"I hereby declared that that I have read through this report and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Control, Instrumentation & Automation)"

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AUTOMATED GUIDED VEHICLE (AGV)
USING PLC SYSTEM

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This Report Is Submitted In Partial Fulfillment Of Requirements For The Degree of Bachelor In Electrical Engineering (Control, Instrumentation & Automation)

Faculty of Electrical Engineering
Universiti Teknikal Malaysia Melaka

APRIL 2008

DECLARATION

"I hereby declared that this report entitled 'Automated Guided Vehicle (AGV) using PLC system' is a result of my own work except for the excerpts that have been cited clearly in the references."

Signature : 

Name : MOHD ASRAF BIN JASNI

Date : MAY 2008

DEDICATION

For my beloved mother, Siti Alama binti Ibrahim and father,
Jasni bin Yusof

ACKNOWLEDGEMENTS

Alhamdulillah, I am grateful to almighty Allah S.W.T because at last I have finished my Bachelor Degree Project and my report without any problem. It is difficult to finish this Bachelor Degree Project and report without the help.

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Thank you.

ABSTRACT

This project is about the design and implementation of loading and unloading process of an Automated Guided Vehicle (AGV) using the Programmable Logic Controller (PLC) system. It comprises of integrated between Programmable Logic Controller (PLC), sensors, Direct Current (DC) electrical motor, conveyor system, and pneumatic system. The function of an AGV is to carry loads or work parts from one station and unload the loads or work parts at other station. Pneumatic system is used in the loading station to transfer loads or work parts to the AGV. There is a small conveyor system on the AGV which is used in the loading and unloading process. The AGV moves from one station to other station using the DC electrical motor with a driver or controller that control the speed of the motor. Line follower sensor is used in this AGV to detect line as a route in carrying the loads. This AGV use Programmable Logic Controller (PLC) as a master controller.

ABSTRAK

Projek ini adalah mengenai merekabentuk dan pelaksanaan bagi proses pemuatan dan pemunggahan (loading and unloading process) yang ada pada kenderaan terpandu automatik (Automated Guided Vehicle) dengan menggunakan sistem pengawal logik aturcara (PLC). Ia terdiri daripada integrasi antara pengawal logik aturcara (PLC), penderia, motor elektrik arus terus, sistem pengangkut (conveyor system), dan sistem pneumatik. Fungsi kenderaan terpandu automatik ini adalah untuk membawa beban atau bahan kerja dari satu stesen ke stesen yang lain. Sistem pneumatik digunakan di stesen pemunggahan (loading station) untuk menolak beban ke kenderaan terpandu automatik. Terdapat sistem pengangkut (conveyor system) berskala kecil pada kenderaan terpandu automatik yang digunakan dalam proses pemuatan dan pemunggahan (loading and unloading process). Kenderaan terpandu automatik ini bergerak dari satu stesen ke stesen yang lain dengan menggunakan motor elektrik arus terus berserta pengawal kelajuan motor. Penderia garisan digunakan pada kenderaan terpandu automatik untuk mengesan garisan sebagai laluan ketika membawa beban. Kenderaan terpandu automatik ini menggunakan pengawal logik aturcara sebagai pengawal utama.

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AGV	-	Automated Guided Vehicle
AGVS	-	Automated Guided Vehicle System
PLC	-	Programmable Logic Controller
PIC	-	Programmable Interface Controller
LED	-	Light-Emitting Diode
IR	-	Infra Red
AC	-	Alternating Current
DC	-	Direct Current
IL	-	Instruction List
SFC	-	Sequential Function Chart
I/O	-	Input or Output
FMS	-	Flexible Manufacturing System
CPU	-	Central Processing Unit
RAM	-	Random Access Memory
ROM	-	Read Only Memory
TRIAC	-	TRIode Alternating Current
SPST	-	Single Pole Single Throw
SPDT	-	Single Pole Double Throw
DPST	-	Double Pole Single Throw
DPDT	-	Double Pole Double Throw
QPDT	-	Quadruple Pole Double Throw
RS 232	-	Recommended Standard 232
GSM	-	Global System for Mobile communication

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Automated Guided Vehicle or Automatic Guided Vehicle (AGV) is a mobile robot used in industrial application to move work parts or loads around a manufacturing facility or warehouse. It usually used for a repetitive task. AGV is capable of completing any tasks that are not capable to workers. In this project, AGV is used to execute the loading and unloading process of a work part or load. Therefore, it can become a prototype of an integrated system which comprises of programmable logic controller (PLC) and other mechanism such as sensors, conveyor system, and pneumatic system.

1.2 Project Overview

The project is to implement the hardware of an Automated Guided Vehicle (AGV) prototype and also the loading and unloading process. The software application is also used in this project. The most important things in this project are the integration between Programmable Logic Controller (PLC), sensor, Direct Current (DC) electrical motor, conveyor system, and pneumatic system. The OMROM PLC is used to control the whole sequence of the process except the pneumatic system that manually control by operator. This project is divided into two sections which are mechanical part and electrical part. The mechanical parts are consisting of mechanical drawing, measuring, and fabrication process. The electrical parts are consisting of electrical drawing, electrical wiring, and programming.

