

AUTOMATED GUIDED VEHICLES (AGVS)

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ABSTRACT

This study is about material handling system, AGV robot. AGVs are material handling system that used automated vehicles which are programmed to move materials or goods. This study focus on; concept and operation of AGV; AGVs contribution in productivity and flexibility of the operations; importance of AGVs in the industry; disadvantages and advantages of AGVs. Concepts that are applied in AGVs operation are Just in Time (JIT) and Kaizen. AGVs operations involved are sensing system; magnet tape and AGV routing. AGV is a machine that really helps not only in manufacturing industry, but also in services industry. They can improve the production line, reduce overall cost of production, increase employee satisfaction, and maintain employee motivation all at the same time. AGVs also can maintain quality and reduce labor cost.

Keywords

Material Handling system, AGV sensing system, AGV operation, carry mouse AGV, Hybrid AGV

1.0 INTRODUCTION

Automated Guided Vehicles (AGVs) are the material handling system that used automated vehicles which are programmed to move the raw materials or finished goods between different production and warehouse station without driver. This is because of this system used to increase efficiency, workers safety, decrease damage of goods and reduce overhead of employees to complete the jobs. In a manufacturing system, Automated Guided Vehicle (AGV) is mostly used in order to increase the productivity and flexibility.

1.1 Background

The creations of Automated Guided Vehicle (AGV) have been around since the 1950's and the technology was first developed by Barret Electronics from Grand Rapids, Michigan. It was then developed by the Europeans in the 1970's and nowadays AGVs can be found in any countries. One of the first AGVs was a towing vehicle that pulled a

series of trailers between two points, and today's there are many task given to AGVs and they also have their own name and potentials. Considering the full potentials and advantages of the Automated Guided Vehicle (AGV) in our livings, it is valuable to do this project, as it also will be the first step towards the creation of more intelligent technology or system. The simplest AGV model may use just a sensor to provide its navigation and can be the complex one with more advance systems to do the task. AGVs can work or do the entire task needed but the safety for the AGV as well as the worker and environment surround is provided. Although the AGVs may not be glamorous of robots, but their work, which usually menial, are often be essential to the smooth running of factories, offices, hospitals, and even houses. They can work without much complaint around many workplaces all over the world.

1.2 Problem Statement

There are many reasons which yield to the creation of Automated Guided Vehicle (AGV) around the world. Mostly the reason is the material handling problems that often occurred in the workplaces and the facilities provided in the workplaces is not suitable for production. Usually the AGVs are implemented in factories. In the industries or factories, the AGVs can ease the physical strain on human workers by performing tiring tasks, such as lifting and carrying heavy materials, more efficiently with no signs of fatigue creeping in. Besides, AGVs also are used in hospitals, offices, houses, and even can be found anywhere outdoors but AGVs is not well known by the people surrounding. This show AGVs are not popular among services sector. Next, the price of AGVs also high this makes people not like to use them.

AGVs can carry long distance than human workers, and their movements can be tracked electronically at all times. Their movements can be timed to feed or collect products or materials from the work cells in the factories. Besides that, in the hospitals thousands of staff spends a portion of their day moving medical supplies, bedding, medicines and other equipment around large hospitals. By using the AGVs, the strain on the workers can be ease as well as the hospital's system would be more smart and

systematic without any bad complaint from the patients and people. AGVs also capable of both cutting cost and releasing more staff hours to tend and care for patients. Therefore it is very significant that the valuable knowledge on AGV construction is studied and be further implemented from the result of this project. It is due to its advantages to our own living and technology.

Our paper aims are to find:

- Concept and operation of AGVs.
- AGVs contribution in productivity and flexibility of the operations.
- Importance of AGVs in the industry.
- Disadvantages and advantages of AGVs.

2.0 LITERATURE REVIEW

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 AGVs. It has become one of the fastest growing classes of equipment in the material handling industry (Tanchoco and Bilge, 1997). Until today there are many researchers that have shown interests in improving the system in order to achieve more productivity and flexibility in manufacturing environments. According to (Groover, 1987) an Automated Guided Vehicle System (AGVS) is a materials handling system that uses independently operated, self propelled vehicles known as the automated guided vehicle or AGV that moves along defined pathways between delivery points or stations.

AGVs operating in an integrated system environment that is typically interface with automated storage and retrieval systems (ASRS), conveyor systems or other automated systems. AGVs system controller is networked as part of integrated material handling system. Besides, the products can be tracked throughout the integrated system and since there is a common control system, it will be easier to optimize the total system performance. Carry-mouse AGV is the equipment for carrying the materials to different part or section to finish the products. These automated guided vehicles carry objects to determined station whenever needed with set up a rail track by sticking magneto tapes on the floor. In addition, the carry-mouse used maximum of 8 workstations that determining to carry the loads to different workstations automatically. They also easy to implement because their height is 200mm will make them to sneak through the under-carriage and carry material automatically. On other hand, magneto

tapes that stick on the floor will establish the route. The route is equipped with supersonic barricade sensors and styled warning horn to tell where material being carried.

