Implementation of Autonomous Vehicle with Microcontroller

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ABSTRACT

The main concept to design and implement a basic self-guided vehicle which will be programmed and distended by anyone possessing basic experience with the C programing language. The Self-Guided autonomous Vehicle, uses ready-made, easy, straightforward method to get elements like a toy R/C car or a simple basic design of an vehicle of our choice to maximize convenience of this technology .This Paper divides the vehicle design by practicality. It starts by documenting the locomotion system that was a modified toy. Next, it describes the Microcontroller board. Then it highlights the programming language, Interactive C that makes multitasking systems straightforward for beginners. The device system that comprises a GPS receiver, a solid state electronic compass and a wireless communications system to get waypoints. Finally, the thesis documents the program code necessary for sure-fire navigation and explains the verification method, wherever the vehicle needs to follow a set of waypoints that were outlined by latitude-longitude coordinates.

KEY WORDS: Autonomous vehicle, Miniature unmanned air vehicle (miniatureUAV), Arduino

1. INTRODUCTION

Self-Driving Autonomous vehicle is a transport medium without any human intervention. The title itself is enough to acknowledge the core concept .Every mighty company like Google, Amazon are working on this project. Both of these are autonomous making use of machine learning algorithm.

Autonomous cars detect surroundings with enormous techniques for example GPS, radar, lidar, odometer, and computer vision. Advanced control

Systems interprets information that are sensory in order to identify the appropriate navigation path, as well as obstacles and relevant signage. Autonomous cars have control systems that are able to analyse sensory data to distinguish the different cars on the road, which is helpful in planning a path to the desired destination.

Unmanned Autonomous Vehicles (UAV) may be a terribly necessary application of control systems, sensors and computing. They enhance the flexibility to finish missions in places where people in general wouldn't unremarkably go. With a lot of destinations at our reach, such as outer area, war zones, and health-hazardous areas, autonomous machines become the sole viable agents to satisfy our interests in those territories. Autonomous vehicle platforms have, to date, not been offered to the typical student. Most often, the scholar should become a part of a well-established robotic science laboratory to be able to access any kind of mobile automaton platform.

Therefore, engineering students, who have an interest in autonomous vehicles, don't simply have the chance to implement their management concepts. The purpose of this analysis was the event of a reasonable pilotless autonomous vehicle. The vehicle was termed the Self-Guided small Vehicle, (SGMV). The vehicle utilized GPS navigation, a solid-state compass and ultrasonic sensors. Upon completion, this guided vehicle was to become a platform for the other engineering student or roboticist to implement navigation schemes and/or add sensors for the vehicle to react to its surroundings.

2. REQUIREMENTS

The hardware requirements of the project implementation of autonomous vehicle with microcontroller includes Arduino UNO/mega, GPS module, Ultrasonic sensor/IR sensor and servos, motors, chassis, etc.,

Arduino Uno R3: Arduino is open-source hardware. Arduino is a PC equipment and programming organization, venture, and client group that outlines and produces microcontroller units for building computerized gadgets and intelligent articles that can detect and control protests in the physical world. Arduino projects might be composed in any programming dialect with a compiler that produces binary machine code.

Figure.1. Arduino Uno R3

GPS Module Arduino: The NEO-6 module arrangement is a group of remain solitary GPS recipients highlighting the elite u-blox 6 situating motor. Their minimal design and power and memory choices make NEO-6 modules perfect for battery worked cell phones with exceptionally strict cost and space limitations. Current current electrical

power into mechanical power. The most widely recognized sorts depend on the strengths delivered by attractive fields**.**

DC Motor: A DC engine's speed can be controlled over a wide range, utilizing either a variable supply voltage or by changing the quality of current in its field windings.

Figure.2. DC Motor

Ping Sensor: Ultrasonic sensors (otherwise called handsets when they both send and get, however for the most part called transducers) chip away at a guideline like radar or sonar which assess properties of an objective by translating the echoes from radio or sound waves individually. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object.

Figure.3. Ping Sensor

The software requirements include Arduino IDE, Eclipse IDE and Google map API.

Related Work: 11 companies working on driverless cars: Volvo, Google, Tesla and more are investing in autonomous vehicles.

Google's Waymo is an autonomous car development company spun out of Google's parent company, Alphabet in December 2016. It then took over the self driving manufacturing which Google had begun in 2009. Alphabet describes Waymo as "a self-driving tech company with a mission to make it safe and easy for people and things to move around".

Amazon Prime Air is a cargo airline and conceptual drone-based delivery system currently in development by Amazon. The hub will begin operations in April 2017 and will quickly expand under a $1.49-billion expansion plan with 40 Boeing 767-300F's and 200 daily takeoff and landings. The Main problem of these technologies is cost. The big giants working on this have contributed millions of dollars to build autonomous vehicles ensuring ZERO fatality, which in-turn restricted students from involving in such researches.

