Fabrication of Automated Guided Vehicle using RFID Technology

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Abstract— Automated guided vehicle is an industrial device for unmanned transportation which transports all kinds of goods and products without human intervention in manufacturing, warehouse and distribution environment. The positive of the AGV is that they can operate as a standalone application with more efficiency. The control of the AGV is assisted by the microcontroller, obstacle sensor (IR sensor), relay and RFID reader. The AGV plays major role in the manufacturing and assembly sections in the industries. Efficiency and control of the AGV is further improved by the artificial intelligence that is controlled by Bluetooth /Wi-Fi.

Keywords: Automated guided vehicle, radio frequency identification

I. INTRODUCTION

A. Automated Guided Vehicle

An automated guided vehicle is a transportation device used to carry light weight or over whelming goods from one spot to the next. It is regularly used in the industries for the regular moment of the goods or manufactured items. Automated guided vehicle is mainly used in the machine station of the industries. Automated guided vehicles widely reduce the transportation cost of the manufacturing industries

1) Description

The chassis of the automated guided vehicle is made up of GI sheet and the plastic wheel is mounted underneath of the chassis. The geared D.C motor of 12V is connected to the plastic wheels and the motor is fixed with the help of check nut. The rubber caster wheel is fixed at the front portion of the chassis for the directional movement. The radio frequency identification sensor is fixed below the chassis to sense the radio frequency wave from the RFID tag. The radio frequency identification sensor is fixed with the help of bolts and nuts. RFID sensor is connected to the pick 16F877A microcontroller. Obstacle sensor is fixed horizontal to the length of the chassis to identify the obstacle Infront of the automated guided vehicle. Internal relays are connected to the geared D.C motors for on and off of the electrical supply and voltage regulator is fixed with the microcontroller for the regular voltage supply for the electrical circuits. The 6V battery is placed above the chassis and fixed. 16*2 LCD display is integrated with the microcontroller for the display of the command. The radio frequency tags consist of integrated circuit used for the signal transmission.

B. Types of Automated Guided Vehicle

Various automated guided vehicle available in the market and this type of automated guided vehicle is decided by material used or product it will carry. Automated guided vehicle is produced of different types of materials, including GI steel and plastic. Most automated guided vehicle come with standard sizes and it is used for normal loads, but some of them are designed for very little or huge loads.

1) Unit load automated guided vehicle

Unit load automated guided vehicle used for carrying palatized load, large containers and unit load. Unit load automated guided vehicle reduces the product damage and reduce in traffic. Unit load automated guided vehicles are battery powered autonomous system. They are used in the place of fork trucks that require a person for the operation.

2) Forklift automated guided vehicle

Forklift automated guided vehicles are used in picking and transporting the pallets, containers and many other transportable loads. Forklift automated guided vehicles consists of forklifts at different size based upon the requirements for loading and unloading. It can pick up and deliver at floor level or to stands, conveyors, belts, racks. Forklift automated guided vehicles are classified into latent type, carrying type, traction type.

3) Tugger automated guided vehicle

Tugger automated guided vehicle is used in the manufacturing industry to transport more goods faster. Tugger AGV's reduce the operational efficiency and operation cost. It increases the safety of the workers, products and equipment with precise and controlled movements. The product delivery and timing can be tracked so we can easily identify the location of the products.

II. LITERATURE REVIEW

Ebben [1] et al., saw the need for efficiently managing resources. In his paper, he suggested four important notes for routing the AGVs towards a battery station if its resource level drops below a certain threshold:
− Select the nearest station
− Select the first station on the current route
− Select the fastest reachable battery station on the current route
− Select the battery station that will cause minimum delay in travelling

Gaur [2] et al., saw a need for AGV based material handling system. In his paper, he suggested four major factors such as through put, Unit load, Flow path design, Fleet size. Material handling involves the movement of materials from one place to another for the purpose of processing, storing and retrieving in which he suggested the correct flow path, carrying the unit load goods and ratio of the fleet size in the industry.

Through put is measured with respect to time and quantity. Through put time refers to time spend on the job (i.e. time between the arrival and dispatch of the goods).

Unit load is the load carried in distinct parts are transported as a single unit load by an AGV for processing in an industry.

Flow path is the important factor in the operation of the efficient AGV system. The path followed by the AGV determines the total distance travelled by the vehicle.

Fleet size is the required number of automated guided vehicle for the transportation of the goods in the industry

III. SELECTION AND FABRICATION OF AUTOMATED GUIDED VEHICLE

A. Material Selection

The material selection is the important process in designing and fabrication of new product. Ultimate aim of material selection is to reduce the cost of the automated guided vehicle. Where best material is chosen by the material analysis of automated guided vehicle.

