UNIVERSITI TEKNIKAL MALAYSIA MELAKA

AUTOMATED GUIDED VEHICLE (AGV) SYSTEM WITH FLEXIBLE DIRECTION

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Engineering Technology (Industrial Electronics) (Hons).

by

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2015

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **Automated Guided Vehicle (AGV) System with Flexible Direction**

SESI PENGAJIAN: **2015/16 Semester 1**

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of the Bachelor Degree of Electronics Engineering Technology (Industrial Electronics) with Honours. The member of the supervisory is as follow:

……………………………….

(Shahrizal Bin Saat)

ABSTRAK

Kenderaan Berpandu Automatik (AGV) adalah sistem yang direka untuk melaksanakan perjalanan tanpa pemandu kenderaan. Kenderaan Berpandu Automatik (AGV) mengembangkan keberkesanan dan mengurangkan kos dengan berkhidmat untuk memekanisir kemudahan pembuatan atau gudang yang boleh mengurangkan kos dan tenaga kerja. Terdapat banyak sebab-sebab yang mendorong kepada penciptaan Kenderaan Berpandu Automatik (AGV) di seluruh dunia. Kebanyakan sebab itu adalah untuk mengatasi isu-isu logistik yang sering berlaku di tempat kerja dan untuk membuat penambahbaikan kepada kemudahan yang disediakan di tempat kerja. Kenderaan ini juga boleh digunakan dalam banyak kawasan terutamanya di kawasan yang berbahaya seperti di pelabuhan, tapak ukur dan tujuan ketenteraan. Ia mempunyai manfaat yang boleh memudahkan penggunaan tenaga fizikal kepada pekerja manusia dengan melakukan urusan tugasan yang memenatkan, sebagai contoh, mengangkat dan menghantar barang dengan lebih berkesan tanpa tanda-tanda keletihan atau menyebabkan masalah kesihatan. AGV ini boleh menjalankan tugas yang lebih berbanding pekerja manusia dan pergerakan mereka boleh dikesan secara elektronik pada setiap masa. Tujuan projek ini adalah untuk menghasilkan prototaip AGV yang autonomi sepenuhnya "AGV talian berikut" mampu mengikuti jalan yang pra-direka ditandakan pada permukaan. AGV ini mempunyai pergerakan yang fleksibel sewaktu melakukan pusingan, hanya roda yang diperlukan untuk berpusing tanpa mengganggu pergerakan badan.

ABSTRACT

Automatic Guided Vehicle (AGV) is a system designed to perform an unmanned travel of a vehicle. Automated Guided Vehicle (AGV) expands effectiveness and decrease costs by serving to mechanize a manufacturing facility or warehouse which can reduce costs and man power. There are numerous reasons which respect to the creation of an Automated Guided Vehicle (AGV) around the world. Most of the reason is to beat the logistic issues that frequently happened in the workplaces and to make improvement to the facilities provided in the workplaces. This vehicle can also be used in many area especially dangerous places such as at harbour, surveying and military purpose. It has the benefit which can facilitates the physical strain on human workers by performing tiring errands, for example, lifting and conveying overwhelming materials for more effectively with no indications of exhaustion inching in. This AGV can carry the task more than human workers and their movements can be tracked electronically at any times. The purpose of this project is to produce a prototype of an AGV that fully autonomous "line following AGV" capable of following a pre-designed path marked on a surface. This AGV has flexible movement which during a turning point, only the wheels that needed to turn without disturbing the body movement.

DEDICATIONS

Special dedication to my beloved parents,

To my siblings,

To the lecturers,

To all my course mates,

4BETE 2015/2016

Thank you for always supporting and helping me during the journey of completing this project.

Thank you for all the memories.

ACKNOWLEDGMENTS

In the name of Allah S.W.T, the most Gracious and Merciful, praise to Allah the Lord of the universe. May blessing and peace of Allah be upon His messenger, Muhammad S.A.W.

I would like to take this opportunity to extend my deepest gratitude to the following persons who helped me a lot in this project, which enabled me to complete my research project in time as a partial of the requirement for the Bachelor's Degree in Electronics Engineering Technology (Industrial Electronics) with Honours. First and foremost, a special thanks to my supervisor Mr. Shahrizal bin Saat, who helped me a lot for the project research, for all the support, continuous patience, and supervision given throughout the project.

A lot of thank you to every lecturer who had taken effort in advising, supporting, and guiding me as well as provision of the valuable time management, encouragement and patient during the time of completing this project.

Apart from that, thank you to my classmates with their encouragement and help. Last but not least, my special thanks, to my family members for their continuous support and advice from the early stage of my study.

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AGV	-	Automated Guided Vehicle
IR	-	Infrared
DC	-	Direct current

CHAPTER 1

INTRODUCTION

1.0 Introduction

This chapter will briefly discuss on the project background, the problem statement, its objective as well as the scope of the project. Furthermore, it will discuss about the projects significant which outline benefits that can be derived from the outcome of this project.

