Automated Guided Vehicle(AGV) for Industrial sector

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Abstract— **Automated Guided Vehicle (AGV) is the future drift that provides unmanned transportation - that transports all kinds of products without human intervention in production, logistic, warehouse and distribution environments. The key pro of AGV is that they can operate as a standalone system with higher efficiency. The proposed work has a predominant feature of AGV in which the EPROM is used for holding the data. Taking up the advantage of EPROM (non volatile), the robot can retain and progress with their current execution even when the system comes back to the powered state after a period of power loss at crisis conditions. The AGV's serves many of the industries with greater efficacy compared to the manual functioning. The AGV is implemented using ATMEGA 328 controller which has a remarkable EPROM compared to other controllers. The controller is being assisted by the ultrasonic sensor that enables the obstacle detection capability in the bot. The AGV can be further promoted to the elevation of automation by its artificial intelligence that is being controlled by Bluetooth / Wi-Fi.**

Keywords—EPROM, ATMEGA 328 Controller, ultra sonic sensor, Bluetooth.

INTRODUCTION

The Automated Guided Vehicle (AGV) is used in most of the manufacturing systems for loading and unloading the materials. The main usage of AGV is for dispatching the goods from one location to another with greater ease. The AGV can tow objects behind in trailers to which they can autonomously attach. Such trailers are utilized to move raw materials or finished product. Earlier this was done completely by human effort which was not that efficient. The human work has been replaced by the usage of Line followers[1]. The line followers have been classified into major types based on their utility. Wired line follower in which a slot is being made on to the floor and a wire is placed along which the AGV follows using the sensor that detects the relative positioning of the radio signal. The main disadvantage of wired line follower is that the installation becomes very tedious in case of dynamic industries. The Wired Line followers[2] are restored by Guided Tape[3] in which the AGV's use tapes for the guide path. These tapes are of two types: magnetic or colored The AGV is fitted with the apt guide sensors that are used to follow the path of the tape. The advantage of guided tapes over wired guidance is that it can be easily removed and relocated. A flexible magnetic bar[4] can be embedded in the floor, like a wire - but works similar to the provision as magnetic tape and so remains unpowered or passive. Another benefit of magnetic guide tape is the double polarity. Small pieces of magnetic tape may be placed to change states of the AGC (Automated Guided control) based on polarity and sequence of the tags. The Guided Tape is though its initially a smaller amount, but lack the advantage of being embedded in high traffic areas in which the tape become damaged or dirty.

The next to the Guided Path its Laser target navigation[5] in which routing is made by mounting reflective tape on walls, pole or fixed equipment. The AGV carries a laser transceivers on a rotating turret using which the angle and distance to any reflectors that in line of sight are automatically calculated. This data is compared to the map of the reflector layout stored in the AGV's memory and attains the required navigation. The demerit of Laser Target navigation is that it produces greater overheads and requires more system maintenance.

Currently in the world of consumer society, where the corporations which are seeking to improve work efficiency, minimize the cost of human operators in logistics, and also bring the production cycle time down, make an accurate utilization of robots can promote the operation of the working process by simplifying it to greater extent. Such progress is rendered by Automated guided vehicle (AGV) a type of mobile vehicle that works without human intervention. Compared to the previous trends the navigation in AGVs more often than not use signal paths[6], lane paths or beacons. The AGV's are completed by the usage of sensors for navigation is optical sensors, magnetic sensors, laser scanner. Modern AGV differ from the conventional ones, instead of using fixed paths many modern AGVs are free-ranging[7]. Thus their preferred tracks are software programmed, and can be changed fairly easy when new stations or flows are supplemented. While moving the vehicles it is necessary to ensure the safety of the environment[8], personnel are taken care by the vehicle itself. The safety is ensured by the process of sensors that detect obstacles and approaching danger in their path.

This paper proposes a method of AGV navigation which is constructed using ATMEGA 328 controller used for controlling and coordinating all the peripherals. The motion of AGV is obtained using 4-servo motors which are driven by 2 motor drivers. Separate EEPROM memory module is being used for storing the inputs. The AGV is controlled using a Bluetooth module. This paper is organized as follows: The AGV system description is presented in Section II. Section III explains the path replanning in presence of any obstacle. The Simulation and Experimental analysis are shown in Section IV. The paper is summarized with a conclusion in Section V.

