Current Status about Automated Guided Vehicle and Their Advantages and Application

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Abstract - Automated Guided Vehicles (AVGs) are self-propelled modern vehicles that are developed for material handling of goods widely employed in the automated manufacturing systems. AVGs are becoming an integral part of flexible manufacturing system (FMS). The first AVG vehicle was brought in the market in the 1950s by Barette Electronics. In this paper, a study was made about the different types of Automated Guided Vehicles and their technologies and also brief about the technology to improve its guidance and control in order to avoid the unexpected system malfunction.

Keywords - AGVs, flexible, driverless, traffic control, latest technology.

I. INTRODUCTION

An AGV is like a forklift truck, but without the driver. It is a driverless vehicle that follows guided paths and an off-board controller by a computer. The destination can be reached as per the instruction by computer. The Automated Guided Vehicles (AGVs) are modern material handling and conveying systems that are being widely employed in automated manufacturing technologies. An Automated Guided Vehicle system (AGVs) is a computer-controlled, the driverless vehicle used for transporting materials from point-to-point in a manufacturing setting. The AGVs are the independently works, self-operated that senses through various types of sensors and operated by means of large-capacity batteries. AGVs are the vehicles that guided by means of pre-defined paths such as guided tape, magnetic bar line, motion sensors, etc, The AGVs are versatile in nature and possess flexible material-handling system. Therefore AGVs are becoming an integral part of flexible manufacturing system (FMS) installations.

II. TYPES OF AGVs

The Automated Guided Vehicles can be widely classified into three types as:

- Guided driverless trains
- Guided pallet trucks
- Guided unit load carriers

2.1 GUIDED DRIVERLESS TRAINS

The guided driverless train also known as towing vehicles or automated guided tractors are most commonly used for transporting large amounts of bulky and heavy materials from the warehouse to various locations in the manufacturing plant. Fig.1 shows a typical driverless automated guided train. A variety of tractors can be used such as flatbed trailers, custom trailers and bin trailers. Different types of loading pieces of equipments are used for loading and unloading. The loading trailer includes hand pallet truck, cranes, forklift truck, automatic transfer equipment, shuttle transfer, and programmed automatic loading and unloading device.
2.2 GUIDED PALLET TRUCKS
The guided pallet trucks are designed to lift, maneuver, and transport palletized loads. These guided palletized trucks are used for picking up or dropping up the loads from and on to floor level, which eliminates the need for fixed load stands. Fig. 2 shows the typical Guided Pallet Trucks. It does not require any special accessories for loading and unloading the guided pallet. It is basically used in the floor-level loading and unloading operation. The following are the sequence of operations is being carried out in pallet trucks:

- Loads are pulled off onto a pallet forks.
- Lowering of the pallet forks to the floor.
- Pulling out from the pallet and
- Finally automatically returns empty to the loading area.

2.3 GUIDED UNIT LOAD CARRIERS
Guided unit load carriers have a deck that permits unit-load transport operation. These load carriers are used in settings with short/Medium guide paths, high volume and need for independence and versatility. Fig.3 illustrates a typically guided unit load carrier. These load carriers are also used in warehousing and distribution systems. These load carriers are much useful for long passage paths where there is a minimum restriction of movements.
III. VEHICLE GUIDANCE TECHNOLOGY (AGV GUIDANCE SYSTEM)

As discussed, the AGV is operated with onboard batteries and it moves generally in a fixed path. One of the most important elements in an AGV is guidance control. The goal of an AGVs guidance system is to keep the AGV on track or on a pre-defined path. The main advantage of AGVs guidance system is that the guide path can be changed easily at low cost compared to the high cost of modifying the fixed-path equipment such as conveyors, chains and tow lines. Path can’t be changed easily whereas the AGVs guidance system is that the guide path can be changed easily at low cost compared to the fixed path equipment which is the main advantage in AGVs guidance vehicles. Generally, the guide path does not obstruct another system.

3.1. TYPES OF AGV GUIDANCE APPROACH

AGV guidance approach can be divided into two categories according to the different navigation ways as (4):

1. Fixed-route guidance method and
2. Free-route guidance method

3.1.1. FIXED-ROUTE GUIDANCE METHOD

Fixed route guidance is to set medium guidance information in the path, AGV can drive with it, such as electromagnetic guidance, tape guidance, etc. Fig.4 depicts a typical fixed-route guidance method (4).

![Guidance System Diagram]
3.1.2. FREE-ROUTE GUIDANCE METHOD
Free-route guidance stores the size of the co-ordinates; AGV can identify the current position and decide the driving path, such as laser-guidance and image recognition guidance. Fig 5 shows the Free-route Guidance method (4).

