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Automated Guided Vehicle System

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ABSTRACT

Automated guided vehicles have been used for transporting material and parts between workstations. This reduces human efforts and time. In this project a three wheeled AGV prototype is built that can move on a flat surface to deliver material from loading station to required station. There is one loading station and three unloading stations. The AGV uses line follower sensor to follow the path, the path is black in color. The controller used is PIC 16F877 microcontroller that controls all navigation. An IR sensor is added that stops the AGV as soon as it reaches the required station. The AGV was tested for all the three workstations and performed as per requirement.

***Keywords*— automated guided vehicle, track, and workstations**

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I. INTRODUCTION

Automated guided vehicles (AGVs) have been the most widely used method of transporting material from one workstation to required workstation in flexible manufacturing systems. AGV is a robot that follows marks or wires on the floor. In some cases AGV can also uses vision or lasers. In industries AGV increases efficiency and reduces cost by helping to automate a manufacturing facility or warehouse. AGV not only reduces the down time needed for setup work, but also adapts more quickly and flexibly for layout changes.

The AGV can also be called a laser guided vehicle (LGV) or self-guided vehicle (SGV). Lower cost version of AGV is often called Automated Guided Carts (AGCs) and is usually guided by magnetic tape. Mobile robot is mostly used for difficult task with dangerous environment such as bomb defusing. Furthermore, the mobile robot can be categorized into wheeled, tracked, or legged robot. AGV are essential for the smooth running of factories, offices, hospitals, and even houses. AGV performs tiring tasks, such as lifting and carrying heavy materials, more efficiently with no signs of fatigue creeping that can ease the physical strain on human workers. They can work without any complaint around many workplaces all over the world.

AGV seems endless applications as the load carrying capacities can range from a few kg to hundreds of tons. The aim of the project is to build an AGV that can carry load from loading station and deliver at the required station.

A. Objectives

The objective of this dissertation is to design and fabricate a working AGV model that follow track on ground or flat surface.

1. The AGV is three-wheeled including two driving wheels and one free wheel that have ability to follow path on floor.
2. The track is made of segments of two types: lines and arcs.
3. The AGV is controlled using PIC 16F877 microcontroller; the microcontroller controls all operation of the system. In other words, the microcontroller acts just like

the brain for the model that controls all operation of the system.

4. This project is worked out in four main phases' i.e. mechanical design, mechanical fabrication, electronic hardware design, microcontroller programming.

II. VEHICLE LAYOUT

Guided vehicle systems consist of several components, including mechanical chassis, ground clearance, wheels, motor, guided path navigation and communication systems etc.

A. *Mechanical Chassis*

Mechanical chassis is physical or structure frame that holds the body of vehicle. The main function of the chassis is to provide a firm foundation for prime mover, transmission, steering gear, control and pay load. The usual chassis in any automobile or vehicle is made up of channels and guards. In the present case, keeping the miniaturization in view, aluminum sheets is selected. The length of the proposed vehicle so selected to accommodate

1. Control unit
2. Driving rear wheels
3. Loading area
4. Line tracking circuit.

To mount all these components on the chassis, the length of chassis selected is 250 mm and width 180 mm. The length and width selected is sufficient to hold all the components properly which can be easily accessed.

B. *Ground clearance*

Ground clearance is the amount of space between the base of an automobile tire and the underside of the chassis or the shortest distance between a flat, level surface, and any part of a vehicle other than those parts designed to contact the ground. Vehicles with a lower ground clearance will benefit from an increase in handling as their center of gravity will be significantly lower than average. A lower ground clearance equals better handling and performance.

The main aim of the vehicle in present case is to carry load from loading station to unloading station. DC motors are to be mounted below the chassis for driving the two rear wheels. The diameter of motor is 20 mm; by keeping this in view the ground clearance should be more than 20 mm to avoid any damage to the undercarriage parts of vehicle so here ground clearance 35 mm is selected.

C. *Wheels.*

Two wheeled robots are harder to balance than other types because they must keeping moving to maintain upright. Two wheels plus a caster or four wheels are the combinations for wheeled robots. Both combinations of wheels can turn in place and are known as differential drive for two wheel version, while the four wheels has to be driven independently to turn in place. The two wheels and a caster method have its advantages including here the possibility to measure the movement by adding encoders. For the four-wheel method, adding an encoder could generate inaccurate measurements compared with real movements of the robot. So in this case 3 wheeled vehicle is preferred. The larger the wheel the faster vehicle will move. Likewise, the faster the RPM of your motor, the faster your vehicle will move. Here 70mm Diameter x 19mm Thick x 6mm Bore Wheel is selected so that there can be enough ground clearance.

Wheel diameter: 70mm
Wheel thickness: 19mm
Hole diameter: 6mm
Wheel weight: 40gms

The two 70mm diameter wheels are connected to rare end of vehicle. As the chassis width selected is 180mm, the wheel base length is 200mm and the frame width is 180m.

D. *Electric motor*

Electric motors used in the present case are the DC motors. The DC motors provide a high torque and has high efficiency. The following DC motors are available in market.

