UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Faculty of Manufacturing Engineering

AUTOMATED PALLETS TRACKING SYSTEM FOR MANUFACTURING ASSEMBLY AREA

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Master of Manufacturing Engineering
(Manufacturing System Engineering)

2013

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A thesis submitted
in fulfillment of the requirements for the degree of Master of Manufacturing Engineering (Manufacturing System Engineering)

Faculty of Manufacturing Engineering

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2013

DECLARATION

I declare that this thesis entitle Automated Pallets Tracking System For Manufacturing Assembly Area is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : .....

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfilment of the requirements for the degree of Master of Manufacturing Engineering (Manufacturing Systems Engineering). The member of supervisory committee is as follow:

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ABSTRACT

Efficiency in production job floor is a very important element for manufacturer to keep their company competitive. A good material handling system and good inventory control system are some of the factors that can contribute to high efficiency of production job floor.The purpose of this study is to solve a real industry-related problem in material handling that affect production efficiency at PHN Industry Sdn Bhd. The problem currently being faced at PHN is that the pallets are not available at the right time as needed due to the absence of a system that monitors the movement of these pallets based on some pre-define schedules. The problem can be solved by developing an Automated Pallets Tracking System. This study involved software and hardware development. The system used Radio Frequency Identification Devices (RFID) as identification and tracking device. The Visual Basic Programming is used to design Graphic User Interface (GUI) system while Microsoft SQL is used as pallets database. The Arduino Microcontroller is used as interface medium for RFID system and GUI. The hardware and software components were successfully integrated into a system and the performance is validated. The validation results showed the capability of the system to identify and track pallets in real-time. However, several modifications and improvements are desired before the system could be applied in actual industrial environment.

ABSTRAK

Kecekapan di bahagian pengeluaran adalah elemen yang sangat penting bagi pengilang untuk memastikan syarikat mereka terus berdaya saing. Satu sistem pengendalian bahan dan sistem kawalan inventori yang baik adalah merupakan faktor yang boleh menyumbang kepada kecekapan yang baik di bahagian pengeluaran. Tujuan kajian ini adalah untuk menyelesaikan masalah berkaitan pengendalian bahan yang menjejaskan kecekapan pengeluaran di PHN Industry Sdn Bhd. Masalah yang dihadapi PHN sekarang ialah tidak terdapat palet bila ia diperlukan kerana tiada sistem yang dapat memantau pergerakkan palet-palet ini seperti jadual yang telah ditentukan. Masalah ini akan dapat diatasi dengan mereka bentuk Sistem Penjejakan Palet Secara Automatik. Kajian ini melibatkan pembangunan perkakasan dan perisian. Sistem ini menggunakan Peranti Pengenalan Frekuensi Radio (RFID) untuk mengenal dan menjejaki. Pengaturcaraan Visual Basic digunakan untuk mereka bentuk sistem Antara Muka Pengguna secara Grafik (GUI) manakala Microsoft SQL digunakan sebagai pengkalan data untuk palet. Pengawal Mikro Arduino digunakan sebagai medium antaramuka untuk sistem RFID dan GUI. Komponen-komponen perkakasan dan perisian berjaya diintegrasikan menjadi satu sistem dan prestasi telah divalidasikan. Keputusun validasi menunjukkan sistem tersebut dapat mengenalpasti dan menjejaki palet-palet dalam masa sebenar. Walaubagaimanapun, beberapa pengubahsuaian dan penambahanbaikan perlu dilakukan sebelum sistem tersebut diapplikasikan di dalam persekitaran industri yang sebenar.

ACKNOWLEDGEMENT

I would like to express my sincere appreciation to my supervisor, Dr. Zamberi bin Jamaludin, for guidance, committed and continous supervision. I am also very thankful to Mr Mohd Nazrin in helping me looking for the project.

A big thanks to Public Service Department (JPA) for sponsoring my Master Degree and ADTEC Taiping for considering unrecorded leave for me on completing my project.

My sincere appreciation also extends to all lecturers and my colleagues who have provided assistance at various occasions. Their views and tips are useful indeed.

