Design And Simulation of Line Follow AGV

Shrithika Pravin[1], Carol Santhosh P[2], Gokul G[3], Kishor Kumar V[4]
[1, 2, 3, 4] Dept of Mechatronics Engineering
[1, 2, 3, 4] SNS College of Technology, Coimbatore

Abstract- *This paper's goal is to highlight an automated guided vehicle that automates material handling and manufacturing maintenance procedures, which will necessitate the use of a traversal application at the industrial level. The robotic system is designed to work in a complex environment and along multiple paths across the industrial unit. In terms of current technological breakthroughs, this initiative has had a significant impact on the industrial sector. It has the potential to outsmart manual labour and manage traffic flow within the warehouse and workspace.*

Keywords- Arduino Technology, Autonomous Vehicle, Industrial Automation, Warehouse manipulation.

I. INTRODUCTION

An autonomous guided vehicle (AGV) is a programmed mobile vehicle that is used in industrial applications to transport products around a manufacturing plant. Material management is the most critical aspect of every production or distribution activity; without it, the finished product is unprofitable. It must be done in a safe, efficient, cost-effective, timely, and precise manner while avoiding material damage. There are several types of AGVs and autonomous mobile robots, but the most common type is one that uses reflective coloured tape for moving in a range of applications.

The general design is based on the Arduino Mega (microcontroller) embedded system board with IR sensor navigation. By simply enabling specific choices on the control panel board directly on the robot, we can supervise and manage the status of the system connected to the microcontroller and communicate the modules. Our prototype can carry a heavy load of machined parts or small lightweight components weighing up to 200kg. The robot follows the predetermined path to the production line, where it is dispatched to deliver the raw materials on time. It is capable of sensing obstacles in its path (person or object) and autonomously responding in order to ensure that items are transported without errors or damage.

II. METHODOLOGY

A. Existing methods

AGVs must know where they are in the manufacturing plant or assembly line in order to travel properly. There are two techniques to determine position: relative and absolute. Absolute position measurement employs the absolute position as it is mapped. In the relative positioning approach, the position is calculated relative to a factory-determined reference point. With this foundation in place, we can look into the various navigation tactics employed by AGVs and how safety is ensured when working alongside people.

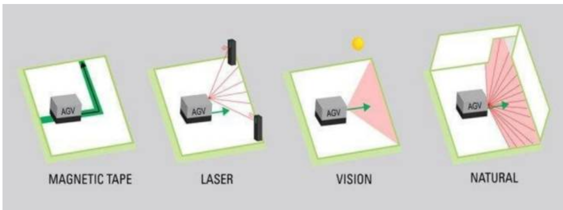

Fig.1. Types of AGV

B. Proposed System

One of the simplest ways to make the AGV operate is to use the line follows approach. It detects the line using an infrared sensor and follows it. This strategy outperforms all others in terms of efficiency. In terms of logical complexity, the line following method is quite straightforward. As a result, it is sturdy and functions with the fewest faults possible. When compared to line follow AGVs, AGVs that use Slam technology to map the route are more expensive. The routes for the line that follows AGV can take several forms, such as a bicycle loop, a street-like path, and so on, and they can be regulated via control points. The control points can be any form of sensor, including line-following patterns, NFC tags, RF cards, QR codes, and so on. The RF card is employed as a control point in the industry we service. The AGV system we propose comprises mostly of vehicle peripheral on-site components as well as a stationary control system. Vehicle, Guidance Path System, Floor Control, and Traffic Management System are the essential components of an AGV system.

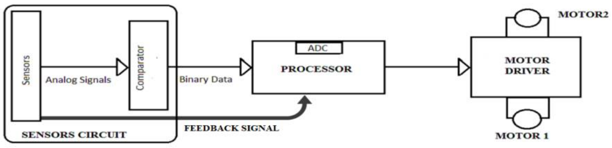

Fig.2. Process Block diagram

In the suggested concept, an AGV model can follow a line trace horizontally on a flat surface. During operation, this AGV type uses a microcontroller to control all navigation and lifting functions. In other words, the microcontroller serves as the model's brain, controlling all system operations. A sensor circuit of IR sensors acts as the navigation equipment to process line following along with straight, right, left; RFID circuit may direct the turning operations to achieve material loading locations. Two brushed DC motors function for right and left drive which is controlled using PWM driver controller board. The robotic system is powered using a 24V/10Ah lithium ion battery for a long life and efficient charging. The steering and speed commands are issued by the AGV's central processing system. The map is saved in the AGV memory for the pre-defined industrial environment and controlled by the warehouse's stationary control unit.

