UNIVERSITI TEKNIKAL MALAYSIA MELAKA

TYRE LIFTING SYSTEM FOR MOBILE ROBOT

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

by

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FACULTY OF MANUFACTURING ENGINEERING
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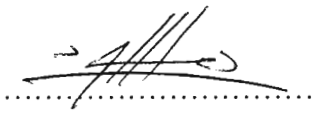

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ABSTRACT

This project focuses on the development of Tyre Lifting System for mobile robot. Mainly, the Tyre Lifting System development consists of three main parts: mechanical part, electrical and electronic part, and programming part. As for mechanical part is a base design, and any mechanical relevant part while for electronic part is a circuit design for sensor and PIC16F877A. The development for the lifting tyre platform used machining process and fabrication. The electronic circuit constructed and then attached to a microcontroller which acts as the tyre lifting main controller for the tyre movement.The main idea of the mechanism is to lift the tyres when detecting an obstacle. The inputs are received from sensors which are mounted at the mobile robot platform. In this project, microcontroller is used to perform the step of lifting tyre sequence.

ABSTRAK

Projek ini menumpukan pada pembangunan sistem mengangkat tayar dinamik untuk robot mudah alih. Pembangunan sistem mengangkat tayar mengandungi tiga bahagian utama: bahagian mekanikal, bahagian elektrik dan elektronik, dan bahagian pengaturcaraan. Bahagian mekanikal meliputi reka bentuk badan, reka dan mana-mana bahagian berkaitan mekanikal manakala untuk bahagian elektronik meliputi rekabentuk litar untuk penderia dan mikropengawal. Pembangunan untuk platform mengangkat tayar mengunakan proses mesin dan proses pembuatan. Litar elektronik dibina dan disambungkan dengan mikropengawal dan bertindak sebagai pengawal utama untuk pergerakan mengangkat tayar. Mekanisme utama sistem ini adalah untuk mengangkat tayar apabila mengesan halangan. Input-input diterima dari pengesan-pengesan yang dipasang pada platform robot mudah alih. Dalam projek ini, mikropengawal digunakan untuk mengawal proses mengangkat tayar.

DEDICATION

Specially dedicated to
my beloved parents who have encouraged, guided and inspired me
throughout my journey of education

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Alhamdulillah, praise be to Allah for His blessings and giving me the strength along the challenging journey of completing the project. Primarily, I would like to take this opportunity to express my deepest gratitude towards my project supervisor, thank my supervisor, Mr. Mohd Hisham b. Nordin who has persistently and determinedly assisted me during the project. It would have been very hard to complete this project without the passionate supports and guidance encouragement and advices given by him.

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LIST OF ABBREVIATIONS

AGV	-	Automated Guided Vehicle
ALU	-	Arithmetic Logic Unit
CPU	-	Central Processing Unit
D.C.	-	Direct Current
I / O	-	Input / Output
IR	-	Infrared
LED	-	Light Emitting Diode
PC	-	Program Counter
PCB	-	Printed Circuit Board
PIC	-	Peripheral Interfaces Controllers

CHAPTER 1
INTRODUCTION

1.1 Background

A mobile robot is an automatic machine that is capable of movement in a given environment. Mobile robots have the capability to move around in their environment and are not fixed to one physical location. Mobile robotics the branch of robotics concerned with movable robot systems that are able to locomote within an environment or terrain. Mobile robotics and robots are mainly used in research on navigation and exploration, with applications for autonomous guided vehicles.

A few advantages of mobile robot are it is suitable to transport material. It can be useful to move in dangerous location. Besides that, it can be use in research and exploration task. Mobile robot has been use in performing variety of task and can move in different location. The purpose of this research is to create mechanism of lifting tire for mobile robot platform.

1.2 Problem Statement

Nowadays, mobile robot faces many critical problems and challenges in the technology today. The problems that usually occur are the mobile robot not stable when moving across an obstacle.

This mobile robot has a disadvantage when crossing the cable wire. The wheel will crash with the obstacle and make the mobile robot unstable. The purpose of this research is to create mechanism of lifting tire including mechanical structure, circuit and programming for the lifting system.

1.3 Objectives

The objectives of the project are:

a) To design and create tire lifting system for mobile robot in order to overcome the small obstacle like cable wire.

1.4 Scope of project

Scope that is covered for this project:

a) Mechanical design for tire lifting system for mobile robot platform.
b) Mechatronics for tire lifting system for mobile robot circuits.
c) Sensors for tire lifting system for mobile robot
d) Programming for PIC.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

This chapter reviews some of the previous works that have been done in the field of mobile robot technology. This section highlighted the mobile robot, classification, type of mobile robot navigation, and previous research including mobile robot development, problem that faced and mechanism of lifting tire, the common applications of lifting tire method for the mobile robot and analysis on the tire lifting the method as well as design of effective design for the mobile robot.