B. AGV Chassis

Material used - Mild steel sheet

1) Mild Steel Sheet

Mild steel sheet otherwise called as plain-carbon and it is the most common form of the steel variety. Mild steel sheet price is very less when compared to other steel sheet. Mild steel sheet made up of low carbon content so it is malleable. Mild steel has low tensile strength and also cheap.

Fig. 3.1: Mild steel sheet

2) Plastic wheel

Plastic wheel is a circular block of hard material having bored circular hole at the center through which we can place the axial bearing. High quality rubber is mound over the circular cross-section of the plastic wheel. The plastic wheel is used in the AGV having high strength and rigidity.

Fig. 3.2: plastic wheel

3) Rubber Spherical Caster Wheel

Rubber spherical caster wheel made up of rubber and bearing for the rolling of the rubber wheel. Rubber spherical caster wheel can rotate 360 degree. Rubber spherical caster

wheel is fixed to the chassis using bolts and nuts. It can provide friction free movement for the automated guided vehicle.

Fig. 3.3: Rubber Spherical caster wheel

4) Geared DC motor

Geared dc motor is an electrical machine which can coverts electrical energy into mechanical energy. The control of geared dc motor is quite easier using relay. Wide range of geared dc motor is available in the market in which we have used 12V geared dc motor and the rated RPM is 10.
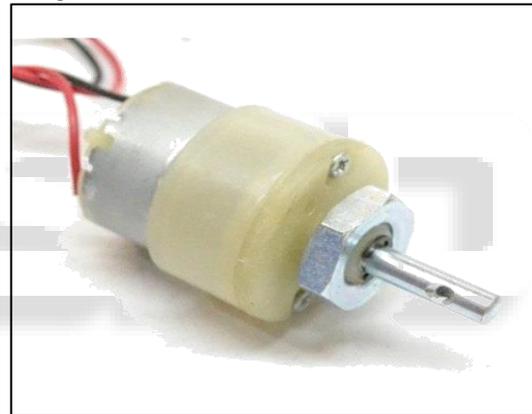

Fig. 3.4: Geared DC motor

5) Ball bearing

Ball bearing is a component used for smooth rotation of the shaft and reduce friction on the shaft. Advantage of ball bearing is point contact. Coefficient of friction in ball bearing is very low. The ball is correctly aligned between two races to contain the balls inside the races. Bearing has elastic seals on both side of the bearing to keep the oil inside and so extra oil required.

Fig. 3.5: Ball bearing

6) Rechargeable battery

Battery is energy storage device which stores electrical energy. Various types of rechargeable batteries are available in the market such as lithium-ion, lead acid batteries in which we have used 6V battery. The rechargeable battery has long life, high reliability, high overall efficiency, low discharge, minimum maintenance cost.

Fig. 3.6: Battery

7) Pick 16F877A Microcontroller

Pick 16F887A Microcontroller is built on a single IC of microprocessor system microcontroller where developed for the low-cost products. Microcontroller consist of resistor, capacitor, potentiometer, voltage regulator and 16*2 LCD display. Microcontroller process and controls command signals from the RFID sensors and obstacle sensor. It provides command signals to the relay counter for the appropriate rotation of the geared DC motor.
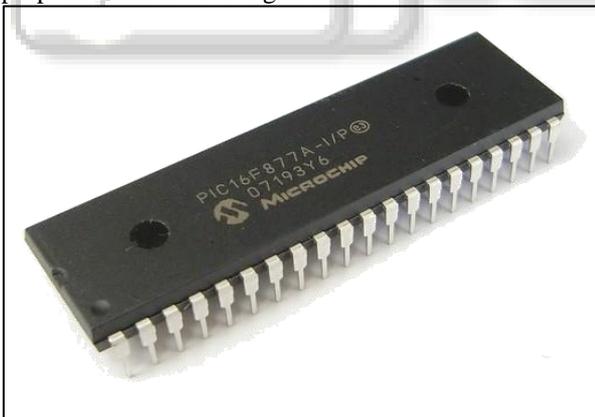

Fig. 6.7: Microcontroller

8) LCD Display

16*2 LCD Display is used for the display of the command signals. The LCD display have long life and wide range of operating temperature. LCD use +5V power supply and LCD displays are used in calculators, watches and other measuring instruments having limited amount of numeric data.

