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Autonomous Transport Vehicle Using RF-ID Technology and Dijkstra's Algorithm

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Abstract: Autonomous Transport Vehicle (ATV) is a driverless transport vehicle. It is basically used to transport people to pre-determined locations. As an autonomous vehicle, it is capable of sensing its environment and navigating without human input. To make the ATV cost effective and less complex than presently available, driverless cars, which uses DIP technology, GPS, Cartesian coordinating etc., here we use RF-ID tagging for pre-determining the location. This ATV uses IR sensors to determine the path. ATV determines the shortest path to be taken between two predetermined locations using Dijkstra's Algorithm. It uses an obstacle sensor which is the ultrasonic sensor for detection of pedestrians on the path. An on-board LCD display is in-cooperated within ATV to display information regarding its functioning. Such type of small scale ATVs can be used in institutional areas like within the campus and in tourist areas like parks for recreational purpose. Here we use our ATV inside the campus for transportation purpose within the campus.

Keywords: Cartesian Coordinating, Dijkstra's Algorithm Arduino Mega.

I. INTRODUCTION

Autonomous Transport Vehicles are those vehicles which can navigate through the environment without the help of human input. At present vehicles are driven by human. This includes human intervention in driving. But this will lead to driving stress, along with the loss of time, energy, leads to less productivity, less energy efficiency. In order to convert a normal vehicle into autonomous, it seems to be a very expensive process. The need for autonomous vehicle is becoming fast and inevitable. Autonomous vehicle comes with many advantages. It reduces driver stress and allows motorists to rest and work while traveling. Along with this, autonomous vehicles reduce the costs of paid drivers. Provide independent mobility for non-drivers, and therefore reduce the need for motorists to chauffeur non-drivers, and to subsidize public transit. Increases safety and reduces many common accident risks and therefore crash costs and insurance premiums. Keeping all this in mind, we intended to build an Autonomous transport vehicle which is cheap and has less manufacturing cost in large scale production. Inspired from Google car and pre mapping of the location we developed an Autonomous Transport Vehicle (ATV) which is cheap, efficient, ecofriendly, and self-navigating on private roads. ATV makes the transportation of humans and goods from one location to another with ease and less cost.

ATV is guided with the help of the RFID scanner and tags. RFID scanner and tags are very cheap and efficient. We use these passive components to navigate the ATV through the road. This is done by installing the RFID cards at different location and placing the scanner on the ATV. This will help in the navigation of the ATV between locations. Arduino mega is used here for coding process. Arduino coding is done for navigating and accepting the input and providing steering and driving output. Each RFID card is provided for a specific location and the scanner will pick up the ID address of the cards. Based on this information the required output is given to the driving unit. Along with this, obstacle sensor and pedestrian alerting facilities for the ATV is incorporated. When an obstacle is sensed, the ATV will stop and wait for the obstacle to clear the road. ATV is mainly supposed to be used in private roads. It can be used for recreational purpose and also within the campus. ATV can provide a smooth and pleasant ride. Basically this can be employed on any streets other than public roads with less cost. In future DIP, GPS, etc. can be included in the ATV to be used in public road. All these capabilities in an ATV can lead to efficient driving just like a normal vehicle.

II. METHOD OF IMPLEMENTATION

A short overview of the components used in the device is given below:

A. CENTRAL COMPUTING UNIT

Arduino is an open-source computer hardware and software company, project and user community that designs and manufactures microcontroller-based kits for building digital devices and interactive objects that can sense

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and control objects in the physical world. It provides a set of digital and analog I/O pins that can be interfaced to various expansion boards and other circuits. The boards feature serial communications interfaces, including USB on some models, for loading programs from personal computers. Here in this project we use the Mega 2560 microcontroller board based on the ATmega2560. It has an operating voltage of 5V, input voltage of 7-12V. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), DC Current per I/O Pin is 20 mA, 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

This Arduino acts as the central computing unit in this project. It controls the main units of ATV i.e., the location detection unit, navigation and driving unit and obstacle sensing unit. A Display unit is present so as to display the output information from the Arduino board.

