MANEUVER FIRE FLASHOVER ROBOT

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CANDIDATE'S DECLARATION

I admit this work is my own work, except for each extract and summary that I have explain its source.

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Date :

CONFORMATION

I admit that I read this work. In my opinion this work was adequate from scope and quality of "Project Sarjana Muda" (PSM) report, Bachelor of Electronic Engineering (Electronic Industry).

Signature :

Name : SITI AISYAH BINTI ANAS

Date

For my beloved father and mother

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ABSTRACT

A maneuver fire flashover robot is developed as one of the application to identically the fire fighter in a real life. By developing this project, a task that had been done by fire fighter can be replicate. This robot will operate in the maze to find and pick up the ping pong ball that represent as the victim while the other task was extinguish the fire that represent by the candle. After completing this task, this robot will need to return back to the starting area to perform a final task of a fire fighter that was a rescue the victim to the safe place. Current robot have a problem regarding to it locomotion that is a round wheel locomotion. The problem that rise was time taken is longer during the turning process, imprecisely position after turning and concern about the stability of the chassis. Other problem that rises was returning to the starting area without reliable reference and high power consumption for the ping-ping's lifter. With the problem rise, this project objective will be developing the movement of the omni wheel for a robot's sharp turn, to develop the digital compass as a tools of remembering the path way and to develop the suitable lifter of ping pong ball. This project will make a navigation operation by using the latest and modern wheel call omni wheel that can move freely in any angle. During navigation in the maze, it will be help by using the digital compass that will keep updating the current position for the robot and interact with infra-red sensor to the programmable integrated circuit (PIC) as a microcontroller to mapping the path way.

ABSTRAK

Sebuah project iaitu *"Maneuver fire flashover robot"* akan dibangunkan dengan merujuk dan meniru cara kerja bagi seorang ahli bomba dan penyelamat. Melalui projek ini, tugas seorang ahli bomba dan penyelamat boleh ditiru. Robot ini akan beroperasi didalam kawasan *"maze"* dimana ia akan mengangkat bola ping-pong yang diistilahkan sebagai mangsa manakala tugas yang lain adalah memdamkan kebakaran yang akan di gantikan dengan api pada lilin. Selepas kesemua tugas tersebut selesai, tugasan terakhir adalah membawa pulang bola ping-pong ke kawasan permulaan dimana ia adalah salah satu tugas seorang ahli bomba dan penyelamat untuk membawa pulang mangsa ke tempat yang selamat. Robot yang digunakan pada masa ini mempunyaai masalah di bahagian rodanya. Masalah yang berlaku adalah pengunaan masa yang lama semasa membuat operasi membelok, posisi robot yang tidak menentu selepas membuat operasi membelok dan kekuatiran mengenai ketidak seimbangan rangka badan robot. Masalah-masalah lain termasuklah robot tidak mempunyai rujukan yang meyakinkan untuk pulang ke kawasan permulaan dan juga pengunaan bekalan kuasa yang tingi oleh pengangkat bola ping-pong. Dengan permasalahan yang berlaku, beberapa objektif telah diambil kira iaitu mengunakan roda *"Omni"* untuk membuat operasi membelok, mengunakan digital kompas untuk mengingat laluan di dalam *"maze"* dan membangunkan sebuah pengangkat bola ping-pong yang sesuai. Dengan menggunakan roda terbaru dan moden yang diberi nama roda *"Omni"*, ia membolehkan pergerakan berlaku pada semua arah. Semasa melalui *"maze"*, robot ini akan dibantu oleh digital kompas untuk memberitahu kedudukan yang terbaru dan

ia juga akan berinteraksi dengan sensor infra merah ke "*Programmable integrated circuit"* (PIC) sebagai alat pengawal bagi proses pemetaan laluan.

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PIC	–	Peripheral interface circuit
AC	–	Alternate current
DC	–	Direct current
PWM	–	Pulse width modulation
IR	–	Infra red
PCB	–	Printed circuit board
LCD	–	Liquid-crystal display
LED	–	Light-emitting diode
IC	–	Integrated circuit
V	–	Volt
MHz	–	Mega Hertz
MB	–	Mega byte
DRAM	–	Dynamic random access memory
PID	–	Proportional integral derivative
F	–	Force

SCL	Serial clock
SDA	Serial data
UV	Ultraviolet
NaOH	Sodium hydroxide

LIST OF APPENDIX

CHAPTER 1

INTRODUCTION

This chapter consists of introduction, problem statement, objective, scopes, brief description of the methodology and structure of project. By completing this chapter, it will provide the information and the structure for project.