10RPM /12V 6mm DC Geared Motor
30 RPM/ 12V DC 6mm Geared Motor
45 RPM/ 12V 6mm DC Geared Motor
60 RPM/12V 6mm DC Geared Motor

Among these motors 30rpm/12V 6mm DC motor is used which is sufficient to drive the system. If a higher voltage than that supported is applied to the motor, it may heat up and can be damaged. By keeping these factors in view DC motor of 12 V, 30 rpm is selected.

E. *Position sensors*

To detect the track and workstations the position of sensors is important factor. Control unit can be placed at the front end or rear end of vehicle. In this case the control unit is placed at the front end so that the AGV movement can be easily controlled and can avoid any damage to the control unit at the time of loading and unloading of pay load. The line follower sensor for detecting the path is situated at the front part of AGV. An IR sensor is placed parallel to breadth of chassis to stop the AGV as soon as it comes it reaches the required unloading station. During straight path the two motors run in forward section with equal speed. When left motor stops and right works the AGV takes left turn. When left motor works and right stop the AGV takes right turn depending upon the curvature.

F. *Vehicle model*

The AGV is built such that the AGV is stable during loading, unloading and in working. A dumper arrangement is provided at the rear position of AGV above the driving wheels. The control unit is situated at the rest of surface. Motor for driving are provided at the rare end hence the AGV will be stable during loading. The following figure shows the front view the vehicle model. The vehicle modeling is done using CATIA software.

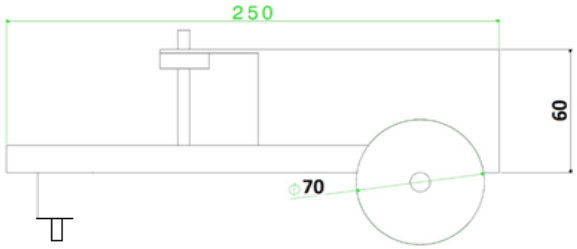

Fig. 1 Front View of AGV model

The fully fabricated prototype of AGV possesses the intelligences such as following particular path, loading at loading station and unloading at required station.

Fig. 2 AGV model

G. *Guide path*

The guided path is the track which the AGV follows. The track is made of black paper which is fixed on horizontal floor and is unidirectional. The path is designed by keeping in mind the dimension of vehicle, as the frame width is 180mm the thickness of track selected is 120 mm. The length of track is 350 mm. The track is made of segments of two types: lines and arcs.

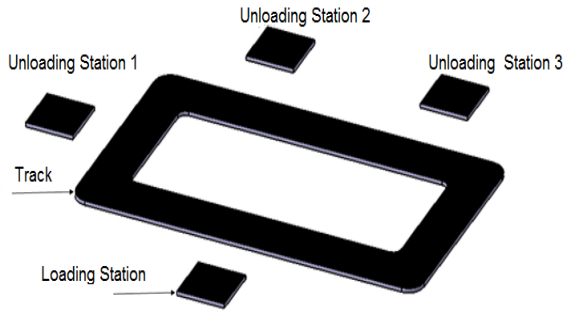

Fig.3 Guide path

And the workstation is represented by the black paper at the left side of track. The line follower sensor is used to follow the track. The vehicle is designed such that it can complete one delivery in 2 minutes.

III. Control Unit and Working of The System

The following figure shows the block diagram of control unit.

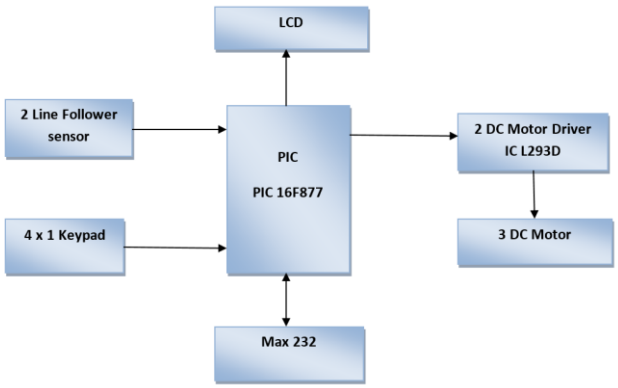

Fig.4 Control Unit

The principal parts or functions are in block diagram are represented by block connected by lines that shows the relationships of the blocks. The direction of all arrows is from the microcontroller or towards microcontroller. In this 16 by 2 LCD is used that can display the two lines containing 16 characters each. Keypad 4 x 1consist of a number of switches, connected in row/column. It is used for starting and stopping of system and also selecting the station. Line follower is used to follow the track. The system needs the regulated 5 V output for the most of the IC's. Now the output of bridge rectifier is unregulated DC. To get 5V regulated DC output from it we have used regulator IC 7805.PIC16F877 control all navigation and responses to environment used to control the system.