![Fig. 5 Free-route guidance method](Source: Slideshare-AGVs)

IV. VEHICLE TRAFFIC CONTROL METHOD
There are three methods for traffic control which can be used to minimize the interference between vehicles and to prevent collisions:

1. Forward sensing control
2. Zone sensing control
3. Combinational control

4.1. FORWARD SENSING CONTROL
Sensors are used in AGV to detect the obstruction by detecting sensors that can identify another AGV in front of it and slow down or stop. Sensor types used in this control include optical and ultrasonic devices that cause the AGV to stop when the presence of another vehicle is detected. Fig. 6 shows the forward sensing control method. Some specified distance that must be maintained between AGVs. The sensing device continuously “Looks” forward to sense any object that falls within the specified distance. If anyone vehicle gets too closer, then the sensors will detect the closing vehicle and cause the one in the rear to stop. The movement of the vehicle occurs again only when the obstacle is removed.

![Fig. 6 Forward sensing control Method](Source: Slideshare- AGVs)

4.2. ZONE SENSING CONTROL METHOD
The zone sensing control is the most widely used in which the guide path areas of the shop floor are divided into zones (4, 5). Only one AGV is allowed in a zone at a given time. In zone sensing control, the central computer keeps track of the entire guide path, which is divided into zones. Once an AGV enters a zone, that zone becomes blocked for other AGVs. Fig 7 shows the typical diagram.
4.3. COMBINATIONAL METHOD
In combinational control, both the forward control sensing and Zone sensing controls are selectively used to obtain the benefits of both strategies.

V. LATEST TECHNOLOGY OF AGVs

5.1 CA-B50100-NSI BI-DIRECTIONAL AGV
A Creform NSI bi-directional AGV works as an automated tagger, travelling along a magnetic tape guide path, slipping under a stationary cart from either direction and when necessary rotating in place. A tow pin extending into the cart’s frame conveys it to a designated workstation or unloads point. One NSI AGV has the ability to mobilize multiple carts or a series of NSIs which is programmable and can control 50 courses with up to 128 commands for each and it’s manufactured in the U.S.A. Course programming can be accomplished with PC or an HMI (Human Machine Interface) touch screen located on the front of the unit.

5.2. SMART AND MOTORIZED cart/eQart
The eQart is our first ever smart cart and the first step into our journey of automated material handling carts. The eQart is a smart & motorized which is flexible, affordable, and user-friendly and can be used for stand-alone transportation, for towing or in a mother-daughter configuration. This flexibility is revolutionary within the automation market. The eQart supports companies to overcome challenges with increasing material handling. The eQart is used to create the world’s first smart cart.

We have been able to add a brain, battery, motors, camera, full-colour LEDs, and sensors to our carts. The eQart guides optically through the camera and allows it to follow any contrast line on the floor by magnetic tape. It has a total weight capacity of 2200lbs, and because of the FlexQube concept, the top structure can be easily adjusted to match your materials. So no longer are carts needed to be merged with AGV systems.
VI. FUTURE TECHNOLOGY OF AGV

Over the past several years, in AGV systems the technology for software and sensor has improved a lot. Companies are providing the software with more accuracy, safety, and efficiency than ever before. Several advanced technologies could make an immense impact on the AGV industry. Following lists define those technologies and explain how they could affect the AGV market.

VII. ADVANTAGES OF AN AUTOMATED GUIDED VEHICLE SYSTEM

- Reduced Labor Costs.
- Increased Safety.
- Less Maintenance Costs.
- Increased Accuracy and Productivity.
- Damage is minimum.
- High availability/reliability.
- Random material handling capability due to programmability.
- Integrated operation of all AGVs.

VIII. DISADVANTAGE OF AN AUTOMATED GUIDED VEHICLE SYSTEM

- Not suitable for Non-repetitive work.
- High Initial Investment.
- Decreased Flexibility of operations.

IX. INDUSTRIAL APPLICATION:

- Automotive and Vehicle Fabrication.
- Pharmaceutical.
- Paper and print.
- Food and beverage.
- Hospital.
- Warehousing.
- Theme parks.
- Chemical Industry.
- Manufacturing Facility.
- Plastic Pet.
- Raw Material Delivery.
X. CONCLUSION

This paper presents a classification, types, and control for automated guided vehicle systems. Automated guided vehicle is a combination of automation and robotic technology and there are several ways that anyone can go for further research. Nowadays the AGV is widely used in all industries to perform various tasks which involve automation. AGVs don’t require any driver which is mostly used direct current motors with batteries for moving the vehicles with computer-controlled load carriers. Safety, reliable cost reduction is possible in AGVs.

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