SYSTEM DESCRIPTION

The AGV constructed in this paper is by ARDUINO board which is represented in Figure 1

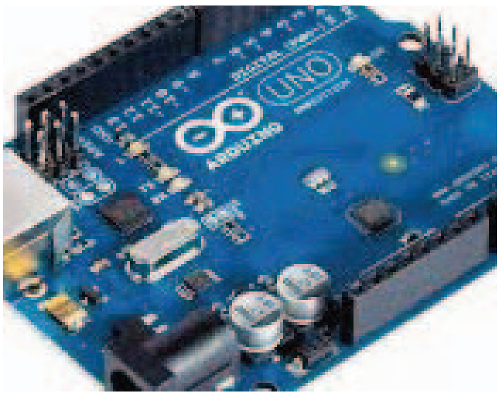

Figure 1: Arduino Uno Board

We use Atmel®AVR®Atmega 328 in our AGV which is is a low power CMOS 8-bit microcontroller based on the AVR RISC architecture. They are capable of executing powerful instructions in a single clock cycle; the Atmega328 achieves throughputs approaching 1 MIPS per MHz, which allows the system designed to optimize power consumption as well as processing speed. They posses 14 digital input/output pins in which 6 can be utilized as PWM outputs 6 analog inputs, a 16 MHz quartz crystal, a USB slot, a power jack, an ICSP header along with a reset button. They provide everything that is required to connect with a PC for inter-communication[9]. The board can be powered either using a AC-to-DC adapter or with the USB port or using a battery. The Arduino board is more user friendly in which programming part becomes very effortless even for an intricate applications. The navigation of AGV is obtained using servo motors which are connected to the controller using an interface of motor driver. In our work we use L293D motor driver which facilitates AGV navigation with ease. The L293D pin diagram is represented in Figure 2

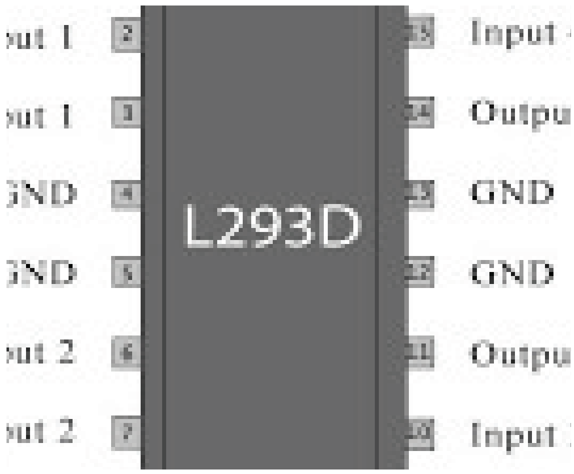

Figure 2: Pin diagram of L293D (motor driver)

The interconnection between the Arduino and Motor driver is given by Figure 3

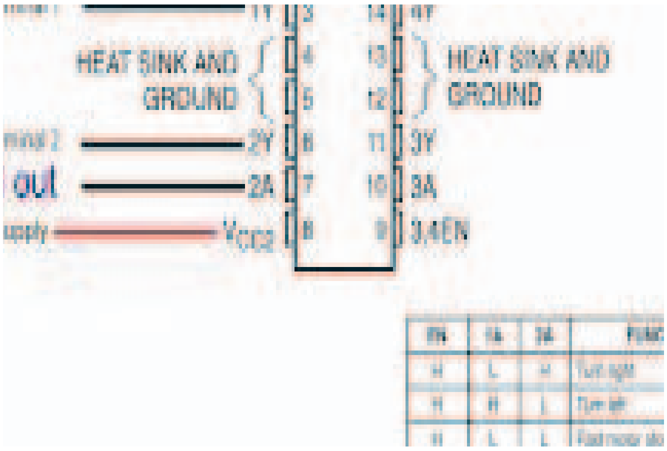

Figure 3 : Motor driver with Arduino

The data are stored into the EEPROM module. There is a need for additional EEPROM module as it the EEPROM storage in Arduino is not appreciable[10]. The data is fetched in such a way that they are executed in either ways – top to bottom or bottom to top fashion. But as it's required to execute in both ways the programming is made for dual execution. The usage of EEPROM takes a vital part in AGV. Taking up the advantage of EPROM (non volatile), the robot can retain and progress with their current execution even when the system comes back to the powered state after a period of power loss at crisis conditions.

Another important feature that is used for controlling the AGV is the Bluetooth Module. The usages of mobile phones have increased to a greater extent. Thus it would be very simpler in case of controlling systems through phones. One such feature is enabled using the Bluetooth module[11]. They enable us to control the AGV in different states from our place within the working sector (ought to be within visible range of 10m). The Bluetooth module is represented in Figure 4. They posses 4 pins in which VCC – is used for powering the module, along with TX – for transmitting and RX – for receiving and along with that VSS – for grounding purpose.