Last but not least, a big thank to my wife, sons and daughters for their support and understanding.

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LIST OF ABBREVIATIONS

GUI	-	Graphical User Interface
MP1	-	Master Project 1
MP 2	-	Master Project 2
RFID	-	Radio Frequency Identification Device
GPS	-	Global Positioning System
USB	-	Universal Serial Bus

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CHAPTER 1

INTRODUCTION

1.1 Background

Efficiency in production job floor is a very important element for manufacturer to keep their company competitive. Many factors can affect production job floor efficiency. A good material handling system, low production loss time and good inventory control system are some of the factors that can contribute to high efficiency of production job floor.

This project aims at solving a real industry-related problem in material handling that affect production efficiency at PHN Industry Sdn Bhd, Shah Alam, Selangor. PHN is a metal-based automotive components manufacturer. PHN supplies automotive components to car manufacturer like Proton, Perodua, Toyota, Honda and etc.

1.2 Problem Statement

Different types of automotive components are assembled at the PHN's plant, for example dash panel, hood, head lamp, shield front fender and engine mounting bracket. All parts from different vendors are divided into two receiving areas. Receiving area 1 is to receive large-scale components while receiving area 2 is to receive small-scale components. Parts from receiving area 1 will undergo blanking, stamping, assembly, transit area and pre-delivery inspection process while the small components from receiving area 2 will undergo assembly, transit area and pre-delivery inspection process only before send to the customer. A crane is used to move the huge-scale components from receiving

area 1 to blanking and stamping area while a forklift is used to move the components from receiving area 2 to another station.

There are many pallets used to move all of these components at the PHN's plant. Some special purpose pallets are used for special parts and undergo different processes compared to common pallets. Forklifts are use to move these pallets including the special pallets from one station to another. The problem currently being faced at PHN is that the special pallets are not available at the right time as needed due to the absence of a system that monitors the movement of these pallets based on some predefine schedules.

To overcome this problem, a system that can track these special pallets in real time will be developed. Radio frequency identification device (RFID) will be used to track these special purpose pallets. The RFID based tracking system will send the information to a central tracking control system thus enabling an accurate tracking on the movements and whereabout of these special palettes reducing any efficiencies.

1.3 Objective

The objectives of this project are:

i. To design a system that tracks pallets location and parts carried in real-time using Graphic User Interface (GUI).

iii. To validate performance of the pallets tracking system.

1.4 Scope

The scopes of the project are:

i. To design a pallet tracking system for Empty Pallets Storage Area, IH-S Storage Area and Transit Area only.

ii. Focus only on special pallets for P2-Saga Model only.

iii. To design pallets tracking system GUI for Forklift Operators and Line Leaders.

iv. Pallets tracking system is to be integrated with radio frequency identification devices use for automatic pallet detection.

1.5 Contribution

The Automated Pallets Tracking System will make material handling system in a company becomes more efficient. Upon application of such system, the company could reduce their loss time while improving inventory tracking system. This will indirectly cause productivity productivity to increase, meeting the customer demands.

1.6 Report Structure

This report is divided into five chapters. The following Chapter two covers the literature review on parts identification and tracking system, data communication system and Graphic User Interface. Chapter three covers methodology designed to implement this research project. This chapter includes information gathering, development of hardware/software of the system, system integration, system validation, verification/analyzing the result and plan of study. Chapter four illustrates the result of the project from validation stage. The discussion on the result will carry out in this chapter. Finally, Chapter five concludes the finding and main results of Automated Pallets Tracking System and the recommendation of future development can be carried for this research project.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This research project focuses on the design of a system that can identify and track pallets in real time. For that reason, in this chapter, several topics are reviewed before start designing the system. The first reviewed is to identity the possible identification and tracking can be use. Then the review on data communication system and software needs for running the system will be done.

2.2 Identification & Tracking System

Identification and tracking system has been applied in many sectors such as manufacturing, construction, healthcare, transportation and retail. Automatic identification using RFID technology and wireless sensor networks are capable of providing real-time identification and localization information of moving objects (C.Bardaki et.al., 2011).