1.3 Problem Statements

There are several reasons why this AGV model is designed. In industry, workers cannot carry large load in a single task. Thus, AGV is designed to take the advantage that can carry large load in a single task in a long distance route. Human or workers cannot work for a long period. Workers usually work for 8 to 10 hours per day. Thus, AGV can be used to prevent this problem and works for 24 hours per day. So, the productivity can be increased. A truck or forklift usually moves depend on the operator that drives on it. This makes the speed of the truck or forklift will vary according to the operator. This situation can make the product to be damaged because the speed increases and decreases abruptly. So, AGV is the best solution because it moves in a constant speed without operator and moves in a fixed route. Most of the system in factory using integrated system between PLC and industrial robot. Thus, this AGV model can be used as an introduction about the integrated system between PLC and other mechanisms.

1.4 Objectives of the Project

1. To implement loading and unloading process on the AGV.
2. To be able makes programming for the PLC.
3. To implement the hardware installation, electrical wiring, and mechanical mounting to control the sequence of the system.
4. To acquire experience in system design, electrical wiring, mechanical mounting and troubleshooting.

1.5 Project Scope

Scope of the project can be defined as what will be covered in the project developed. The project scope of this project is:

i. Design and develop the complete automated system that is used to apply the loading and unloading process in term of hardware and software development.

ii. Hardware development and implementation consists of the chassis of the prototype AGV, line following sensor to detect black pathway, DC electrical motor to drive AGV, conveyor system for loading and unloading process, and pneumatic system to transfer loads or work parts to AGV.

iii. The programming or software development and implementation of OMRON CX-Programmer version 6.0 software for OMRON PLC.

CHAPTER 2

LITERATURE REVIEW

2.1 First Review: Development Of An Automated Guided vehicle (AGV) With An Obstacle Avoidance System (Shivendra Kumar)

Automated Guided Vehicle (AGV) is a mobile robot that is used in a manufacturing facility. It uses guided path for navigation which is mono-directional or bi-directional. AGV halts upon seeing object or obstacle in its path. This research is about designing and developing an AGV with line tracing and obstacle detecting capabilities and implements a suitable obstacle avoidance algorithm.