Besides carry-mouse AGV, Hybrid AGV is used to transfer the loads that cost-efficient alternative suit simple to transfer material from one place to another place. This equipment is similar with electric forklift but they combined with automated control system that called Hybrid AGV which made them as automated guided vehicles (AGVs). Function of Hybrid AGV is to allow a fast switch to automated transportation without manual mode option. These AGVs provided safe transportation which consists of automatic stopping system and minimized transport damage and delivery error during production. They used specifically in warehouse and distribution centre while the production of goods needed to change workstation of processes.

2.1 AGVs Concept

Concept of just in time and Kaizen are used in this AGVs operation. Just in Time (JIT) is an overall management philosophy where all operational resources, including raw materials and spare parts, personnel, and facilities necessary unto the extent applicable. The JIT aim is to raise productivity and reduce wasteful by using AGVs. Kaizen stand for improvement that means continuous changes needed in the process of improvement of the products and services. By using this concept AGVS operation will be more efficient, such as from big AGVs they came to smaller AGVs and from manufacturing industry they can spread to service industry.

3.0 METHODOLOGY

3.1 AGVs Operation

3.1.1 AGV Sensing System

The production system in this research will apply on the two types of AGV; the carry-mouse AGV and the Hybrid AGV. The carry-mouse AGV will be using magnet tapes to navigate their travelling path to prevent them to collide with each other when using many AGVs at one time. In order to solve that problem, the application of magnet tapes with different combinations of polarity, sequence and distance are used in order to make the AGVs paths' unique. There are also other methods to navigate the travelling path, but the colored tape method might need to be replaced frequently since the color might fade. In addition, it is more complex to control their speed because they do not have different polarity like magnet tapes. Laser guided AGV is too expensive for a mere short-travelling transporter, and thus is not cost efficient.

The Hybrid AGVs on the other hand, must be equipped with laser guidance. The AGVs will be used to travel long distance, and so, they must have the ability to independently compute the space that they will be travelling, and see whether they are in the right track or not. If not, they will compute difference between the actual place they are at and their expected place, and re-enter the right path again. They also might want to avoid collision with other AGVs in the area. This is the reason why they must have a collision avoidance sensor. That way, they can detect one another and avoid any unwanted contact.

3.1.2 AGV Routing

There are several sections of the manufacturing process or production line. The AGVs will be involved in most of the section. The number of AGVs purchased is based on the size of work piece and number of output (utilisation) in this company.

- i. In the production line, the AGVs will be involved in sending raw materials or parts to the line, the movement of the unfinished parts in the line, and after production at the end of the line. We will use the carry mouse AGV (standard AGV) for sending raw materials towards the line. The route of AGV for sending raw materials as shown at the *Figure 1*.

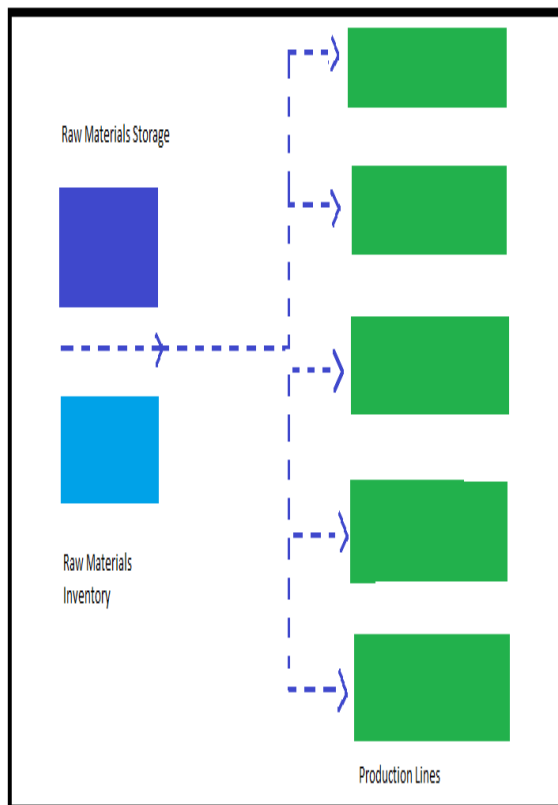


Figure 1: Production line carry mouse AGV route

- ii. The in-line movement will also use carry mouse AGV (standard AGV), since Hybrid AGV is too big, and will only slow down the production line. *Figure 2* below is the figure of their route.