Fig. 3.8: LCD Display

9) RFID Reader

Radio frequency identification reader is a low power consumption, low cost, small in size and it is easy to use. RFID reader detect the RFID cards within the range and the working frequency of the RFID reader is 125KHz. RFID reader emits radiofrequency waves via its antenna. Tag respond and transmit data signal for the received radio signals from the RFID reader. RFID reader send the command signals to the microcontroller for the directional change of the automated guided vehicle.

Fig. 3.9: RFID Reader

10) RFID Tag

Radio frequency identification tags contains tiny radio transponder which is radio receiver and transmitter. Radio frequency identification tag receives electromagnetic pulse from the RFID reader and transmit digital data. There is two types of RFID tags which is active tag and passive tag in which we have used passive tag. Active tag requires external power supply for the data transfer where passive tag does not require external supply for the data transfer.
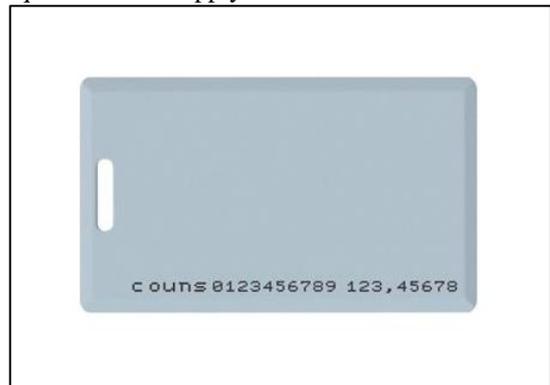

Fig. 3.10: RFID Tag

11) Obstacle Sensor

Obstacle sensor consists of IR receiver and IR emitter and the distance adjustor used in the IR sensor used for the change of the obstacle detection distance. Obstacle sensor work effectively in the low light condition. Obstacle sensor emits IR waves and receives reflected IR signal from the object.
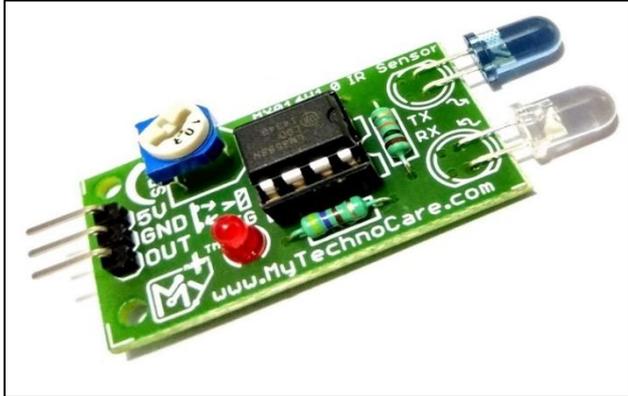

Fig. 3.11: IR Sensor

12) Dual channel relay

Dual channel relay is an electrically operated switch used for the on and off the geared DC motor. Current flowing through the relay coil which generates magnetic field attracts a level and changes the control of the switch. Dual channel relay works based on the data signal from the microcontroller. Each relay connected to the motor works separately as per the command signal from the pre-programmed microcontroller.
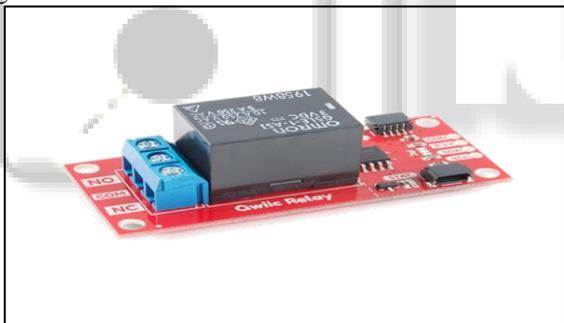

Fig. 3.12: Dual channel Relay

C. Processes Involved in Fabrication

1) Cutting

Cutting is the separation of physical object into two or more portions by applying the forces. There are lot of cutting methods such as etching, electric discharge machining, laser cutting, plasma cutting, water jet cutting.

2) Drilling

Drilling is the cutting process that uses drill bit to make a hole of circular cross-section drill bit is usually a hardened tool to make circular holes. The drilling process such as spot drilling, center drilling, deep hole drilling in which we have used spot drilling process for the making of holes.

3) Welding

Welding is a fabrication process for joining the metals. Many energy sources can be used for welding process such as gas flame, electric supply, laser, electron beam, friction. Welding can carry out in different environments, including in open air, under water and in outer space.

4) Bending

Bending is a fabrication process used to bend the sheet as per the required dimensions. Bending of the sheet metal is required for the perfect design of the automated guided vehicle.

