UNIVERSITI TEKNIKAL MALAYSIA MELAKA

CONTROL DESIGN OF A LINE FOLLOWER ROBOT WITH IOT-BASED MONITORING SYSTEM

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

by

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APPROVAL

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Industrial Automation and Robotic) with Honours. The member of the supervisory is as follow:

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ABSTRAK

Di dunia sekarang ini penggunaan robot sangat biasa bukan sahaja di bidang perindustrian tetapi juga termasuk dalam kehidupan seharian kita. Oleh kerana robot mudah alih autonomi menjadi semakin terkenal sejak kebelakangan ini, masih terdapat beberapa robot yang boleh diubahsuai. Robot pengikut garis umum yang ada di pasaran sekarang lebih banyak untuk tujuan pendidikan tetapi masih ada beberapa industri yang menggunakan robot pengikut garis sebagai pengangkut barang berat dan ada beberapa bahagian dan performance yang dapat diperbaiki sejak robot digunakan sebagai pengangkut pemantauan fungsi sistem untuk mencegah kesalahan sangat penting. Robot tidak mempunyai sistem pemantauan yang dapat membolehkan pengguna memantau robot sehingga sukar untuk dipantau sejak berada di kawasan industri. Dengan menerapkan sistem pemantauan IoT ia membolehkan pengguna memonitor keadaan robot melalui telefon atau komputer, ia akan mengurangkan masa yang diperlukan untuk memonitor robot secara manual, ia juga dapat menambahkan fitur penghalang penghalang untuk membolehkan robot berfungsi dengan lebih efisien.

ABSTRACT

In the world maket today the usage of robot are very common not only in the industrial field but also included in our daily life. As the autonomous mobile robot are became more and more famous this lately there are still a few robot that can be improvised. The common line follower robot that exist on the market now a days are more to education purpose but there still a few of industry using line follower robot as the transporter for heavy object and there are some week point that can be improve since the robot is used as transporter the monitoring of the system function to prevent fault is very important. The robot didnt have monitoring system that can allow the user to monitor the robot thus it is hard to monitor since it in the industry area. By implementing the IoT monitoring system it allow the user to moniter the condition of the robot through phone or computer it will reduce the time need to moniter the robot manually it also can added the obstacle avioding feature to allow the robot to function more efficiently.

DEDICATION

Dedicated to my beloved parents Mr. LIM JIN JOCK and Mrs. TEO CHOON BER, who have respected and supported me in everything I do.

Dedicated to Dr. Syed Najib bin Syed Salim, who taught and guided me throughout the journey of completing the final year project.

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LIST OF SYMBOLS

D, d	-	Diameter
F	-	Force
g	-	Gravity = 9.81 m/s
I	-	Moment of inertia
1	-	Length
m	-	Mass
N	-	Rotational velocity
P	-	Pressure
C	-	speed of sound
r	-	Radius
T	-	Torque
A	-	ampere
V	-	Velocity
w	-	Angular velocity
x	-	Displacement
z	-	Height
q	-	Angle

LIST OF ABBREVIATIONS

LFR	Line Follower Robot

CHAPTER 1

INTRODUCTION

1.1 Project Background

This project is to develop the controller that suitable for the line follower robot with IoT-Based monitoring system with infrared sensor and microcontroller. This line follower robot is a common autonomous robot that can travel from a location to another by following the line. It is commonly used on the industry for transporting item automatically with the help of this type of robot the item can be transport trough for a place to another without the manual control of a human. This type of robot usually need sensor to detect the line and follow the line that have been drown on the surface and it will start moving when the signal is given and react based on the line the turning will occur when the line is curved. The movement of the robot is controlled using motor and motor driver and can be program using microcontroller and the reacting of the robot can be improve using PID controller method. The IoT monitoring system is conduct by using NodeMCU microcontroller board that have ESP 8266 module build in to allow connection with internet and by setting up a cloud that allow information exchange between the phone, laptop and also the robot, instruction can be given to the robot and the condition or progress of the robot can be monitored. The line following robot will be adding obstacles avoids which allow the robot to avoid obstacles that occur at the front of the robot that will cause crash of the robot that will cause the damage to the item. The Arduino software is program using PID control method to smoothen the robot motor movement.

1.2 Problem Statement

Line follower robot is widely used on the industry to carry heavy or dangerous material or item that not suitable for human to carry. There are some problems that the robot facing when operating in the industry. There are some of the lines follower robot that didn't contain advance controller and causes the robot fail to travel smoothly when there is a turn or curve occur and there will have some error that create an unstable oscillation that cause fault to happen. When there is an interrupt on the travel path or obstacle that blocked the path, the user must spend a lot of time to check and monitor the condition of the robot. By implement the IoT-based monitoring system the user will allow to monitor the condition of the robot and the robot is allowed to feedback task progress to the user and sending fault report through the IoT-monitoring system.

1.3 Project Objectives

i. Develop a line follower robot which based on microcontroller with IoT Based monitoring system into the robot to monitoring the robot activities condition.

ii. Design PID controller for line follower.

iii. To analyse the performance to the system with difference type of controller and without controller.

1.4 Work Scope

To archive the objective of the project, there are several criteria that need to be consider:

i. Development of Line Follower Robot.

ii. Implementation of the IoT monitoring system to monitor the progress of the robot car.

iii. Implementation controller that suitable for the robot to smoothen the movement.

iv. PID tuning with trial error method and Ziegler-Nichols Method.

v. Compare the performance of robot with P, PD and PID controller as well as without controller.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This section will discuss the summaries overall of Line follower robot system with controller and the IoT based monitoring system. This chapter is to explain past research and existing research. This project is made up using microcontroller to control the movement of car robot and using infrared sensor and ultrasonic sensor as input to allow the robot to follow the line on the ground and avoid obstacles. This chapter will discuss the theory and the concept using to solve the project problem. Journal, articles, and case studies are the main sources of information.

2.2 Line Follower Robot

Line follower robot or LFR is a self-operating mobile robot that can detect the line that drawn on the floor which difference with the floor colour and follow the line, generally the path is predefined and can be visible as black line on a white surface with high contrasted colour or can be invisible like magnetic field depend on the sensor used (Pakdaman and Sanaatiyan, 2009; Pakdaman, Sanaatiyan and Ghahroudi, 2010).

The basic of LFR function is by capturing the line that been premade with sensor on the robot and the signal will be send to the microcontroller. In an act of millisecond, the microcontroller will send the signal to the motor driver and motor driver will control the rotation direction and speed of wheel and allow the robot to move in difference