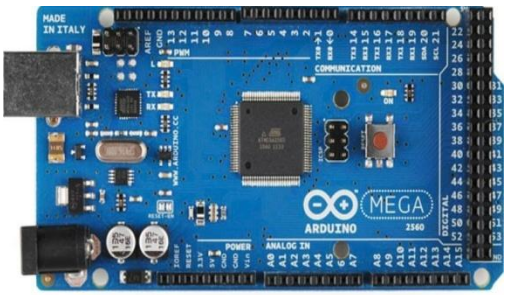

Fig. 1 Arduino Mega is used as the central computing unit to which all the inputs are given and the output is taken.

B. LOCATION DECTECTION UNIT

In this project RFID card and reader is used detect the location required to reach. RFID stands for Radio- Frequency Identification. The acronym refers to small electronic devices that consist of a small chip and an antenna. The chip typically is capable of carrying 2,000 bytes of data or less. The RFID device serves the same purpose as a bar code or a magnetic strip on the back of a credit card or ATM card; it provides a unique identifier for that object. A significant advantage of RFID devices is that the RFID device does not need to be positioned precisely relative to the scanner. RFID devices will work within a few feet (up to 20 feet for high- frequency devices) of the scanner. The RFID tag does not have to be scanned directly, nor does it require line-of-sight to a reader. The RFID tag it must be within the range of an RFID reader, which ranges from 3 to 300 feet, in order to be read. RFID technology allows several items to be quickly scanned and enables fast identification of a particular product, even when it is surrounded by several other items.

The RFID reader will be fabricated on the vehicle which in turn read the identification numbers of different tags placed in different locations. The RFID reader will be provided with the identification number of the tag in the desired destination that the vehicle has to reach. The vehicle will take the shortest path available to reach the destination. The different locations to be reached by the vehicle are provided with separate RFID tags. The RFID tags are placed in a favourable distance so that the reader will be able to recognize the particular tag. And thus the different locations are switched and can be identified by this RFID technology.

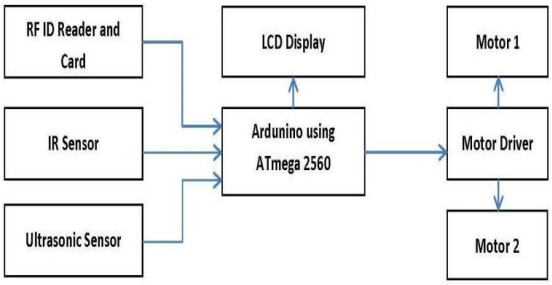

Fig. 2 Block Diagram

D. NAVIGATION AND DRIVING UNIT

A Passive Infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based motion detectors. All objects with a temperature above absolute zero emit heat energy in the form of radiation. Usually this radiation is invisible to the human eye

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Fig. 3 Overview of the campus.

because it radiates at infrared wavelengths, but it can be detected by electronic devices designed for such a purpose. The term passive in this instance refers to the fact that PIR devices do not generate or radiate any energy for detection purposes. They work entirely by detecting the energy given off by other objects. PIR sensors don't detect or measure "heat"; instead they detect the infrared radiation emitted or reflected from an object. A PIR-based motion detector is used to sense movement of people, animals, or other objects. An individual PIR sensor detects changes in the amount of infrared radiation impinging upon it, which varies depending on the temperature and surface characteristics of the objects in front of the sensor. When an object, such as a human, passes in front of the background, such as a wall, the temperature at that point in the sensor's field of view will rise from room temperature to body temperature, and then back again. The sensor converts the resulting change in the incoming infrared radiation into a change in the output voltage, and this triggers the detection. Objects of similar temperature but different surface characteristics may also have a different infrared emission pattern, and thus moving them with respect to the background may trigger the detector as well. PIRs come in many configurations for a wide variety of applications.