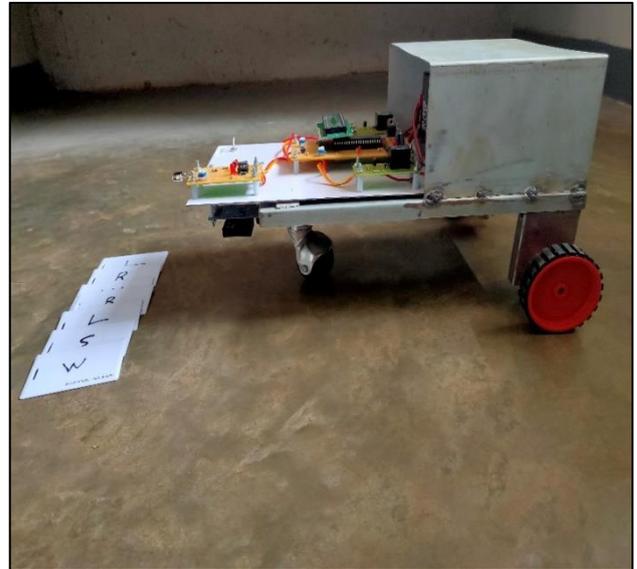**D. Prototype of Automated Guided Vehicle**
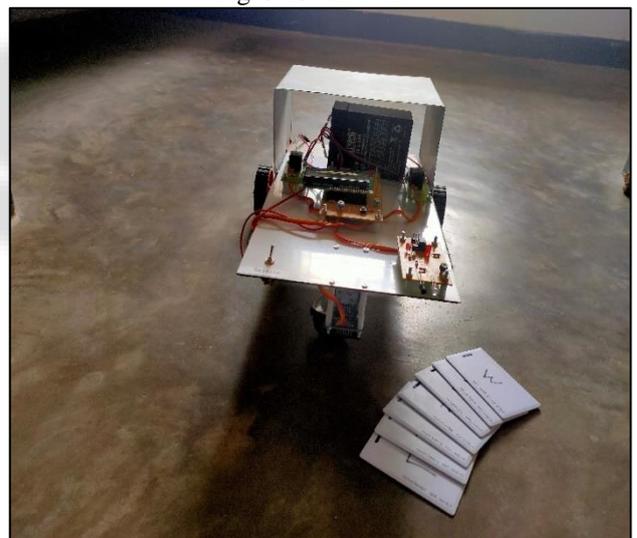

Fig. 3.13: side view

Fig. 3.14: front view

IV. WORKING

Toggle switch is switched on in which the battery power supply is regulated to 5v for entire electric circuit. The push button is switched on where the automated guided vehicle starts moving at the rated rpm of 10 in a straight path. Directional movement of the automated guided vehicle is controlled by the radio frequency reader and tag such as left turn, right turn, wait tag, stop etc. RFID reader emits RF waves which strikes on the RFID tag. The circuits in the RFID tag receives the radio signals and reflect the required data to the RFID reader. Data from the RFID reader send to the microcontroller for the data comparison and microcontroller send appropriate command signals to the

relay counter for the proper working of the geared DC motor while changing the direction relay plays a major role.

V. ADVANTAGES AND DISADVANTAGES

A. Advantages
− Pollution free
− Low running cost
− By using EPROM, it is used in FMS
− Less manpower required
− Easy control

B. Disadvantages
− High initial cost
− Battery charger required
− Battery charging time is high
− AGV does not sense the obstacle in the AGV paths.

C. Application
− Open field work
− Using rechargeable battery, it can be able to use in indoors also
− Used in assembly section

VI. INFERENCE AND CONCLUSION

A. Inference
After the fabrication of automated guided vehicle, it is observed that obstacle detection in the path of the AGV is quite difficult so obstacle sensor is used in the front of AGV to detect the obstacle.

B. Conclusion
In this project there is some limitations by its strength and built quality, it is regarded to be a little forward step, as far as AGV is concerned. In case of test run of this project we realized it is not a good idea to take this design for carrying huge loads based on the torque and speed of the AGV. This product is good for low and moderate load.

REFERENCES
[1] G.R. Nagpal, "power plant engineering" Khanna publishers, Delhi.
[2] Dr. R.K. Bansal, A text book of Strength of Materials, Laxmi Publications (P) Ltd.
[3] R.S. Khurmi, J.K. Gupta, A textbook of Machine Design, S. Chand Publishing House(P) Ltd.
[4] T. Thiagarajan, fundamentals of electrical and electronics engineering, SciTech publishers, Chennai.