UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF AN AUTOMATED GUIDED VEHICLE

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

by

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2014

ABSTRAK

Tujuan projek ini adalah untuk mengkaji dan membangunkan sebuah kenderaan dipandu secara automatik (AGV) yang boleh mengangkat dan menarik troli seberat 300kg secara automatik menggunakan navigasi garisan. Tumpuan kawasan kerja AGV adalah di kawasan gudang . Oleh itu projek ini hanya tertumpu kepada pembangunan dan prestasi AGV. Di dalam projek ini, reka bentuk AGV menggunakan SolidWork 2012. Empat roda mecanum dengan 120W arus terus (DC) berus motor telah digunakan untuk menggerakan AGV dan bagi sistem navigasi digunakan penderia penentukuran maju. Penderia ini diletakan di hadapan AGV. Untuk penilaian prestasi AGV, data telah dikumpulkan dengan menandakan kawasan yang AGV telah lalui untuk mencapai matlamat sasaran dua titik di kedudukan (titik bermula) ke titik yang lain (titik berakhir). Data yang telah dikumpulkan dan derekodkan setiap 40cm untuk mendapatkan pergerakan AGV sebenar. Untuk memastikan kejayaan penilaian navigasi, proses pengukuran data akan dijalankan sebanyak 5 kali. Hasiln simulasi ditunjukan dalam gambar,jadual dan garf. Pada masa yang sama AGV boleh mengangkat dan menunda troli 300kg.

ABSTRACT

The purpose of this project is to study and develop an Automated Guided Vehicle (AGV) that can lift and tow a trolley 300 of kg weight automatically using the line navigation. The focus working area of AGV is at the warehouse. Therefore, this project focuses on the development and performance of AGV. In this project, the SolidWork was used in designing the AGV. Four mecanum wheels with 120W DC brush motor were used to move the AGV and an Advance Calibration Sensor was used as the guidance system. This sensor was placed at the front of AGV. In archive the AGV performance, data was collected by marking the area that AGV in achieving to reach a target goal of two position point (start point) to another point (last point). Data was recorded every 40cm to get the actual movement of AGV. In ensuring the success of navigation, the process of data measurement was conducted 5 times. The results are shown in pictures, tables and graph. At the same time the AGV can lifting and towing a trolley 300 kg.

DEDICATION

For my father Ahmad bin Hj Bahari and my mother Zaiton bt Awang

and my family,

Their loving and unconditional support throughout my life.

Without whose love and supported this may not be completed.

And also for those I love very much.

ACKNOWLEDGEMENT

First of all, I would like to express a thousand of thank to my Project Sarjana Muda supervisor Dr. Fairul Azni bin Jafar for teaching and guiding me throughout of the project. He not only provides me valuable knowledge but also his own private times to help us overtake any difficulty during the study.

Secondly, I would like to say thanks to my family for supporting me all the time without knowing the meaning of tiredness. Thank you for the warm care that provided by them in every moment of my life.

Thirdly, not forgotten language advisors Madam Teh Zanariah binti Mohd Raus and Madam Nadiah binti Zainal Abidin are not give up for teaching and guiding me about writing project reports ways until successfully.

Finally is a special thanks to my lecturer Mr. Mahasan Mat Ali, assistant engineer mechatronic laboratory , Mr Muhamad Asari bin Abdul Rahim, my friends especially Rozaimi bin Sabri and Mohd Aidil bin Othman for giving ideas to helping and supporting me in completing this project.

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LIST OF ABBREVIATIONS

AGV	-	Automatic Guided Vehicle
DC	-	Direct Current
PIC	-	Programmable Integrated Controller
SLA	-	Seal Lead Acid battery
RPM	-	Rotation per Minutes
LED	-	Light-emitting Diode
GI		Galvanized Iron
kg		kilogram
m		meter
cm		centimeter
mm		millimeter
V		Voltage

CHAPTER 1

INTRODUCTION

New inventions, manufactures and designs come from multiple ideas that are generated into large concept and futuristic thinking. The process development of the product requires a lot of time, cost and effort. Therefore, it requires a high attention to make it success. The development and design of Automated Guided Vehicle (AGV) is an invention to improve quality and performance. The goal of this project is to develop an AGV Unit Load Vehicles and keep the AGV on track or predefined path. Easy in modification of guidance system is the major advantage of changing the guide path at a lower cost compared to chains, conveyors and others. Usually, AGV navigation is used by wired, guide tape, laser target navigation and others.

1.1 Background

An automated guided vehicle system (AGVS) is a material handling system that use independently operated, self – propelled vehicles guided along defined pathways. The vehicles are powered by on – board batteries that allow many hours of operation (8-16 hour is typical) before needing to be recharged. A distinguishing feature of AGV, compared to rail–guided vehicle systems and most conveyor systems, is that the pathways are unobtrusive. AGV is appropriate where different materials are moved from various load point to various upload points. AGV is therefore suitable for automating material handling in batch production and mixed model production.