1.1 Background

An Automated Guided Vehicle (AGV) is a mobile robot that follows marker or wires in the floor, or uses vision or lasers. They are frequently utilized as a part of modern applications to move materials around a manufacturing facility or a warehouse. Automated Guided Vehicle (AGV) is a very important part of all, for it's a kind of delivery vehicle that can direct itself by following the program and the guide route to do the motions like moving forward, stopping and turning as well as to stop at the programed work stations and load, unload goods.

Automated Guided Vehicles (AGV) expand effectiveness and decrease costs by serving to mechanize a manufacturing facility or warehouse. Today, many types of guiding system for AGV have been proposed to control the AGV in performing unmanned travel. Usually, this vehicle can be used in many areas such as at harbour, surveying and military purpose. An example is a robot or an AGV that travel into a mine field to detonate a dangerous mine. Thus, the AGV that will be created could use flexible movement to achieve its destination.

1.2 Problem Statement

There are numerous reasons which respect to the creation of an Automated Guided Vehicle (AGV) around the world. Most of the reason is to beat the logistic issues that frequently happened in the workplaces and to make improvement to the facilities provided in the workplaces. Typically the AGVs are actualized in production lines, hospitals, workplaces, houses, and even can be discovered any places without the individuals encompass acknowledged it.

In the industries or factories, the AGV can facilitates the physical strain on human workers by performing tiring errands, for example, lifting and conveying overwhelming materials for more effectively with no indications of exhaustion inching in. This AGV can carry the task more than human workers and their movements can be tracked electronically at any times. Their movements can also be timed to encourage or gather items from the work cells in the factories.

This project is aiming to develop an Automated Guided Vehicle (AGV) which has the flexible wheel movement that will successfully navigate to a series of path defined by the user.

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1.3 Objective

The objective of this project is to create and develop an Automated Guided Vehicle (AGV) and the research will study on how the flexible direction of the AGV works. The objective of this project are:

i. To develop a system that will be sturdy enough to cover mostly flat terrain by having a flexible movement of wheels.

ii. To develop an AGV system that a fully autonomous "line following AGV" capable of following a pre-designed path marked on a surface.

iii. To design an Automated Guided Vehicle (AGV) that able to follow a path of points provided by user.

1.4 Scope of Work

The scope of this project is to create an AGV model that capable navigating to the point defined by user. This effect is to be done using IR sensor that allows the AGV to follow the path marked on a surface. The microcontroller will acts just like the brain for the model that controls all operation of the system.

The idea for the model is a four-wheeled mobile robot that has the ability to move by using flexible movement. There are four wheels including four driving wheels controlled by four motors. Each motor and wheel are implemented with servo motors. This include the IR sensor which also hold by a servo motor. The combination of this movement with the rotation of the wheel can move the AGV in any direction.

To develop the whole project, it consists of three methods which are the concept wheel turning, the electronics structure, and the software programming. The matter to be considered is how the robot can move base on a flexible movement of the wheel. It is also important to choose the most suitable microcontroller, actuators, and sensors to achieve the project objectives.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

In this chapter, reviews of researches which are related to this project will be discussed. This chapter will describe details about the literature review on the parts and systems used in this project. This chapter will provide the theory of the key components, AGV, IR sensor and servo motor. Furthermore, it will include the explanations and information of the components chosen for this project. This information is very useful to help the author to understand how these component functioning and their performance.

2.1 Automated Guided Vehicle (AGV)

Automated guided vehicle (AGV) is a mobile robot that follows markers or wires in the floor. Some of the AGV use vision, magnets, or lasers for navigation. AGVs are usually used in industrial applications to move materials around a manufacturing facility or warehouse. Application of the automatic guided vehicle has broadened during the late 20th century.

The first AGV was brought to market in early 1950s by Barrett Electronics of Northbrook, Illinois. The first AGV was simply a tow truck that followed a wire in the floor instead of a rail. In 1976, Egemin Automation (Holland, MI) had developed an automatic driverless control system for use in several industrial and commercial applications. This technology expands and then a new type of AGV which can follows invisible UV markers on the floor instead of being towed by a chain had been discovered. The first such system was deployed at the Willis Tower (formerly Sears Tower) in Chicago, Illinois to deliver mail throughout its offices.

Over the years the technology has become more sophisticated and today automated vehicles are mainly using laser navigation that able to communicate with other robots to ensure product is moved smoothly through the warehouse. Today, the AGV plays an important role in the design of new factories and warehouses, safely moving goods to the rightful destination.

In the industries, numerous components need to be transferred from place to place during the manufacturing process. These components widely vary according to their size and shape. AGVS are designed to meet the needs of definite industry. In this research, the robots were capable of handling cylindrical polystyrene blocks no more than 300 mm diameter. The operation of the interactions of the robots was based on an imaginary industrial environment where one of the robots picks up a block from a predefined loading place and supply it to the another robot after manoeuvring a certain distance. Then the other robot sensed the delivery and travelled a linear trajectory to perform final delivery of the block to unload it (Hossain, Ali, Jamil, & Haq, 2010).