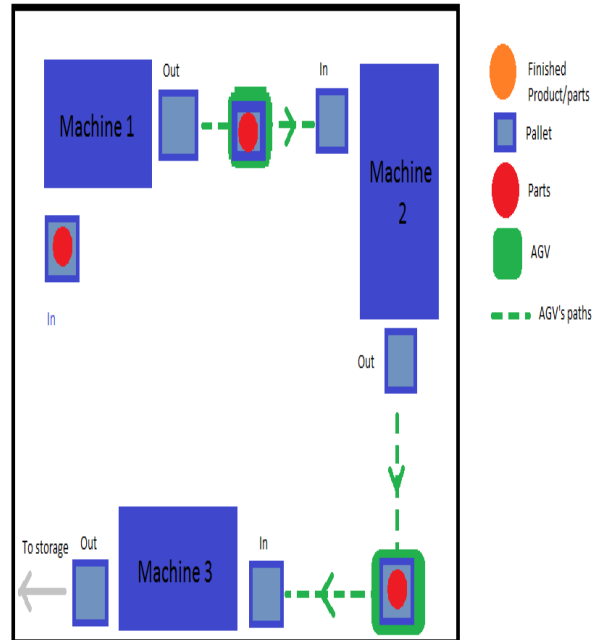


Figure 2: In line movement of carry mouse AGV

- iii. For storage, we will use the Hybrid AGV since it will involve movement of heavy products and pallets. It will also involve quite a long travel, and thus Hybrid AGV will be well suited to the task. The route is simply to take the finished products and bring them to the warehouse. The routing will be set beforehand by naming the specific path we want the AGV to take, and then let host computer guide the AGV in our wanted path by pulling the AGV through the exact route that we want the AGV to take. After guiding the AGV once, the control centre will then be able to set the AGV routing as how we want.

4.0 FINDINGS

From the finding, AGVs can increase the productivity and flexibility of the operations in the industries. This is because AGVs have the characteristics of intelligence and adaptability and use integrated control system and sensing system. Besides that, AGVs also improved product quality by optimizing the shift productivity (less idle time) and used flexible automated system that easy to conduct. The operational flexibility will increase when the labor cost been lower, reduce inefficient manned travel and at the same time it can reduce

dependence on seasonal staffing or temporary workers.

AGVs are important in industry because;

- They reduce error at important sections.
- Allow detailed movement/transfer/ storage log recording.
- Allow heavy, mass part transfers.
- Allow human resources to be used at a more significant department.
- Allow AGV to handle multiple workstations with few errors.

There are also having an advantages and disadvantages of AGVs. The advantages of AGVs are the use of labors are minimized, integrate safely with workers and equipment, reducing employee injuries and product damage, reduced production time, increase production rate and space-saving factory floor. Meanwhile, the disadvantages of AGVs are expensive, high maintenance costs and shortage of technical support.

5.0 DISCUSSION & CONCLUSION

Automatic guided vehicle can do many things that we human should not need to do, or are not able to do. This is because AGVs are machines that can be designed to adapt to any situations that we need it to handle. For example, handling plastic productions involve taking care of heated and molten plastics. AGV can easily be made to withstand a high temperature without accumulating any emotional stress, unlike us humans.

AGV is still not well known in developing country, even though most developed have already implemented this technology into their daily production operations. In order to make it well known in Malaysia, we should apply AGVs into services, like in hospital, airport or hotel. They can carry medicines in a big medicine preserving box and carry it anywhere we want it too. It is just like a moving pharmacy in a hospital. In airport, AGVs can be used to carry the large and heavy luggage. Hotel services can be improved using AGVs by using them, let's say, as an automatic wheelchair for the old and the disabled, or carrying heavy objects such as when we are changing the bed. We can even use them in catering services as drink server. If we use them in services, AGV will surely be well known throughout not only Malaysia, but in the whole wide world because close to 100% of sales are services.

AGV's cost is quite high, not just because of its high technology, but also because of its high usage of electricity. The magnetic tapes uses electrical energy to generate its magnet, the wireless LAN needs

modems and repeaters for emitting signal, the control centre will have the computer server running all day and night, and the AGV itself needs to be recharged before being able to move. We need to save electrical energy in order to use a low cost energy, to preserve Mother Nature and also as a backup plan for handling blackout. One of the alternatives is to use solar energy. It uses a free energy source, and the source is environment friendly. This will lower the cost of using AGV in our production or services.

As a conclusion, AGV is a machine that really helps not only in manufacturing industry, but also in services industry. We can improve our production line, reduce overall cost of production, increase employee satisfaction, and maintain employee motivation all at the same time. The AGV can maintain quality and reduce labor cost. Our workers do not need to lift and transfer materials and parts manually, and so they will be satisfied with the company. They will also not be bored during work, because the AGVs movement can be fun to watch. Thus, the employees' motivation will decrease at a much lower rate. All these factors will improve our products and services in the near future, and also in the long run.

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