Proposed Work: The implementation of autonomous vehicle is carried out using a microcontroller in this project. A microcontroller is a small computer on a single integrated circuit. It is a system on a chip or SoC. It contains one or more CPUs along with memory and programmable input/output peripherals. Microcontrollers are used in automatically controlled product and devices, such as automobile engine control system, implantable medical devices, remote control, office machines, appliances, power tools, toys and other embedded systems.

In our proposed system the Self-Guided autonomous Vehicle, uses ready-made, easy, straightforward method to get elements like a toy R/C car or a simple basic design of an vehicle of our choice to maximize convenience of this technology. So this gives the technology enthusiastist's or hobbyist's the hands on experience with little cost. This generally enables getting various point of perceptions from all the techies, thus booming the research space in this.

Using Differential Drive Actions: Differential-drive locomotion is accomplished by inserting two wheels or tank tracks at either side of the vehicle. every wheel is driven independently. Betting on the direction the wheels flip, the vehicle can move in some definite direction. Table one may be a outline of the differential-drive locomotion theme.

Table.1. Differential drive actions

Left wheel	Right wheel	Vehicle Motion
Forward	Forward	Straight forward
Backward	Backward	Straight backward
Forward	Backward	Turn left on a dime
Backward	Forward	Turn right on a dime
Fast forward	Slow forward	Forward, turning left
Slow forward	Fast forward	Forward, turning right
Still	Still	No motion

Software Part: The prototype model of this project gets the destination point from the user and forms a path (shortest path with the help of A* search algorithm). This user interface (UI) is designed in eclipse with java. For each turn to take the system instructs the vehicle accordingly.

Hardware Design: The hardware is designed in such a way that it automatically detects obstacles and finds a way ahead. The GPS module on it helps positioning the vehicle.

Arduino is a computer hardware and software company, project, and user community that designs and manufactures microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world.

Working: The Autonomous vehicle with a microcontroller is all about making decision on its own without any human intervention. The brain of the robot will be Arduino.

The autonomous vehicle is moved from source to destination by using the GPS module. The GPS module automatically senses the source of the vehicle and the destination is given by the user. Obstacle avoidance plays a major role during transportation. This module includes two ultrasonic SR-04 sensor compatible with Arduino Uno. Ultrasonic sensor has four pins power (5V), ground, trigger, echo. When the trigger is set high, the sound waves are emitted. Then the trigger set to low. After that to receive the emitted sound waves, the echo pin is set to high.

Basic Algorithm:

Table.2. Basic Algorithm

Ping left	Ping right	Direction	Speed
False	False	GPS Guided	Fast
True and Far	True and Far	GPS Guided	Slow
True and near	True and near	Nil	Stop
True and near	False	Turn Right	Slow
False	True and near	Turn Left	Slow

Design and Architecture: The design process for implementation of autonomous vehicle in this project is prepared using a microcontroller. As the magnetometer is sensitive to electrical interference, it must be positioned in such a way that the DC motors does not affect the readings of the compass in any way. With the current location from the GPS and the current heading from the compass, we calculate the path to our destination.

The basic algorithm behind it will be

- Go fast if no obstacles were found
- Turn left if the right ping detects obstacles and is far.
- Reverse to right and move left if right ping detects obstacles and is near,
- Turn right if the left ping detects obstacles and is far,
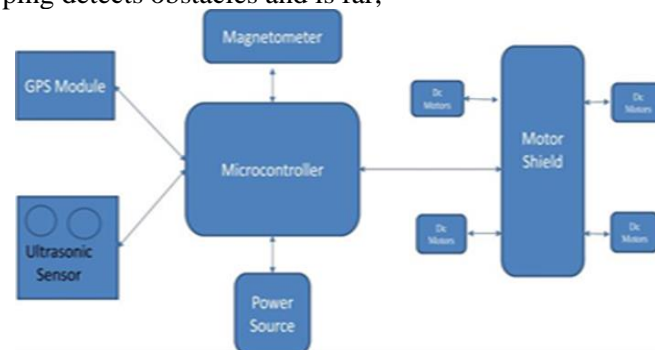
Figure.4. Architecture

- Reverse to left and move right if left ping detects obstacles and is near,
- Slow down if both the ping detects obstacles and is far,
- Stop if both the ping detects obstacle and near.

3. RESULT AND CONCLUSION

This paper presents an autonomous self-driving vehicle which is designed using a microcontroller. The use of microcontroller Arduino makes the project unique and effective. The autonomous vehicle thus designed can handle any kind of obstacles on road. The DC motors used in this model helps the system in providing higher starting torque and fairly constant speed. These motors are made used in fans, pumps, lifts, etc., in order to produce uniform speed.

The GPS module made used in this project uses the Global Positioning System to determine and track precise location and its carrier at intervals. This project has certain properties as that of Waymo and Air prime by Google and Amazon respectively. But unlike these two models the designed model will be able to recognize any kind of obstacles in its way, in this way it is unique from the other models. The only disadvantage of this model is that it would not be able to stop at any traffic light signals and hand signals. This Autonomous car with microcontroller is

very much efficient, cost effective and also time consuming. The disadvantage of this model could be surely cleared on further experimentation.

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