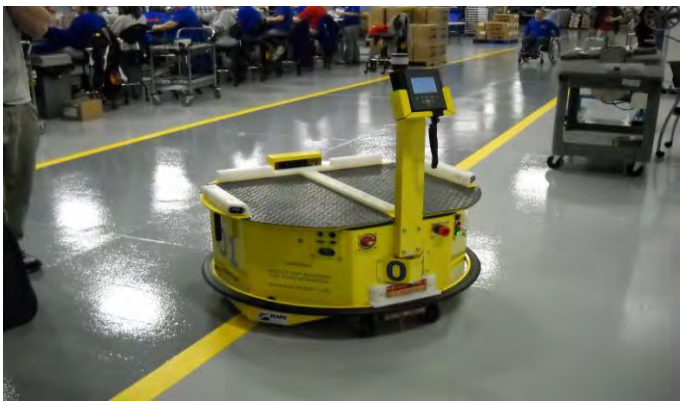

Figure 1.2: Example of Automated Guided Vehicle.
(Source:http://news.thomasnet.com/fullstory/Intelligent-AGV-enhances-lean-manufacturing-environments-582126).

Navigation is achieved by any one of several ways, including by an action defined by buried inductive wires, there is horse riding paths magnetic or optical, or alternatively as inertial or laser guidance.

1.2 Motivation

For the revolution in technology undoubtedly is the robot. Every day a growth of robot can be seen with increasing human like capabilities, such as recognizing objects and moving around independent of human control (Girme et al. 2007). There are many types of mobile robot that have been developed today to perform human tasks. Although the robot has been created with a good design and control, it still has a problem. The problem that always faced by the robot like speed, system, sensor and also the obstacles avoidance. Thus, it motivates to analyze the problem of the mobile robot navigation system in order to produce a good navigation system for mobile robot.

Mobile robot navigation have been installed correctly with a proper fundamental system like speed, shape, and the most important one its can navigate the position with a right performance according to the manufacturer‟s specifications and its environment.

1.3 Problem statement

Previously, PLC based navigation system for mobile robot have been develop and successfully move on the line following. During the navigation, there is problem occurred at u shape path. The robot can move successfully during the straight path but facing some problem during making a cornering. During the cornering, the robot cannot follow the u shape line following and accidently move out of the line.

In the case of this challenge, a study and analysis will be conducted to figure out the problem occur during the cornering performance. Three different experiments will be conducted in u shape. Each experiment will take a reading data and error will be record.

1.4 Objective

i. To analyze the cornering problem of a PLC based mobile robot navigation system.

1.5 Scope

The purpose of this project is to analyze the cornering performance of a PLC based mobile robot navigation system.

i. The analysis covers about the motion and the problems of the robot. This research work is not covers the safety of the robots. The experiment that will be conducted to be in indoor environment. The environment setup will be in a flat silver area at the manufacturing laboratory hall.
ii. The experiment will be conducted on the mobile robot navigation systems that have been developed by previous PSM project.
iii. This project will involve the development of program of PLC and sensor.

1.6 Report structure

Chapter 1 is the introduction of the project. Under this chapter, there have 6 subtitles which are the background of the project, motivation, problem statement, objectives, scope and report structure.

Chapter 2 is all about literature review. This chapter comprises information about the robot, landmark based navigation, line following robot and problems needs to face by the robot.

Chapter 3 describes a design process to achieve the project‟s objectives. It includes the overall project plan, overall methodology flow chart, and details explanation about methods to analysis the cornering performance of the robot.

The result will be presented in chapter 4 and chapter 5 is regarding the conclusion of the project in form of whether it is successful or not based on the objectives achievement and in addition of future suggestion in order to improve this project.

CHAPTER 2
LITERATURE REVIEW

Before starts analyze the project, some articles re-examine from the internet and book ensure the information from that source can be in order to do a research and analyze the cornering problem of mobile robot. These articles will be use as the guideline in this research project. This chapter will summarise and stress on paper content, report and article related to this project. A few theories that have related to this project also will be discussed in this topic.

