DESIGN AND DEVELOPMENT OF VISION GUIDED HEIGHT ADJUSTABLE CONVEYOR PLATFORM ON AUTOMATED GUIDED VEHICLE

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This report submitted in accordance with requirement of the University Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering

(Robotics & Automation)(Hons.)

by

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I hereby, declared this report entitled "Design and Development of Vision Guided Height Adjustable Conveyor Platform on Automated Guided Vehicle" is the results of my own research except as cited in reference.

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Author's Name : MUHAMMAD RAFIQ BIN ABDUL RAHIM

Date : 22 June 2017

APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of Universiti Teknikal Malaysia Melaka as a partial fulfilment of the requirements for the degree of Bachelor of Manufacturing Engineering (Robotics & Automation) (Hons.). The members of the supervisory committee are as follow:

……..

(DR. MOHD HISHAM BIN NORDIN)

ABSTRAK

Kenderaan berpandu automatik (AGV) adalah satu sistem automasi yang merupakan kenderaan tanpa pemandu, kebanyakannya digunakan dalam pemasangan 'Flexible Manufacturing Systems' (FMS). Perkara utama dalam kajian ini adalah untuk membuat AGV dengan keupayaan menyesuaikan ketinggian platform penghantar yang berada di bahagian atas AGV. Perisian seperti SOLIDWORK akan digunakan dalam tujuan ini untuk mereka bentuk beberapa pilihan dan seterusnya memilih satu yang terbaik berpandukan kriteria dan spesifikasi tertentu. Kajian ini terdiri daripada integrasi elektrik, mekanikal, dan reka bentuk disamping untuk membina dan menguji AGV termasuklah mekanisma seperti sensor, kamera penglihatan (pixycam), penghantar dan jack pengangkat elektrik untuk menjadikannya lebih fleksibel. Pengawal mikro seperti Arduino Uno dan Arduino Mega telah dikaji, diprogramkan dan dipasang sebagai kawalan daripada AGV. Ia telah direka dengan cara yang mudah untuk membuka atau diubah suai untuk menjadi lebih cekap. Di dalam projek ini, beberapa ujian telah dijalankan untuk menguji dan menganalisis prestasi AGV. Salah satu eksperimen yang telah dijalankan, warna hijau yang mempunyai saiz penanda 5cm x 5cm dipilih untuk pengesanan kamera menggunakan kamera Pixycam kerana keberkesanan warna ini untuk dikesan oleh kamera dan mencegah dari warna yang tidak dikehendaki berbanding warna lain. Di samping itu, ujian beban seberat 30 kg (maksimum) telah dipilih dan diuji dalam eksperimen ini untuk memerhati pergerakan (masa yang diambil) ketinggian boleh laras untuk AGV ini untuk bergerak ke atas atau bergerak ke bawah. Akhir sekali, ujian AGV mengikut garisan telah dijalankan pada kelajuan tertentu untuk bergerak lurus dan pada masa yang sama selaraskan ketinggian platform penghantar AGV dengan ketinggian platform penerima untuk proses menghantar dan menerima barang.

ABSTRACT

An automated guided vehicle (AGV) is an automation system which is a driverless vehicle, mostly used in several Flexible Manufacturing Systems (FMS) installations. The main item in this study is to make an AGV with the capability of adjusting the height of a conveyor platform attached on it. Software such as SOLIDWORK will be used in this purpose basically to design several options and to choose the best by following specific criteria and specifications. This study includes the integration of electrical, mechanical, and design for build and testing of the AGV including mechanisms such as sensors, vision camera (pixycam), conveyor and electric jack lifter to make it more flexible. Microcontrollers such as Arduino Uno and Arduino Mega have been studied, programmed and installed as the controller of the AGV. It has been designed in a way that can easily be disassembled or modified to become more efficient. For this project, several testings have been conducted to test and analyse the performance of the AGV. In this experiment, green colour which have marker size of 5cm x 5cm are selected for camera detection using Pixycam camera due to the effectiveness for camera to detect and prevent from unwanted colour compared to other colours. Besides, load testing of 30 kg (maximum) have been selected and tested in this experiment to observe the performance (time taken) of height adjustable for this AGV to move upward or move downward. Finally, line following testing have been conducted at a certain speed to move straight and to align the AGV conveyor height with the receiver conveyor's height for loading and unloading process.

DEDICATION

Specially dedicated to my beloved family, supervisor, Perodua supervisors industrial training(PEMSB), lecturers, seniors and friend who have guided and inspired me through my journey in education. Also thank you to their support, beliefs and motivation.

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LIST OF ABBREVIATIONS

AGV	-	Automated Guided Vehicle
CCD	-	Charge coupled device
ISO	-	International Standards Organization
SPI	-	Serial Peripheral Interface
UART	-	Universal Asynchronous Receiver/Transmitter
LED	-	Light-emitting diode
CSI	-	Camera Serial Interface
ANSI	-	American National Standards Institute
PIC	-	Peripheral Interface Controller
COFF	-	Common Object File Format
USB	-	Universal Serial Bus
DNS	-	Domain Name System
NTP	-	Network Time Protocol
CPU	-	Central processing unit
IDE	-	Integrated development environment
PWM	-	Pulse Width Modulation
ICSP	-	In-Circuit Serial Programming
PSM 1	-	Projek Sarjana Muda 1
PSM 2	-	Projek Sarjana Muda 2
AISI	-	American Iron and Steel Institute

LIST OF SYMBOLS

cm^2	-	Centi Metre Square (Area)
lbs or lb	-	Pounds
ft	-	Feet
ft/min	-	Feet per minutes
m/s^2	-	Metre per second squared
mV	-	Millivolts
°C	-	Degree Celsius
mA	-	Milli Ampere
mm	-	Millimetre
V	-	Volt
m	-	Meter
MPA	-	Megapascal
F	-	Farad

CHAPTER 1

INTRODUCTION

1.1 Background Of The Study

Nowadays, several types of industries have practiced the technology of automated guided vehicle (AGV) as the medium or transportation for material or product from one location to another location. The technology of AGV has been in existence since 1953, and this system was first introduced in the 1960s for industrial applications (Yaghoubi et al. 2012).