1.1 Introduction.

Maneuver robot is defines as a clever or skillful action or movement according to the surrounding. Maneuver robot require locomotion to make it mobile from one place to other place or depend on its application. As referred by Dimitrios S. Apostolopoulos [1], this locomotion is a base in mobile robot performance and it gains ability to navigate with environments. Maneuver robot can move freely

depending on type of locomotion and will become a main role in a maneuver robot when this robot use in a complex terrain application. In this project, the locomotion becomes a main role for movement not because of the complex terrain but due to increasing movement performance. The most popular locomotion use is wheeled locomotion which suitable in a low complexity terrain. It is a common combination for maneuver robot with a round wheel and this type of wheel had becomes a standard wheel. By implement this type of wheel, for make a turn normally it will turn left and right in a curve shape and static turning method. When surrounding with terrain requires sharp corner ability, it becomes a problem. The curve shape will require a large area for turning while the static turning requires an extra time to make a turn. Although it is a normal movement, the problem is it causes an extra space and time waste. Therefore, in this project a robot with a new type of wheel call omni wheel will be develops to cover this problem. An addition, a digital compass will be used as additional component to remember of path way or mapping the surrounding area.

1.2 Problem Statement.

The first problem statement is refers to the standard (round wheel) locomotion. The standard locomotion commonly uses skid steering and articulated steering. The skid steering makes a turn with opposite rotation direction at the two sides of wheels as shown in Figure 1.1. As results, turning a robot with a current position or fix position can be achieved but have some problem. The problem occurs when it draw a high power usage. This occurs when high friction in a two side of wheel happens due to the rotation in opposite direction and velocity at the same time. Other than that, it also affect at the time taken [2]. To make a turn, robot need to stop first and then start turning. During this operation, normally it takes a period of time and occurs time wasting.

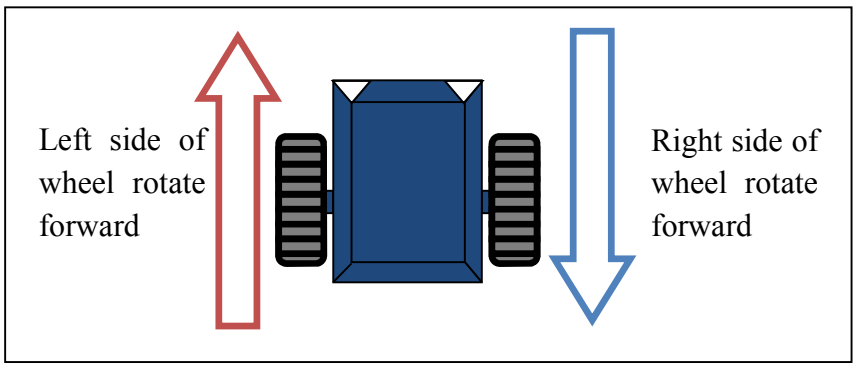

Figure 1.1: Skid steering.

Other steering method is a coordinate (Ackerman) steering that allow robot steer in low power consumption. The low power consumption is due to the operation during the turning process as shown in Figure 1.2. The operations usually use less actuator (commonly one) to control the turning operation. When make a turn, one side of the wheels or actuator will rotate while other side will become static and in some application it will rotate in a low speed. It also require controlling pulse wide modulation or PWM when rotate both side in difference speed while make a turn. These steering methods mostly suitable for the application that moves around curve [3]. The positioning of the robot after make a turn will not precise because this steering method steers in a curve shape.

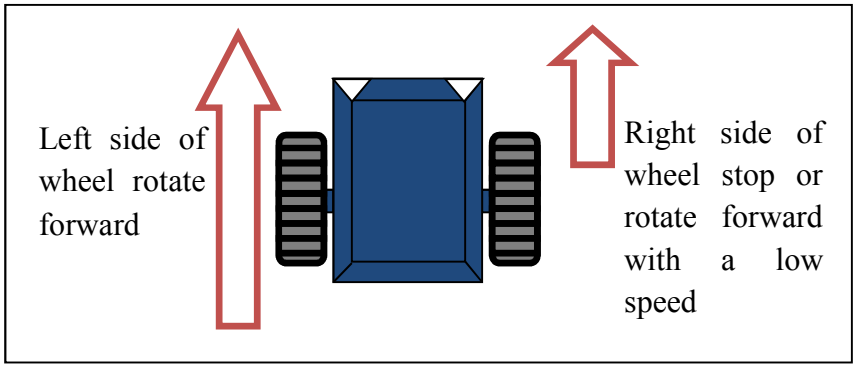

Figure 1.2: Coordinate (Ackerman) steering.