2.1 Overview of mobile robot

P.Lima et al. (2002) wrote that the term mobile robot is principally a platform with a hefty mobility within its environment such as air, land or even underwater. Mobile robot consists of functional characteristics such as a total mobility relative to environment, a certain level of autonomy which limited to human interaction and a perception ability in sensing and reacting in the environment.

Locomotion mechanisms are important things for the mobile robot to enable it to move in unlimited all over the environment. But there are several of possible methods to move, so the selection approach of the robot to locomotion is one of important factor for mobile robot design. By the experiments that have been done in laboratory, the robots have prove that it can walk, jump, run, slide, skate, swim, fly, and, also can made a rolling. Most of these locomotion mechanisms have been motivate by their biological counterparts. The design of autonomous mobile robots competent of smart movement and action involve an integration of much knowledge of other bodies. In current industrial environment, robot especially mobile robot plays an important role since the capabilities in completing tasks that are impossible to be

completed by humans due to limited abilities. Robot are known have the higher ability in doing repetitive works with constant performance, working in dangerous area which could danger human life and make the job faster with less rest time. According to Dudek and Jenkin (2000), a mobile robot is autonomous systems which have intelligent function of traversing a facade with natural or artificial obstacles. The chassis is providing with wheel or legs and possibly a manipulator setup mounted on the chassis for work piece operation, tool or special system. There are variety trepanned operations are perform based on a reprogrammed navigation strategy taking into account the current status of the environment.

The first mobile robot was created approximately 63 years ago beginning in 1950 when Grey Walter assumed to integrate these two cognitive operations, goal seeking and scanning, into en electronic „toy" that would simulate these most basic characteristics of animal and human behaviour (Walter, 2003). Thus, it resulted in creation of the first mobile which has three wheels and often described as turtle because of its shape. Walter named his robot as *Elmer* and *Elsie* also used to be called as *Machine Speculatrix* because it tendency to explore its environment.

2.2 Robot navigation

2.2.1 Landmark based navigation

Navigation based on autonomy robot landmark was widely used in manufacturing industry. Navigation strategy depends on identification and recognition of a distinctive environment display or an object either known a priori or extracted dynamically. This process is inherently difficult in practice due to noise in detector and change in real world. This process is indeed hard in practice because of the noise problem in sensors and changes in the real world.

Landmark navigation is the most important things for the mobile robot to navigate the system by using its sensory input and generally it"s divided into three type of position which is fixed, known and relative position (BorensteinJ. etl.1997). Navigation orders that based on landmark more easy to follow, time saving, and

reduce confusion by preparing visual feedback on the approval of a navigation results.

Landmarks are the geometrical features that a robot can detect from its sensory input. Landmarks can be variety of geometric shapes such as square, line and circle and they may contain an additional information (e.g., in the form of bar-codes). Landmarks are carefully selected in order to easy to recognize for example, there is must be contrast relative that is enough to all background. The characteristics of the landmarks must be known and stored in the robot‟s memory before a robot can use for navigate. The main function in localization is to identify the landmarks definitely and to measure the robot‟s position.

In summarize, there are a few characteristic of landmark based navigation which are, the distance and angle between the robot and the landmark are important thing is positioning accuracy. When the robot move further afield from the landmark, the navigation will become inaccurate. When the robot is nearby a landmark, a greater degree of accuracy will be created.

2.2.1.1 Natural landmarks

Natural landmarks work best in good structured environments such as corridors, manufacturing floors, or hospitals. On the other side, there has an argument that „„natural‟‟‟ landmarks can navigate in best work when they are man-made as is the case in good structured environments. Natural landmarks are those objects or features that are already in the environment and have a function other than robot navigation. The recognizing and matching characteristic features from sensory inputs is the one of the main problem occur in natural landmark navigation. In natural landmarks, there is no modification involved and the flexibility of this landmark is good.