A. *Working of the system.*

The main aim of AGV is to deliver material from loading station to required station. Here there is one loading and 3 unloading stations. The AGV is programmed to deliver the material at selected workstation. Then with the help of keypad the system can be stared or stopped. Suppose destination workstation 3 is selected .At the loading station load is manually placed on the dumper .When the ON button is pressed the AGV start moving forward. The AGV uses line follower to follow the track. The track is black in colour. By using IR sensor the vehicle follows the track. When the AGV reaches the station 1 it compares with the destination workstation as it is not the required destination AGV keeps on moving further. When it reaches station 2 it again compares with destination station as station 2 is not the selected station it moves forward now as soon as the IR sensor detects the workstation 3 the AGV stops there and the unloading is done. Once the load is unloaded it starts moving forward. Now suppose station 2 is selected the AGV stops only at station 2 and the unloading is done .Similarly if station 1 is selected AGV stops at station 1 and unloads.

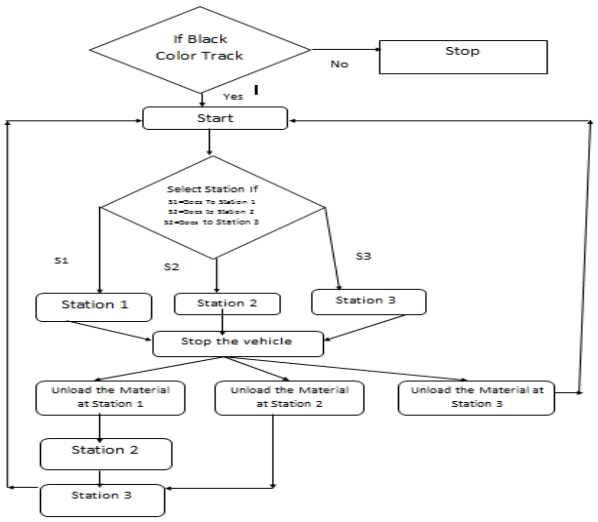

Fig. 5.Algorithm

IV. Results And Discussion

Automated guided vehicle is three wheeled robot having two driving wheels of 70mm diameter at the rear end controlled by two motors and one pivot wheel at the middle of the front end that is able to rotate. AGV has ability to follow line on floor. There is one loading station and 3 unloading station. The controller used is PIC 16F877 microcontroller that acts like brain for the vehicle that controls all operations of system. The AGV follows a fixed path of length 250mm and thickness 110mm and track is black in colour .A line follower sensor is used to follow the track. The system is tested for all the three workstations and found effective at all the unloading stations. The AGV completes one delivery that is from starting from loading station to unloading station in 2 minutes .The AGV travels with speed of 0.0029m/s. The AGV cannot function properly if any obstacle is detected.

V. Conclusions

The AGV is built to deliver material from loading station to required station. All the required components for the control unit have been checked and soldered on a PCB. The soldering is done as per PCB layout and component layout. The motors run as per the programmed speed and the circuit is working well. The AGV increases productivity in all the industries. During the manufacturing of this AGV we found many of intelligence that can be given to it. The AGV uses line follower sensor to follow the track. The followings are the main features of the prototype which is built

1. Speed of delivery
2. Reduction in labour cost
3. Ability to add sensors to detect the payload conditions
4. Reduction in running cost compared to conveyer systems.
5. Continues cycle of working

References

[1] Hark Hwang ad San Hwi Kim,1998,"Development of Dispatching Rules for Automated Guided Vehicle Systems", Journal of manufacturing system volume 17/No.2

[2] Tua Le-A, MBM De Koste, 1991,"A Review of Design and Control Of Automated Guided Vehicle System", Eramsmus University Rotterdam.

[3] Berett A.Peters, Jeffre S.Smith, and S.Venkatesh," A Control Classification of Auomaed Guided Vehicle Systems", 2006, Texas A & M University, TX 77843-3131.

[4] Olivid Brockmeier, Christopher Westcott, and Ja Helge Bohn, 2003, "Automated Loading And Unloading of FDM Systems". Virginia Tech blacksbur, VA 24061-0238, USA.

[5] Choong-Yeun Liong & Careen S.E Loo, 2009, "A Simulation of Warehouse Loading and Unloadig systems Using Arena", JQMA 5(2), 4-56.

[6] Dinis Fernandes, Luis Farrolas, Pdro Brito, 2004, "Progresses on the Design of Small Flexible Automated Guided Vehicles", 1096 Lisboa Codex-Portugal.

[7] Paolo Priore,David De La fuente,Alberto Gomez ad Javier Puente,2005, "A Review Of machine Learnin I Dynamic Scheduling Of Flexible Manufacturing Syatems",Campus de Viesques, 33204 GIJON,Spain.

[8] Yavuz A. Bozer and Mandyam M. Srinivasan, "Tandem AGV systems: A partitioning algorithm and performance comparison with conventional AGV systems". European Journal of operational research 63(1992)173-191 Holland

[9] Bozer, Y.A, and Srinivasan, M.M, 1991, "Tandem configuration for automated guided vehicle system and analysis of single-vehicle loops", IIE Transaction 23/1(1991) 72-82.