The second problem statement is due to the stability of the standard locomotion. When using a two wheel as locomotion the stability of the robot will be

low. Then, the additional part such as castor wheel was added to increasing the stability. However, this stability was not enough because castor wheel only increase a few percent of stability. The stability of the robot more depends on the dimension of the robot. Figure 1.3 below show the current robot center of gravity that corresponding to the stability. When the center of gravity is higher, the percentage of this robot will fall down increase.

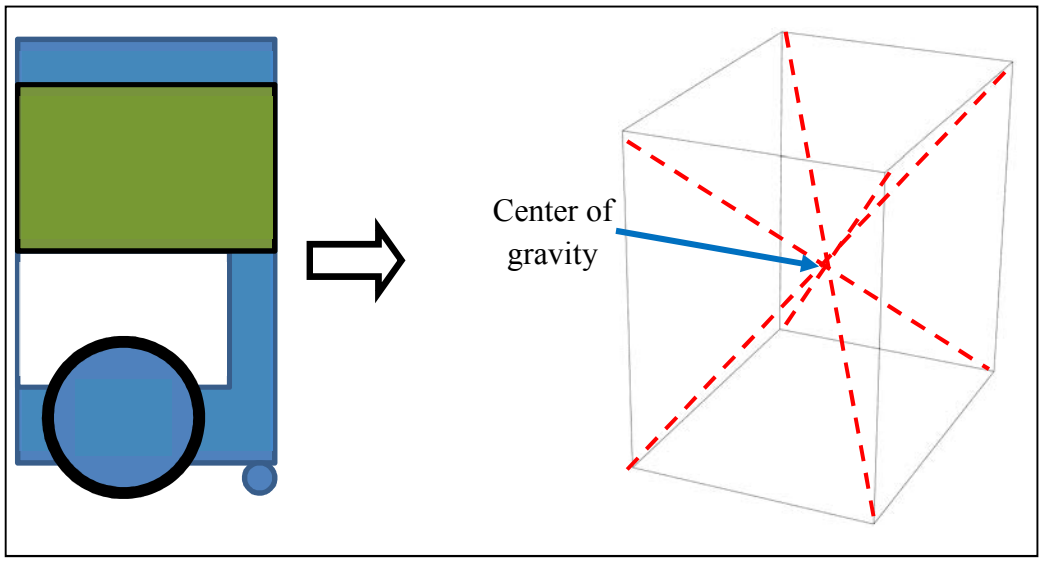

Figure 1.3: Robots center of gravity.

The third problem statement is that the robots only have one way to mapping the environment. The mapping process was a core process to ensure the mobile robots can return to its base after it moves to other place. Normally, mobile robots will memories the path that they had been through and the path includes avoiding the obstacle. When mobile robots instruct returning to the base, they will inverse their path in memory by using concept of last in, first out (LIFO). The LIFO concept is stack or queue that important in the computer science [4]. When the new obstacle present or interruption in the memory occurs, robot will lost it way for returning to the base.

The forth problem statement is regarding to the power consumption due to the motor for vacuum. A vacuum is use to lift up ping pong ball into the robot's

container. By using the vacuum, a high power supply needs to be used to ensure it operational. However, power supply that use was a DC battery and by vacuum itself will drain the battery faster. Since the battery will drain faster, the other operation will interrupt and lead to malfunction of overall system.

1.3 Project Objectives.

The objectives of this project are as below:

i. To develop the movement of the omni wheel for a robot's sharp turn.
ii. To develop the digital compass as a tools of remembering the path way.
iii. To develop the suitable lifter of ping pong ball.

1.4 Scope of Project.

This project is known as "Maneuver Fire Flashover Robot", as it function automatically maneuver in the maze area, perform a fire extinguisher, pick up the ping pong ball and returning to the starting area. This project consists of two main part which is hardware part and software part. The hardware part is focusing in development three main parts which are omni wheel, digital compass and lifter. Those main parts are choose because to archive the objective of this project. Other parts that use are PIC, IR sensor component and fire extinguisher component. The software part is more focusing to the PIC compiler software that is a platform to instruct this project become a maneuver robot. The main instruction for the software part was omni wheel sequence movement and communication between digital compass and PIC. The lifter doesn't have any instruction because this component