III. SYSTEM DESIGN

A. Chassis Model

The establishment of a plan or convention for the construction of an object, system, or measurable human interaction is referred to as design (as in architectural blueprints, engineering drawings, business procedures, circuit diagrams, and sewing patterns). Various fields have different consequences for the design thinking process.

The chassis is the most significant design parameter to consider in this case. It is a load-bearing framework of an artificial item that structurally supports its construction and function. Our vehicle frame, which is the underside of a motor vehicle on which the body is placed; if the running gear, such as wheels and transmission, to justify the load carrying while it is run in the industry.

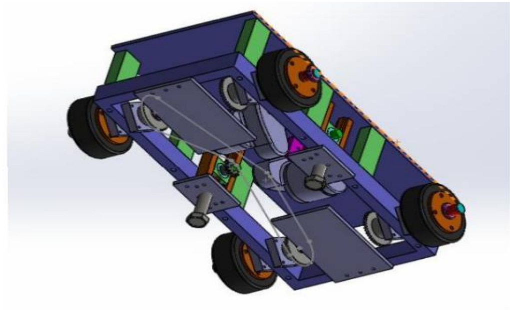

Fig.3. Chassis 3D design

B. Circuit concept

The main arduino micro-controller can be considered as the heart of the circuit board to which other components like HMI display, sensors, RFID transmitters and receivers are connected accordingly based on the pin diagrams of each respectively. The circuit diagram is designed using an electronics circuit PCB designing software called EasyEDA.

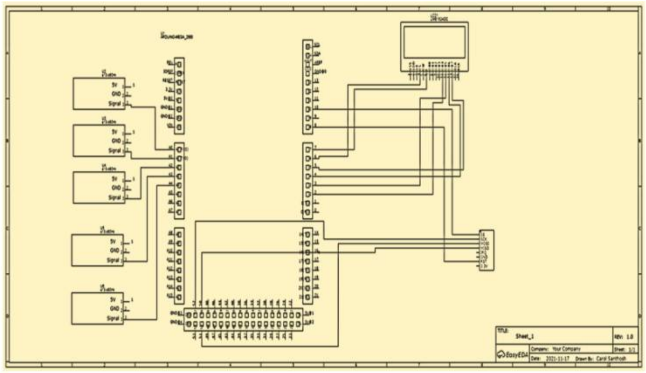

Fig.4. Electronics design

C. Working Principle

A yellow brilliant reflective tape, which is an optical sensor tape, serves as the guiding path for the AGV to follow and traverse precisely. The array sensor detects only the 60mm yellow tape, regardless of ground colour variations. It is placed straight and on curves around the twists to allow for easy movement and crosses stations.