In early 1950's AGV has been introduced, the numbers use of AGV has increased along with the application areas and types (Hamid *et. al.*, 2009). Usually in a storage or warehouse, the operators supply all part required to maintain productivity in the production lines to assembly. The use of AGV in production lines will increase the speed of the production lines. The AGV is now found in all types of industries, with the only restrictions on their use mainly resulting from the dimensions of the goods to be transported considerations (Ali, 2003). Many applications of AGV are technically possible, but the purchase and implementation of such systems are usually based on economic considerations (Chew *et. al.*, 2009).

Nowadays, AGV is very important in production and is widely used in automated Material Handling System (MHS), Flexible Manufacturing System (FMS) and even in container terminals to transport containers. The vehicles can automatically perform loading, routing selection, and unloading process. The system is highly complex and expensive. To realize the full potential, it is essential to design, plan, schedule, and control the system efficiently.

Currently, many companies are still employing human to do the trolley towing task. This is not as effective as the usage of AGV. Operators are prone to error and problem will likely to occur. Hence, it is believed that the application of AGV in the manufacturing industry would help to solve this problem.

1.2 Problem Statement

Currently, trolleys in production line especially in storage area or warehouse are pushed by the operator on irregular intervals. As impact of those problems, it will slow down the production line process. Therefore, a possible solution for this problem is to replace the operators with AGV. This is will eventually lead to increase in the production process, profit, reduce time and save cost. Through out the AGV has a progress on many levels and stages. However, it is very expensive to develop a new AGV product. The development of AGV product requires a lot of extra cost. Hence, by fabricating the AGV it will take a lot of time and cost to fabricate the AGV product.

1.3 Objectives

The objectives of this project are:

i. To develop a AGV Unit Load Vehicles.
ii. To analyze the navigation performance of developed AGV

1.4 Scope

The main target of this project is to develop a prototype new AGVS Unit Load Vehicle that able to lift and tow a trolley with maximum load of 300 kg. The navigation of AGV only focusing line following methods such as forward and reverse movement, left and right turn. However some of criteria such as speed, material selection, actuators selection, power consumption and localization are not considered.

1.5 Organization

Chapter 1 in this project consists of background, problem statement, objectives, scope and organization that are relate with AGV. Meanwhile Chapter 2 consists of literature review study which describes the related works of AGV. After that Chapter 3 describes the methodology used in this study including the overall flow chart and also a Gantt chart to highlight of the project. The progress will provide explanation regarding process of completing this project. Besides that, Chapter 4 presents the developing of AGV from beginning until finish. Chapter 5 also presents the results and analysis of the navigations performance. Lastly Chapter 6 that concludes the project by presenting the final outcome and achievement of this project and states future work that could further improve the outcome of this report.

CHAPTER 2
LITERATURE REVIEW

This chapter focuses on the features of Automated Guided Vehicle (AGV). Section 2.1 of this report will explain the introduction of AGV, section 2.2 will explain about type of AGV, section 2.3 will explain about AGV applications, section 2.4 will explore the navigation of AGV and followed by section 2.5 summary of this chapter.

2.1 Introduction of the Automated Guided Vehicle (AGV)

AGV is very important in product and moving material for more than 50 years. The first AGV was introduced and invented by Barrett Electronic in 1953. It was a modified towing tractor that was used to pull a trailer and follow an overhead wire in a grocery warehouse. Towing AGV was in operation and production in many types of warehouse by the early 1960's and late 1950's. In mid 1970's, the first big development of AGV was the unit load vehicle. This unit load AGV was very popular and gained widespread acceptance in material handling marketplace because their abilities to serve several functions. Hence, AGV has evolved into complex material handling transport by using laser and natural target navigation technologies.

According to Tanchoco and Bilge, (1997) AGV is a material handling in manufacturing system is becoming easier as the automated machine technology has improved. One of the material handling methods that has been widely used in most industry nowadays is the Automated Guided Vehicle System or better known as the AGV. It has become one of he fastest growing classes of equipment in the material handling industry. AGV is one type of Material Handling Equipment (MHE) like conveyors, cranes & hoists, elevator & lifts, automatic storage & retrieval system and so on which are focuses on process of transferring something from one place to another places especially in industrial sector or industrial warehouse. Actually, the goals to maintain or improve product quality reduce damage and provide protection of materials, promote safety and improve working condition, promote productivity, control inventory and so on. For further information, AGV is a driverless vehicle capable of moving along predetermined paths and performing certain prescribed duties. AGVs have become increasingly popular as a means of horizontal material handling transportation system. They are used wherever there is a need for an autonomous transportation system. AGV are particularly useful where products need to be handled carefully or the environment is potentially dangerous to humans. Examples include handling of telecommunication products, IC chips, voltage cables and radioactive materials. In the automotive manufacturing industry, AGV have been combined with robots to perform welding and painting operation. (Yaghoubi, et. al.2012). Now in the modern technology there are many researchers that have shown interests in improving the system in order to achieve more profit, productivity and flexibility in manufacturing environment.