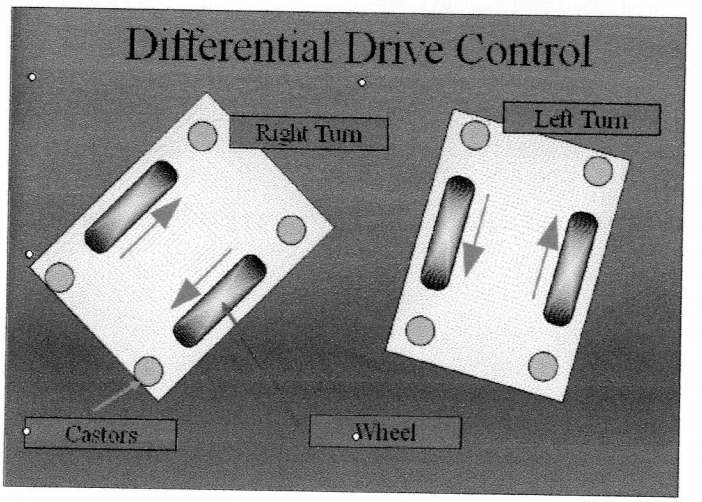

Figure 2.1: Differential drive control

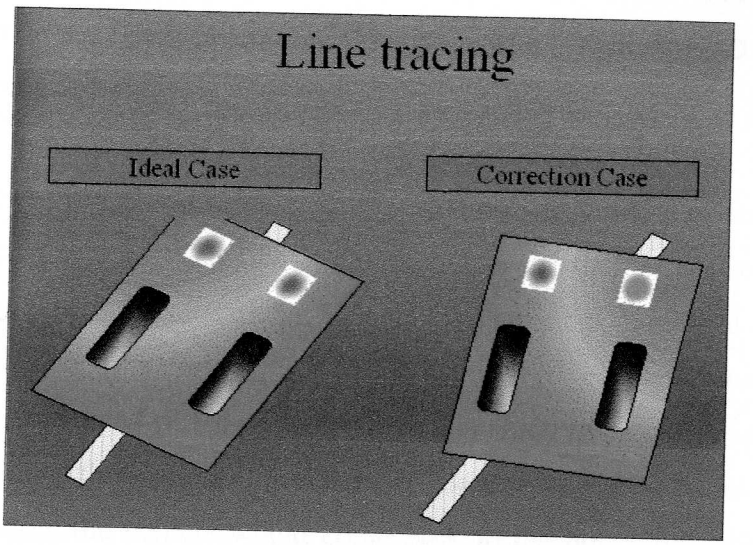

Figure 2.2: Line tracing

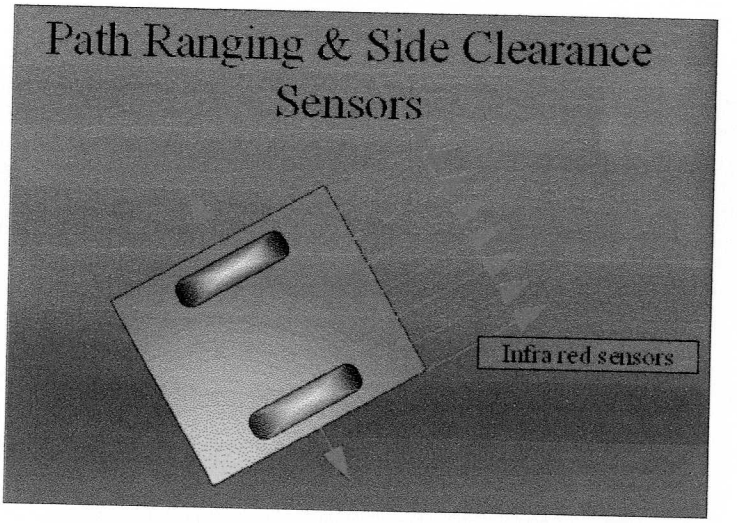

Figure 2.3: Path ranging and side clearance sensors

2.2 Second Review: Study To Determine The Need For Innovative Technologies For Container Transportation System (Dr. Lazar N. Spasovic, 2004)

AGV is assumed that vehicles similar to those currently in operation in ECT, Rotterdam would be used. Vehicles would operate in the shuttle service between the port terminal and intermodal stations. Vehicle assignment is sequential - they would pick up the container at the origin point and transport it to the destination point. After the container is unloaded (lifted off), the vehicle is ready to pick up a new container and transport it in the opposite direction. If there were no backhaul load in the intermodal station, the vehicle would come back to the port terminal empty. Each AGV can carry one 40ft container. Operating parameters for AGV are determined based on specifications obtained from manufacturer of vehicles.

Figure 2.4: Kőgel Kamag AGV for Port of Singapore

2.3 Third Review: Final Project Report, INTI College Malaysia

Automatic Guided Vehicle (AGV) is a vehicle that is programmed to automatically drive from one point to another to transfer inventories and loads. In this report, the structures of AGV along with its features were described. A detailed description on the construction of the body to meet the requirement is mentioned as well as the subsystem. The circuit of the subsystem consists of Infra-Red line follower sensors, Infra-Red Light Barrier, motor controller, battery charging circuit and battery voltage indicator. The software implemented for Programmable Interface Controller (PIC) that integrates the whole subsystems is MicroBasic. A functional AGV requires a high-level of understanding on the programming code and configuration of PIC circuit. The appendix contains some useful information about the AGV.

2.3.1 Line Follower Sensor

Infrared sensors send out signal, in this case is Infrared light and information found in the reflected signal can be used to make inferences about the shape of the environment. Infrared sensors detect radiation reflected and emitted at wavelengths longer than visible light. The LEDs that have been fixed to each pair of IR LEDs will light up to indicate that the sensors have sensed the line. After receiving the IR beam, the signal which is '1' or '0' is sent to PIC. The AGV will move according to the output given by the PIC.

2.3.2 Infrared Light Barrier

For this system the IR transmitter LEDs should be pointed in the same direction as the IR receiver and at the same level. The emitters send signal (infrared beam). When an object comes near the device, the IR light from the LEDs is reflected by the object onto the module and hence the circuit gets activated. The receiver gets the signal then sends the information to PIC. At certain distance that has been set in the programming, the LED starts blinking to signify that there is an object near to AGV. It will continuously light when the distance of the object and AGV is close enough. Then the AGV will stop moving.

2.4 Fourth Review: Internet Article, Automated Guided Vehicle

The Automated Guided Vehicle or Automatic Guided Vehicle (AGV) is a mobile robot used in industrial applications to move materials around a manufacturing facility or a warehouse.

2.4.1 Navigation

AGVS in Flexible Manufacturing System (FMS) are used to transport an object from point A to point B. AGVS navigate manufacturing areas with sensors. There are two main sensors AGVS use for navigation, a wired and a wireless sensor. There are four types navigation which are:

1. Wired
2. Laser Target Navigation
3. Gyroscopic Navigation
4. Steering Control

2.4.2 Path Decision

AGVS have to make decisions on path selection. This is done through different methods:

1. Frequency select mode (wired navigation only)
2. Path select mode (wireless navigation only)
3. Magnetic tape mode

2.4.3 Vehicle Type

There are six types vehicle of AGV which are:

1. AGVS Towing Vehicles
2. AGVS Unit Load Vehicles
3. AGVS Pallet Trucks
4. AGVS Fork Trucks
5. Light Load AGVS
6. AGVS Assembly Line Vehicles