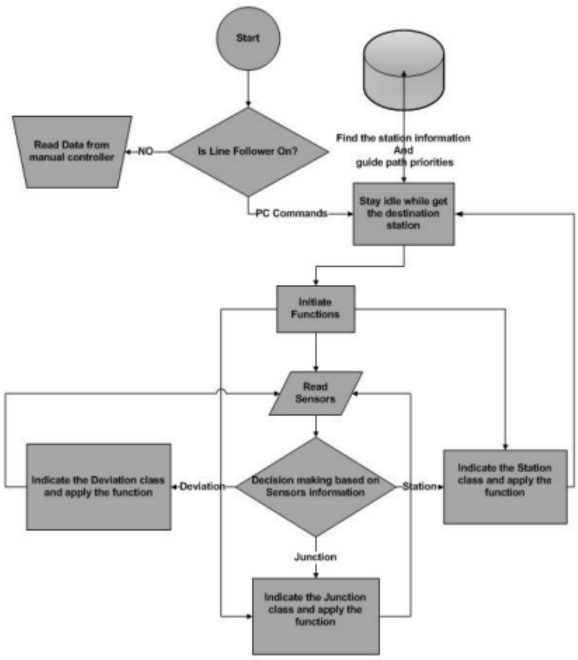

Fig.5. AGV Flowchart

Radio frequency tags are placed beneath the reflective tape and at the stations as needed. These tags are not visible on the path, but they are required to function as stopping locations as well as to guide the vehicle around curves and determine the shortest path or direction of motion. The essential components of station information are the station's height and the path each station takes to the others. The host controller unit's data base stores information about each station. This data is entered into the guiding unit before the AGV is deployed to a station, allowing the AGV to adjust the turning priorities and lifter height to match the station's height. Furthermore, the guiding unit refers to this updated data as a starting point for the next command.

IV. SIMULATION RESULTS

A. Electronics Simulation

A simulation software called Proteus is used for simulating the electrical and electronics part of the project to test if the connections are made right and a certain output is generated. The efficiency of the sensors can be confirmed using this simulating tool with easy construction options. The detailed simulation performed is given in the below figures.

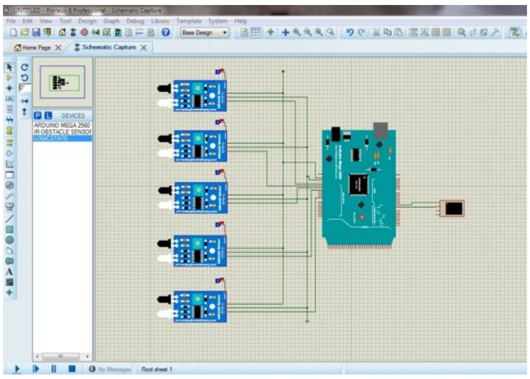

Fig.6. IR sensors testing

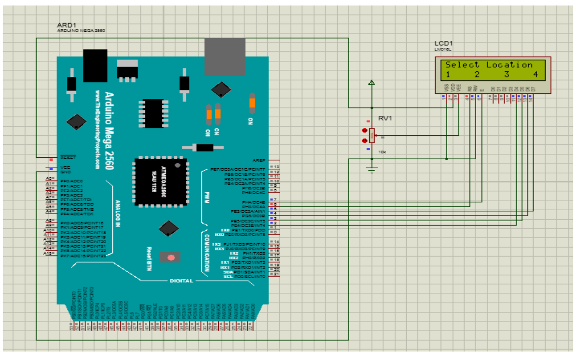

Fig.7. Locations calibration

B. Path Process

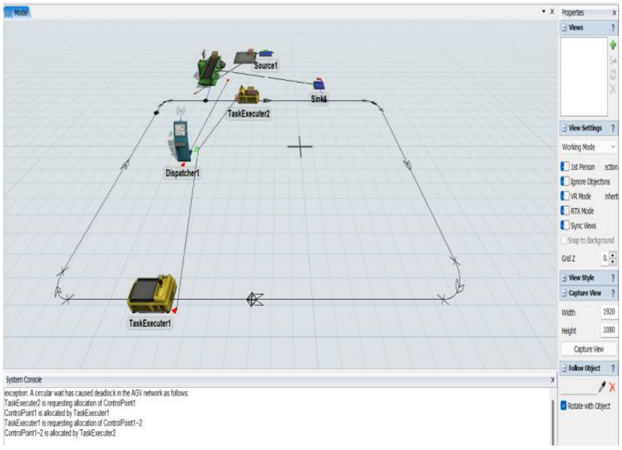

Fig.8. Path simulation

V. CONCLUSION

With the help of simulation technology, the embedding of hardware and software were illustrated. Evidently, this project of the automated guided vehicle can take over the control of material handling and manipulate the warehouse. The components chosen have proved to be of the right specifications in order to carry loads of up to 200kgs and the mechanism designed is most feasible. Moreover, The Arduino Micro-Controller has been used to its maximum potential and is compatible with the industry application. The simulation carried out has been successful and required output functions and performance is obtained. Further development into a robot running in the factory environment can be accomplished with efficient testing.

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