Groover, (2008) stated that AGV is used for the internal and external transport of materials (refer Figure 2.1). Usually, AGV is mostly used in manufacturing systems. The AGV is also used for repeating transportation tasks in other areas, such as warehouses, container terminals and external transportation systems.

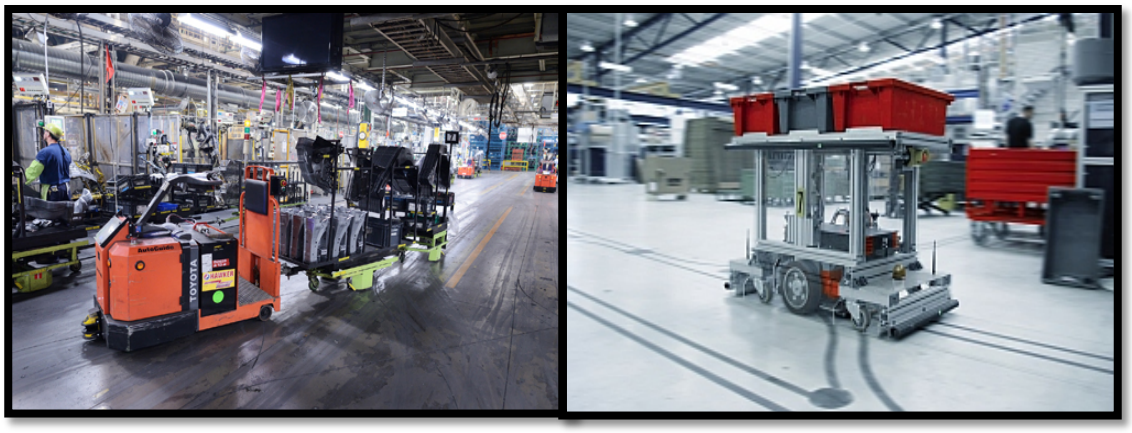

Figure 2.1 AGV used in internal logistic. (Groover, 2008).

2.2 Types of Automated Guided Vehicle (AGV)

Automated guided vehicles can be divided into three categories:

i. Driverless Trains
ii. Pallet Trucks
iii. Unit Load Carriers

2.2.1 Driverless Trains

Driverless trains consist of a towing vehicle pulling one or more trailers to from trains (refer Figure 2.2). It was the first type of AGV to be invented and it still widely used today. A common application is moving heavy payloads over long distance in warehouse or factories with or without intermediate pickup and drop-off point along the path. For trains consisting of five to ten trailers, this is an efficient transport system (Groover, 2008). Towing vehicles can pull a multitude of trailer types and have capacities ranging from 8,000 pounds to 60,000 pounds (Yaghoubi et.al. 2012).

The tugger, or tow-train AGV, has a design similar to standard tow tractors (Dziwis, 2005).

Figure 2.2 Driverless automated guided trains.
(http://www.aziendainfiera.it/en/p/veicolo-guida-automatica-scaglia-indeva)

2.2.2 Pallet Trucks

Automated guided pallet trucks, (Figure 2.3), are used to move palletized loads along predetermined paths. In the typical applications the vehicle is backed into the loaded pallet by human worker who steer the truck and use its forks to elevate the load slightly. Then the worker drives the pallet truck to the guide path and programs it is destination and the vehicle proceed automatically to the destination for unloading. The capacity of an AGV pallet truck ranges up to several thousand kilogram, and some trucks are capable of handling two pallets rather than one (Groover, 2008). Designed to transport palletized loads to and form floor level, eliminating the need for fixed load stands (Yaghoubi et. al. 2012). Conventional forked vehicles have standard fork truck masts (hydraulic or ball-screw) and forks integrated into their design. The interface between the AGV and load is made via the pallet or container fork pocket tractors (Dziwis, 2005).

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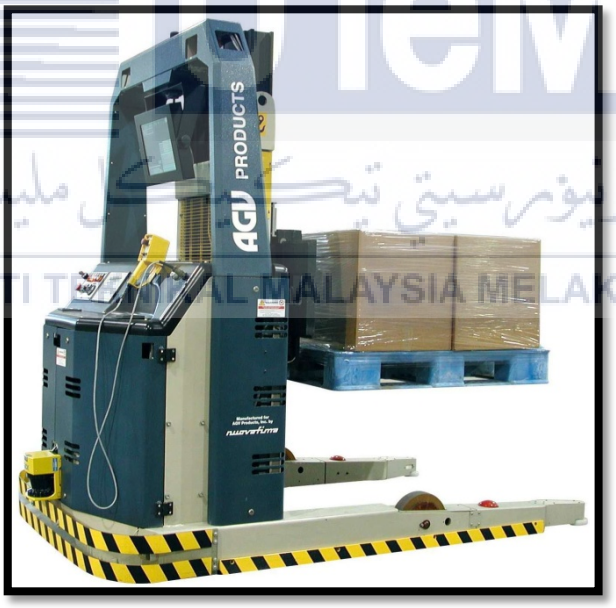

Figure 2.3 AGV pallet truck.
(http://cfnewsads.thomasnet.com/images/large/022/22384.jpg)