2.2 Mobile Robot

Mobile robots have the capability to move around in their environment and are not fixed to one physical location. Mobile robot is any autonomous mobile machine that interacts with its environment through sensors, and attempts to achieve some objective or a small robot that have capability to move around in their environment and not stick to certain location. It is also can perform desired tasks in unstructured environments without continuous human guidance.

The autonomous robot are capable of gain information about the environment, work for an extended period, move either all or part of itself throughout its operating environment without human assistance and avoid situations that are harmful to peoples, properties, and itself. It can be found in industry, military, and security environment. Other than that, it also appears in public consumers for entertainment or to perform certain tasks like vacuum cleaning or mowing.

2.2.1 Classification

The mobile robot can be classified by the environment in which it travel and device that they use to move. First the environment in which they travel can be divide by 3 that is the land or home robot, aerial robots, and underwater robots. Second, the devise that they use divided into legged robot, wheeled robot, and tracks. In this project, the development of the project is based on the device use to move that is wheeled robot that moves in land environment.

2.2.2 Mobile Robot Navigation

There are many types of mobile robot navigation:

2.2.2.1 Manual Remote or Tele-op

A manually tele-op'd robot is totally under control of a driver with a joystick or other control device. The device may be plugged directly into the robot, may be a wireless joystick, or may be an accessory to a wireless computer or other controller. A tele-op'd robot is typically used to keep the operator out of harm's way. Examples of manual remote robots include Foster-Miller's Talon, iRobot's PackBot and KumoTek's MK-705 Roosterbot.

2.2.2.2 Guarded Tele-op

A guarded tele-op robot has the ability to sense and avoid obstacles but will otherwise navigate as driven, like a robot under manual tele-op. Few if any mobile robots offer only guarded tele-op.

2.2.2.3 Line-following Robot

Some of the earliest Automated Guided Vehicles (AGVs) were line following mobile robots. They might follow a visual line painted or embedded in the floor or ceiling or an electrical wire in the floor. Most of these robots operated a simple "keep the line in the center sensor" algorithm. They could not circumnavigate obstacles; they just stopped and waited when something blocked their path. Many examples of such vehicles are still sold, by Transbotics, FMC, Egemin, HK Systems and many other companies.

2.2.2.4 Autonomously randomized robot

Autonomous robots with random motion basically bounce off walls, whether those walls are sensed with physical bumpers like the Roomba cleaners or with electronic sensors like the Friendly Robotics lawn mower. The simple algorithm of bump and turn 30 degrees leads eventually to coverage of most or all of a floor or yard surface.

2.2.2.5 Autonomously guided robot

An autonomously guided robot knows at least some information about where it is and how to reach various goals and or waypoints along the way. "Localization" or knowledge of its current location is calculated by one or more means, using sensors such motor encoders, vision, Stereopsis, lasers and global positioning systems. Positioning systems often use triangulation, relative position and/or Monte-Carlo/Markov localization to determine the location and orientation of the platform, from which it can plan a path to its next waypoint or goal. It can gather sensor readings that are time- and

location-stamped, so that a hospital, for instance, can know exactly when and where radiation levels exceeded permissible levels. Such robots are often part of the wireless enterprise network, interfaced with other sensing and control systems in the building. For instance, the PatrolBot security robot responds to alarms, operates elevators and notifies the command center an incident arises. Other autonomously guided robots include the SpeciMinder and the Tug delivery robots for hospital labs, though the latter actually has people at the ready to drive the robot remotely when its autonomy fails. The Tug sends a letter to its tech support person, who then takes the helm and steers it over the Internet by looking through a camera low in the base of the robot.

2.2.2.6 Sliding autonomy

More capable robots combine multiple levels of navigation under a system called sliding autonomy. Most autonomously guided robots, such as the HelpMate hospital robot, also offer a manual mode. The Mobile Robot Sinside guidance system, which is used in the ADAM, PatrolBot, Speci-Minder, MapperBot and a number of other robots, offers full sliding autonomy, from manual to guard to autonomous modes.

2.3 Movement

A recent research study by Mohd Khairul, (2008) showed that the objectives of the project that he develop to design and construct a mobile robot that can following line and enable to approach the objective area. The mobile robot programmed able to drive the mouse straight ahead and to make clean right or left turn at any junction while following the line in the right speed. Four IR transmitters and receivers placed at the center of the front detection circuit used to make sure the mobile robot moving by following the line. The mobile robot can do task like exploration and navigation. Based on the previous development by the S Datta,R.Ray and dr Banerji, the objective of their research is to develop a vehicle that can navigate autonomously and transport jobs and tools in manufacturing environment. As a result, they develop the Autonomous Mobile Robot

with Manipulator for the Manufacturing Environment. Besides that, in 1998, David P.Anderson also create small mobile robot that can be use to exploring human habitats.