Assets tracking system in manufacturing operation will reduce waste time in searching misplaced assets (K.Thomas and M.Duncan, 2010). Identifying and real time tracking system for construction materials can provide accurate information on material available to the management (M.S Javad, 2012). An automated system using RFID combined with GPS technology for identifying, tracking and locating highly prefabricated components solved the problems in late deliveries, doubled handling and misplacement of components (E.Esin et. al., 2006). A.F Jill and M.Torin found that the current best use of Real Time Location System in hospital environment is for asset tracking.

There are few devices used as identification and tracking system in the market. The suitability of the devices to be uses in the system depends on the application. The common used devices are barcode, infrared sensor, RFID and global positioning system (GPS).

2.2.1 Barcode

Barcode system consists of two parts, bar code tag and scanner. The are two types of lines on barcodes tag which are black and white lines.The scanners will read the tags to get information about the product. Each line has a their own width of between one and four units. The widths of the barcode stripes are proportional to each other. There is a start code consists of three bars at the very beginning of a barcode. The first bar is a thin black bar, then a thin white bar, and another black bar. This start code is a signal to scanners and computers so that they know where to begin reading.

Every four bars or stripes on a barcode corresponds to one of the number. For example, the code for the number four is one, two, one, two. These numbers add up to a total of seven and each digit from zero to nine has its own similarcode. The barcode scanner can reads the black bars or it reads the spaces or white bars. Figure 2.1 shows an example of a barcode.

Figure 2.1 An example of barcode

Barcode has been used in many applications. In Madagascar, the DNA study using the core barcode markers was conducted (Chase et. al., 2005). Although barcodes is a common identification and tracking system nowadays, it still has limitation in their suitability for many industrial applications. A product must be properly aligned in order for a barcode reader to identify the product by its code. In manufacturing environments, time is money, and if it takes several attempts to achieve proper alignment, it can be a time consuming and costly process.

2.2.2 Infrared Sensor

Infrared sensor consists two parts which are an infrared emitter and an infrared receiver. Infrared emitter will emit infrared continuously when power is supplied to it. Infrared receiver work like a transistor with its base current determined by the intensity of infrared light received. The structure of infrared sensor is realized by utilizing MEMS technologies featuring the micro-fabrication method known as semiconductor photolithography and the structure is directly formed onto a silicon substrate (S.Takuhito and K.Seiji, 2010).The lower the intensity of infrared light cause higher resistance between collector-emitter terminals of transistor. It causes limitation of current flow from collector to emitter. This change of resistance will further change the voltage at the output of voltage divider. The greater the intensity of infrared light hitting infrared receiver, the lower the resistance of infrared receiver and hence the output voltage of voltage divider will decreased. Usually the infra-red emitter and infra-red recipient will be installed part by part, directing to an indicative surface. The longer distance between emitter and receiver will decrease the amount of infrared light hitting the receiver if the distance between the sensor and a reflective surface is fixed. Figure 2.2 shows an example of infrared sensor.

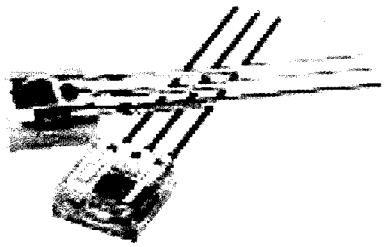

Figure 2.2 An example of infrared sensor

2.2.3 Radio Frequency Identification Device (RFID)

RFID is an automatic identification device. RFID is relying on storing and remotely retrieving data from tags. RFID is similar to barcode technology but uses radio waves to capture data from tags, rather than optically scanning the barcodes on a label. The key characteristics of an RFID system is not require lines on the tag as barcode. RFID system consists of two parts, namely tag and reader. Figure 2.3 shows examples of several types of RFID tags. Through the use of RFID tags to locate at an item, the process of taking inventory of those items much less time-consuming (RFID, 2005). The use of read/write RFID tags provides the flexibility needed to implement an application because the tags identification can be modified or updated (S.M Alenjendro et.al, 2010).