PIR sensors are motion detectors which keeps the vehicle oriented through the given path. It senses the path and will align the wheels in the desired direction by sensing the black colour on the path and it stops when senses white. So the vehicle will be in the correct path without any deviation. The motors used are of 10 rpm. The speed of the vehicle is designed according to the braking distance. Braking distance is the time vehicle will take to stop after sensing an obstacle.

To find the shortest path, Dijkstra's Algorithm is used in this project. Dijkstra's algorithm is an algorithm for finding the shortest paths between nodes in a graph. A more common variant fixes a single node as the "source" node and finds shortest paths from the source to all other nodes in the graph, producing a shortest-path tree. For a given source node in the graph, the algorithm finds the shortest path between that node and every other. It can also be used for finding the shortest paths from a single node to a single destination node by stopping the algorithm once the shortest path to the destination node has been determined. Here each node represents the RF- ID tag placed in each location hence finding the shortest distance required.

Fig. 4 This is the IR Sensor used so as to keep the ATV in its path. It senses the path and will align the wheels in the desired direction by sensing the black colour on the path and it stops when senses white.

E. OBSTACLE SENSING UNIT

Ultrasonic sensors are used commonly in autonomous vehicles. They are used mainly to determine an obstacle in front of the vehicles. There are mainly 4 Pins: echo, Vcc, ground and trigger. Here the echo pin is the receiver and the trigger is transmitter of the ultrasonic sensor. The echo pin determines the obstacle and it transfers the signal to trigger pin. The trigger pin then transfers the signal to microcontroller. As the ultrasonic sensor is connected to microcontroller, it processes it and displays it in the program as output. The output is transferred to the buzzer connected to the microcontroller, the buzzer produces the sound. The main action of the ultrasonic sensor

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is based on duration and distance. There are wide varieties of ultrasonic sensors, the commonly used are of about 2 meters in range. The ultrasonic sensor used in our project is to indicate the hindrance that is responsible for the normal motion of vehicle. The ultrasonic sensor is connected to the microcontroller. The microcontroller is then connected to buzzer as it produces voice based on the indication from the sensor. The program written on the microcontroller is such that the indication of sensor is passed to buzzer. There are 2 ultrasonic sensors used in this project. The first one is to determine the obstacle in front of the path and the second one is fixed behind the vehicle. The purpose of the second one is such that as the vehicle moves through the path indicated, it should also have movement in reverse direction. Thereby in both directions it senses the hindrance.

E. DISPLAY UNIT

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven_segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters(unlike in seven segments), animations and so on.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.
In this project the LCD display is used to display the information regarding our location. It gives information about the path to be taken.

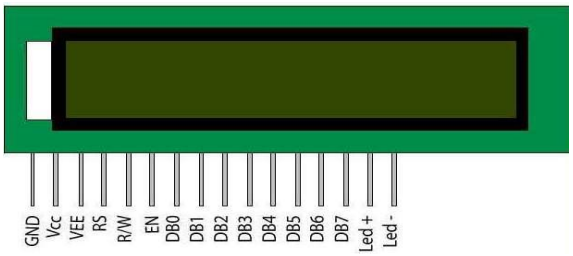

Fig. 5 The 6x2 LCD Display is used to provide information regarding the location.

III. CONCLUSION

An Autonomous Transport Vehicle is developed nowadays so as to ease human efforts. People opt for easier transport with less cost which can be provided by an ATV. The ATV is cheap, efficient, ecofriendly, and self-navigating on private roads. So the need for autonomous vehicle is becoming fast and inevitable. But this ATV cannot be used in public roads and large cities. They are mainly used in private roads such as in tourist areas for recreational purposes and also within a particular campus. This autonomous vehicle can be developed in future by using different technologies like DIP, GPS, Cartesian coordinating etc., and used for larger purposes. If these vehicles come into action, there would be a reduced need for road signage, as the vehicle would receive information electronically through signals. There would also be a better management of traffic flow, which would be monitored over a controlled system. Hence it could become a great privilege to the human race.

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