Analysis of the research on a mobile robot for handling hazardous chemical by Khairul (2008) claim that modification needed in order to improve the mobile robot. First, the mobile robot need more powerful high torque motor applied with the lighter body structure to improve the robot movement. Mohd Khairul,K (2008) identified that the stability is important thing in the design of the robot to give better result of movement. In addition improvement in programming will give better result in the mobility of the robot.

2.4 Lifting Tire Mechanisms

Mobile robot has been introduced into the industry to do many tasks. Forecast indicates that this trend of using mobile robot will continue for the foreseeable future. Early research, the application research of mobile robots with forklift-driving-wheels capable to ascend and descend stairs by the Hirofumi and Noriyoshi in 1999 was concern about the mechanism in lifting the tire of mobile robot.

In a report on a specific case, Hirofumi and Noriyoshi (1999) state that mechanism of lifting tire for mobile robot can be use to ascending the stair and descend stairs. The mobile robot with Forklift-Wheels capable to ascend and descend stairs is shown in figure 2. The FDW robot mobile robot with Forklift-Driving-Wheels capable to ascend and descend stairs is divided into three parts (Body, Front Forklift-Wheels, and Rear Forklift-Wheels).Those forklifts have driving wheels. The robot can move up and down by the front and rear forklifts, and also it can be transferred by using these through the stairs and the step.

This research in develop the mobile robot that can lift the tire is as an alternative method to cross the obstacle. The Forklift system is a good mechanism to lift the tire. This system can be useful to be use for the mobile robot to cross the obstacle.

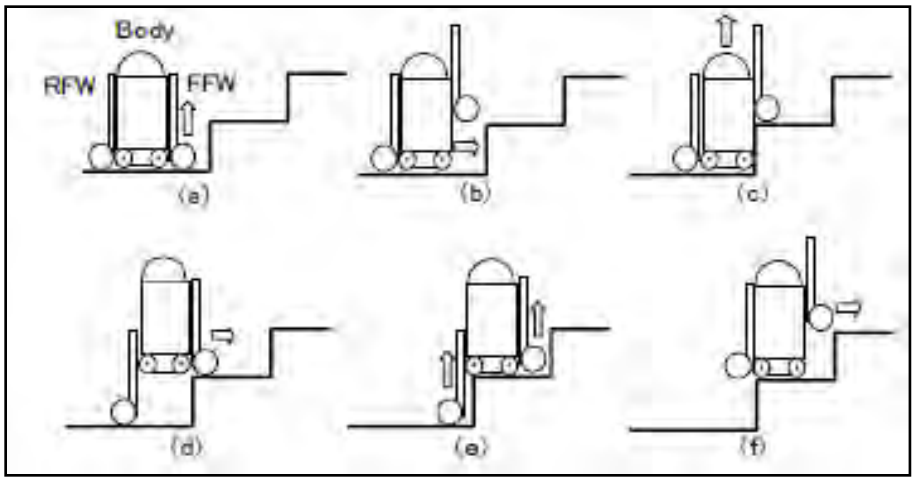

Figure 2.1: Moving patterns on stairs. (Hirofumi and Noriyoshi 1999)

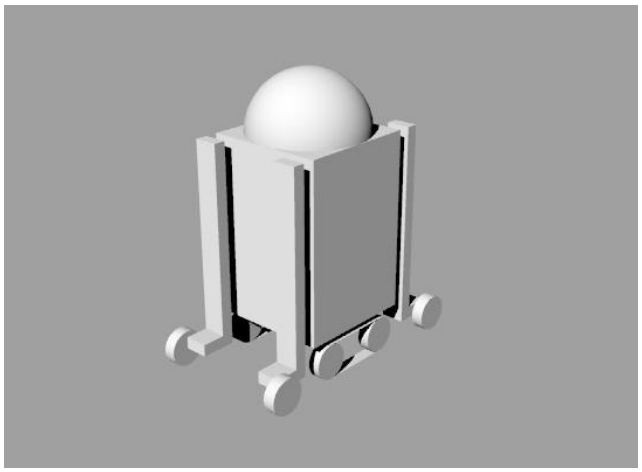

Figure 2.2 Mobile robot with Forklift-Wheels. (Hirofumi and Noriyoshi 1999)

Besides that, the research of a robot that capable to cross the obstacle when climbing the wall describe by the Fischer, F. Tâche, and R. Siegwart (2007) under the title magnetic wheeled robots that can pass difficult obstacles (ridge-type).For passing even more difficult obstacles, some of these robots are equipped with special mechanisms within their structure. This robot also uses linear movements, but needs fewer actuators and is