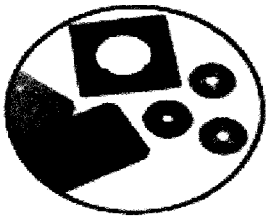

Figure 2.3 An example of RFID tags (Source: RFID)

There are three important problems need to be address related to RFID tag which are reader collision avoidance problem, optimal tag reporting problem and optimal coverage problem (C. Borgaden et. al., 2008). Tracking system using RFID will cause high investment if not considering optimization of optimal numbers of RFID reader. A study about maximal covering location by RFID reader must be conducted to get better system performance (C. Borgaden et. al., 2008). A proper management of RFID technology improved the quality of medical processes, lowering costs and providing the tools to trace material and information flows (Kumar et. al., 2009).

2.2.3.1 RFID Working Principle

Information is sent to and read from RFID tags by a reader using radio waves. In passive RFID, the reader transmits an energy field that energize the tag and provides the power for the tag to respond to the reader. In active RFID, a battery in the tag is used to boost the effective operating range of the tag. Data collected from tags is then passed through communication interfaces (cable or wireless) to host computer systems for interpretation, storage, and action.

2.2.3.2 Passive RFID Tag

There is no electrical power supply in passive RFID tags. An electrical current induced by the incoming radio frequency signal in the antenna. This condition will provides enough power for the circuit in the RFID tag to power up and transmit a response. RFID tags communicate in various ways with the RFID reader. The RFID reader's can collect powers from the incoming signal and also to transmit the outbound signal. Because no onboard power supply, the passive RFID tag can be quite small. As of 2006, the smallest passive RFID tag measured 0.15 mm × 0.15 mm with 7.5 micrometers thin.

2.2.3.3 Active RFID Tag

Active RFID tags have internal power source which is used to generate the outgoing signal. Active RFID tags transmit at higher power levels than passive tags can be use for longer distances. Active tags can operate within hundreds of meters range and battery life up to 10 years. Active tags can be married with other type of sensors. Active tags larger memories than passive tags, as well as the ability to store additional information sent by the transceiver. Real time locating system using active RFID can generate value in manufacturing operation (F. Geraldor, 2011).

2.2.3.4 RFID Reader

An RFID reader can transmit and receive radio frequency signal, controlled by a microprocessor or digital signal processor. The RFID reader captures data from RFID tags, and then passes the data to a host computer for processing. RFID readers come in a wide range of sizes and different features.

2.2.4 Global Positioning System (GPS)

The operation of GPS system depending onthesatellite.GPS satellite always sent a signal to GPS receiver on the earth. The receiver uses the messages to computes the distance to each satellite using the speed of light. The satellite's locations define a sphere.

These distances and satellites locations are used to compute the location of the receiver using the navigation equations. This location is then displayed in form of moving map display or latitude and longitude. Many GPS units show derived information such as direction and speed, calculated from position changes.

For the accurate result, atleast four GPS satellite need to used in an operation. The reception of indirect signals, either in the form of non-line-of-sight (NLOS) reception or

multipath interference, is a major cause of GNSS position errors in urban environments (Z. Jiang and D.G Paul, 2012).

2.3 Data Communication System

Data communications is about transmission of digital signal to a devices. As a rule, the transmission rate of a signal is depending to signal power srenght and noise will affeted to the transmission rate. The best data communication system is the system which can transfered signal to other devices with minimum distortion to the signal.

2.3.1 RS-232

The RS-232 interface using the Electronic Industries Association (EIA) standard for the interchange of serial binary data between two devices. Three wires used in RS-232 to send data, receive data, and signal ground. The signal transmission is bipolar and requiring 5 to 25 volts.

Figure 2.4 illustrates the RS-232 interface pin configuration. The maximum distance is allowed for RS-232 receiver and transmitter is hundred metres. The reason why the range of the RS-232 standard is limited to hundred metres only is the need to charge and discharge the capacitance of the cable connecting the transmitter and receiver.