However, more than fifty years this system are known, a time in which various improvement have been made between actuators and energy supplies to entirely new sensor concepts. But these improved technologies are available mostly to the developed countries where applications of robotics are commonly applied. For the developing or underdeveloped countries, application of robotics is not very famous even in the field of industry. Low labour cost plays an important role for this situation in such countries. However, when the production speed and accuracy are not to be sacrificed, application of automation gives a solution. In the other hand, this is also true for cases with potentially hazardous industrial environments which may harm human workers (Ali et al. 2010).

Besides, the advantages of this system of automation technology can increase the reliability and reduced operating cost, means that it can reduce the manpower and also avoid from injuries in order to prevent loss of human lives by limiting human involvement in the

plant area. Currently, this system is widely used in industry to have a better process workability and completing the process as per schedule. There are many types of AGVs that can be seen at much type of industries, but mostly are used as transportation for supplying parts, materials, and products. The AGVs are capable of performing the tasks with fully automated at low cost. But in the other situation, these systems also need the backup AGVs in case the current AGV are not functioning or not good. This is to avoid from interrupting the process and effecting the production.

Figure 1.1: Industrial AGV (August 5, 2015, the fabricator.com)

The application of automation components such as line following sensors, proximity sensor and the others are mostly used in AGV compared to the system which use vision guided and height adjustable conveyor platform on AGV. Currently, the industries such as automotive industry are mostly using separated conveyor platform with AGV. Therefore, lifter, turntable, and conveyor are separated with AGV to supply the parts in production as shown in Figure 1.2. It shows (Figure 1.2) that turn table and lifter are separated which to supply the parts to the production line (conveyor line). In this case it uses sensors such as limit switch as a signal to receive or send the parts for the next process. However, the parts are supplied from the manpower manually using the trolley and these processes are repeated.

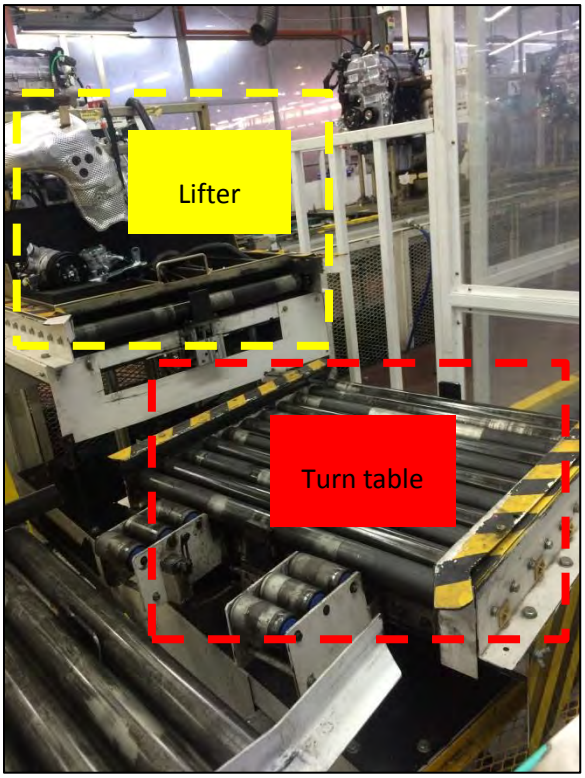

Figure 1.2: Lifter and Turn Table

1.2 Problem Statement

The current automation is not communizing the AGV, conveyor and lifter according the process tact time, efficiency and human factor. At manufacturing system, manual trolley vehicle are used to transport the parts or components from the rack and deliver it at the unloading station manually and this process is performed repeatedly. This method will affect the tact time and efficiency of the production, therefore the process become inconsistent because of the operators need to load the parts into the trolley and unloading it at the lifter and turntable station for the next process. This method will be done repeatedly and can affect the human health due to human factor because of manually parts loading it by operator. It can cause the operator to have a back pain and this can influence the efficiency of the process.

Therefore, for loading, unloading, moving or transporting horizontally any kind of raw materials, products or parts in assembly lines or manufacturing lines should be

developed. Utilization of components such as sensors, vision guided, conveyor, lifter and others will be used in this study by combining the electrical, mechanical and design as countermeasure in this case.

1.3 Objective

The main objectives for this study are:

- To design and develop a height adjustable mechanism for conveyor platform on AGV with camera attached.
- To program and control the AGV
- To test and analyse the performance of the AGV.

1.4 Scope

The scopes for this study are:

- The AGV will only be programmed to move in straight line with guided line or navigation system.
- It will use Pixycam camera with arduino microcontroller which is readily available in the lab.
- The camera is fixed and can only detect colour.