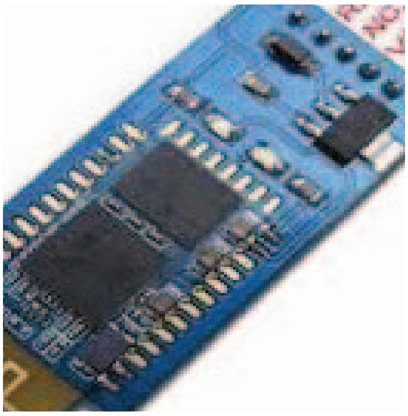

Figure 4: Bluetooth module

All the components are arranged as shown in the Figure and thus the AGV navigation is made possible.

PATH REPLANNING

The need for path replanning occurs as in case of any obstacles that arises in the path of the AGV. Consider a path 'A' in which the AGV is traversing, if the path is obstacle free then AGV moves without and interventions and reaches the destination as per the program. But as in case of any obstacle is seen in the path of AGV towards the destination path then there arises a problem. Such obstacles can be sensed using the ultra sonic sensors. The ultrasonic sensor is given by Figure 5. When any obstacle is detected then AGV tends to stop at that place and waits for the obstacle to move in case of any dynamic one. But when it becomes a static one then there requires a complete change of a path to reach the destination for which the path replanning is required. Its not necessary to have the complete map of the location in which the AGV is to driven. Instead Multiple path storage can be done which saves the memory. To understand the concept of multiple path storage we ought to have an idea about the dry run and free run. The dry run is nothing but the first time configuration of the vehicle to a path. It is like for the first time giving the instruction to AGV so that it's capable of storing the data in it. And this dry run is done only from the source to the destination and not for the reverse process. Because the reverse gets executed automatically this doesn't require further repetition of coding because of which the memory is saved to certain extent and can be used for other purposes. After dry run the path is stored in the memory of AGV and thus the direct job of AGV to get executed when it is left in the same path 'A'.

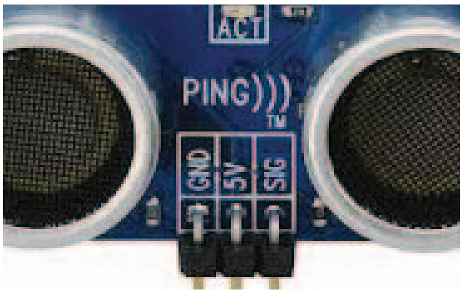

Figure 5: Ultrasonic sensor

As considered before in case of any obstacle in the path 'A' subsequently its necessary to take up a new path for the completion of job. In order to achieve that instead of feeding the complete map of the place the multiple path storage can be used. In this as an initial step the shortest path to the destination is found in the ascending order using any best shortest path algorithm. The path replanning is represented using the Figure 6

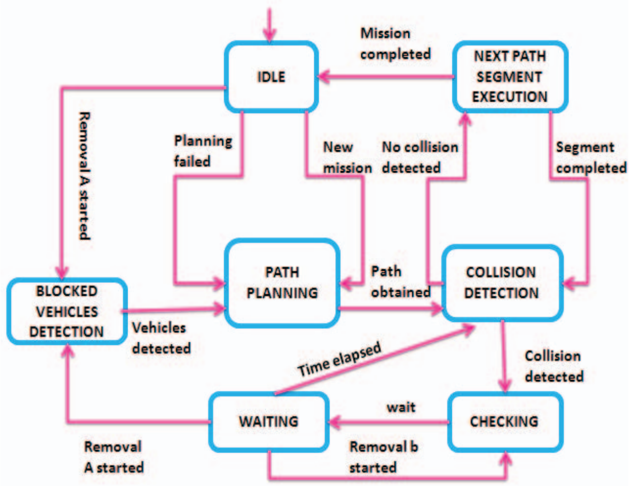

Figure 6: Path replanning

Then the dry run is made for the entire shortest path that was found using the algorithm. After which in case of any obstacle in the path 'A' which is considered to be the shortest path, then the second shortest path is taken and thus the destination is reached without any interventions. As a future work this can be extended for controlling AGV over internet in which the controlling capability is extended to a greater distance. This can be used in the case of large area.

CONCLUSION

This paper proposed Multiple path algorithm that are used for path replanning in case of an obstacle present in the path of AGV. This algorithm serves well in both known and unknown environment. To attain the task, the following were done system modeling, path replanning and controller deign.

ACKNOWLEDGMENT

I would like to thank Mr. R. Imtiaz Assistant professor ECE department, SMVEC for guiding me throughout the project. He has given me technical support and helped me to finish the project successfully.

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