The research presented in this paper approaches the issue of navigation using an automated guided vehicle (AGV) in industrial environments. The work describes the navigation system of a flexible AGV intended for operation in partially structured warehouses and with frequent changes in the floor plant layout. This is achieved by incorporating a high degree of on-board autonomy and by decreasing the amount of manual work required by the operator when establishing the a priori knowledge of the environment. The AGV's autonomy consists of the set of automatic tasks, such as planner, perception, path planning and path tracking, that the industrial vehicle must perform to accomplish the task required by the operator. The integration of these techniques has been tested in a real AGV working on an industrial warehouse environment (Martínez-Barberá & Herrero-Pérez, 2010).

Wireless communication is applied frequently in laser automatic guided vehicle (AGV) communication system, but at present the system usually adopts the wireless static central control mode in which vehicles of AGV system are controlled and managed by a center control unit and cannot communicate with each other. An AGV wireless control system based on wireless sensor network and mobile robots control is proposed to improve the intelligence and efficiency of AGV system, with this communication system all the vehicles are connected by wireless sensor network to implement inter-vehicle communication and distributed control, this enhances the degree of autonomy and flexibility of vehicles, and improves the efficiency of AGV system (Zhang & Pan, 2011).

In this paper, based on the neural network, fuzzy control and bang-bang control, an intelligent coordination control strategy for automated guided vehicle (AGV) steering system is presented. The dynamic steering model of distance error and orientation angle error for AGV is expressed. With least square method of system identification, the model of AGV is identified. Because a toy type of AGV is employed, its structure is simple, but AGV model parameters are variable according to the operating conditions and environment. In order to improve the dynamic performances of AGV, the intelligent coordinated control strategy is used to design the AGV controller in the AGV steering control system. Simulation and experimental results show the effectiveness of the proposed control strategy (Zhan, Guo, & Zhu, 2011).

2.2 DC Motor

DC motor give incredible rate control to speeding up and deceleration with successful and straightforward torque control. the way that the force supply of a DC motor join specifically to the field of engine considers exact voltage control, which vital with pace and torque control applications. A straightforward motor has six sections, armature or rotor, commutator, brushes, pivot, field magnet, and DC power supply or something to that affect.

The brushes go about as contacts between an outer force source and the commutator. The configuration of these carbon brushes permit them to climb and down on a brush holder, to make up for the anomalies of the commutator surface. Along these lines they are said to ride the commutator. The commutator controls current stream in the armature loops, permitting it to stream in one heading just. Every portion of the commutator is specifically associated with an armature loop. So the commutator pivots with the armature. In this undertaking the DC engines utilized for the development of the AGV. Figure 2.1 shows the standard DC motor.

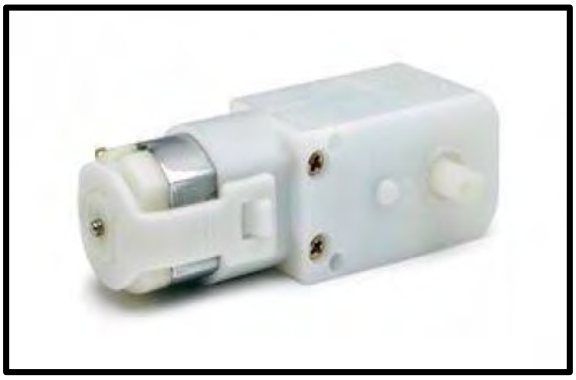

Figure 2.1: DC motor

2.3 Servo Motor

Servo motors are controlled by sending them continuous pulses of variable width. The signal wire is used to send these pulses. The parameters for these pulses are that it has a pulse width and the repetition rate. Given the rotation constraints of the servo (only 180 degree), neutral is defined to be the position where the servo has exactly the same amount of potential rotation in the clockwise direction as it does in the anti-clockwise direction. It is important to note that different servo motors will have different constraints on their rotation but they all have a neutral position, and that position can always be obtained when pulses with pulse width of around1.5 milliseconds (ms) is being sent.

The angle is determined by the duration of a pulse that is applied to the signal wire. This is called Pulse Width Modulation. The servo expects to see a pulse every 20 ms. The length of the pulse will determine where the motor turns and maintain itself. For example, a 1.5 ms pulse will make the motor turns to a 90 degree position (neutral position) and maintain itself there.

When these servos are commanded to move, they will move to the position and hold that position. If an external force pushes against the servo while the servo is holding a position, the servo will resist from moving out of that position. The maximum amount of force the servo can exert is the torque rating of the servo. Servos will not hold their position forever though; the position pulse must be repeated to instruct the servo to stay in position which is every 20ms.

When a pulse is sent to a servo that is less than 1.5 ms the servo rotates to a position and holds its output shaft some number of degrees anti-clockwise from the neutral point. When the pulse is wider than 1.5 ms the opposite action occurs. The minimal width and the maximum width of pulse that will command the servo to turn to a valid position are functions of each servo. Different brands, and even different servos of the same brand, will have different maximum and minimum valid position. Generally the minimum pulse will be around 1ms wide (some servos are 0.5ms) and the maximum pulse will be 2ms wide (some servo are 2.5ms). Figure 2.2 shows the example for servo motor in the market.