DESIGN AND FABRICATION OF AUTOMATIC MATERIAL HANDLING ROBOT

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Abstract: An Automated Guided Vehicle (AGV) is a set of co-operative driverless vehicle, used on manufacturing floor and coordinated by a centralized or distributed computer-based control system. AGV's-based Material Handling Systems (MHS's) are widely used in several Flexible Manufacturing System (FMS) installations. One of the challenges in MHS's is how flexible and adequate is the utilization. The main issue of the flexibility of MHSs is the routing system. It should be designed in a way that it can be easily modified to become adaptable to new or replaced machines. The main focus of this project is to make an AGV with the convenient materials, simple and applicable routing system and more importantly reducing the cost and increasing the flexibility. For this propose an AGV is basically modelled and designed with SIEMENS NX9 software and developed with special specifications.

1. Introduction:

Automated guided vehicle systems (AGVs), commonly known as driverless vehicles, are turning out to be an important part of the automated manufacturing system. With the drastic change from mass production to mid-volume and mid-variety, flexible manufacturing systems, are increasingly in use. They are in requirement of not only machine flexibility but also material handling, storage, and retrieval flexibility. Hence, the importance of AGVs has grown in manifold. It is battery-powered driverless vehicle with programming capabilities for destination, path selection, and positioning. The AGVs belongs to a class of highly flexible, intelligent, versatile material-handling systems used to transport materials from various loading locations to various unloading locations throughout the facility. Therefore, the vehicle comes to stop before any damage is done to the personnel, materials, or structures. They are becoming one of the integral part of flexible manufacturing system installations.

2. Problem Statement:

To design and fabricate an Automated Guided Vehicle that uses black tape, RFID tags & IR sensors to detect path, uses a wireless system to move around the industry carrying a load up to 25 kg.

3. Objectives:

- Designing and fabrication of more compact structure
- Installation of path sensing mechanism at lower cost
- Automatic decision of load on frame

4. Literature Review:

Takayuki Suzuki*:* Four wheels are provided to four corners of a frame of an automatic guided vehicle. One of the wheels is mounted to the frame and remaining three wheels are mounted on a swing frame that is movably fixed upwardly and downwardly to the frame with a shaft and bearings in order that all wheels are touched to a floor surface always. In addition, a cylinder unit is provided. Its cylinder tube is connected to the swing frame and its rod connected to a piston in the cylinder tube is connected to the frame through a universal coupling. In addition, valves are provided to communicate with the both sides of the piston in the cylinder tube through ports of the cylinder tube. When a robot arm provided to the automatic guided vehicle is operated, the valves are closed to inhibit the incompressive fluid to enter and exit the cylinder tube to lock the swing frame.

Q. Li, A.C. Adriaansen & J. T. Udding*:* In this paper, we study the design and control of AGVs, with the focus on the quayside container transport in an automated container terminal. We first setup an event-driven model for an AGV system in the zone controlled framework. Then a number of layouts of the road network are carefully designed for the workspace of the AGVs in a container terminal. Based on the zone control model, a traffic control strategy is proposed, which decouples the motion conflict resolution among the AGVs from the routing problem. A routing algorithm has been constructed with the goal of minimizing the vehicle travel distances and the transportation time. The efficiency of the integrated design and control is demonstrated by computer simulations in terms of a set of defined measures of system performance.

Nanjing University of Aeronautics, China*:* In order to implement vision-based navigation of AGV with complex path, a method incorporating RFID technology with image processing technology is proposed, in which RFID technology is used to recognise nodes and image processing technology is used to detect path. Straight line path is detected by Hough transform in case that AGV runs straight, while curve path is detected by line scanning in case that AGV turns right and left. RFID technology is a non-contact automatic identification technology of which the basic principle is that non-contact information transmission is achieved using radio frequency signals through space coupling and then identification purpose is implemented with the information transported. RFID system must at least include two parts: card reader & tags. Combining RFID technology and vision sensor which can acquire amounts of information from environment, method based on RFID & vision for AGV navigation is presented.

5. Working Methodology:

5.1 Designing: The first stage of our project is the designing of the whole system. The frame is designed in a square shaped skeletal structure, so that it is both light in weight and it can also withstand the force exerted by the load during transportation. The next phase in the design is the design of the Hover board. The Hover board is the heart of the robot because it is fitted with the driving mechanism and also it's should accommodate all the electrical parts (IR sensors, RFID tag readers, PCB and wiring) required for the smooth functioning of the robot.

5.2 Analysis: The next stage of the project was the analysis of the frame which is the part supposed to carry the load. The analysis of the frame was done using ANSYS, during the analysis of the frame with some specified load conditions we were able to determine the deformation of the raw material. The raw material used in the process of analysis is mild steel.

5.3 Fabrication: The fabrication process of this project was carried out in two stages, the first stage was to fabricate the frame. After the analysis of the design we were able to decide the material required for the fabrication. Mild steel is the raw material which is used in this fabrication.

5.3.1 Frame: Mild steel material of 30mm^2 is cut into 4 individual pieces of length 560mm and two more pieces of length 500mm. the 4 pieces are welded together in a square shaped structure, the other two pieces are welded inside the square structure for more stability. It is then fitted with 4 individual legs of length 170mm. The castor wheels are fitted to the 4 legs for the movement of the frame.

5.3.2 Hoverboard: The Hover board is the one which drives the whole system, hence it was supposed to be fabricated in a precise way. The hover board is designed in such a way that it should be able to accommodate all the electrical components, sensors and the locking system. The raw material used to fabricate the hover board is sheet metal of gauge 1.8mm.The sheet metal is cut and bent into a box shaped hover board which is of length 300mm and width of 200mm the motors are fitted at both the ends on the side panel which is of height 100mm.The hover board consists of two motors, battery, PCB, Arduino board, IR sensors and wiring networks.

5.4 Components Used:

- Arduino Mega: This is a micro controller board based on AT mega2560. It has a USB host interface to connect with android based on the MAX3421e. It has 54 digital input/output pins.
- Infrared Sensors: The IR sensors in here are used to determine the path of the robot. It detects the black color of the magnetic tape and guides the robot in a specified path.
- Radio Frequency Identification tag reader: A radio frequency identification reader is a device used to gather information from an RFID tag, which is used to track individual objects. Radio waves are used to transfer the data from the tag to a reader.

5.5 Assembly and Testing: The final stage of our project is the assembly of all the parts. The frame is fitted with four castor wheels for its smooth functioning. The Hover board is fitted with all the electrical parts and the wiring required for the working of the robot. The next process is the installation of the locking system which is an integral part of the system. After all the assembly the next step is the laying of the black taped path for the robot to detect and move accordingly, later the whole system is checked for the working of the system with specified loading conditions.

Fig 1: Working model

6. Results and Discussions:

- This project demonstrates our ability to deliver a feasible solution for a semi-automated terminal.
- The maximum load carrying capacity of this robot is 25kg.
- The average speed with which the robot can deliver the product is from 5 to 7 kmph
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7. Conclusion:

We have achieved the required accuracy and reliability in designing and developing the structure of AGV, study, analysis and development of suitable navigation system for AGV tracks as well as development of a smart AGV using an Arduino based microcontroller.

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