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Design of Autonomous Vehicle Based on GPS Navigation

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Abstract: An Autonomous Vehicle (AV) could be a self-piloted vehicle that does not require an administrator to explore and finish its functions. It is the diffusion of automation in mobility, which is going to accelerate in the near future [3]. Autonomous vehicles are a recently developed subset of robotics and can come in three general forms; air, ground and submarine. One potential function of an autonomous vehicle is to operate a pre-programmed route while avoiding any interference the vehicle may encounter. The vehicle can accomplish this task by using sensors to "see" where it is and what is around it. These sensors vary from close range infrared sensors to longer ranged high frequency radar and global positioning system [8].

In this paper, we developed few algorithms for the guidance mechanism and different techniques have been implemented for the control and guidance of the autonomous vehicles. Microcontroller which is used as control unit for exhibiting the autonomous behavior of AV. Navigational & Guidance Program developed which is responsible for collecting & parsing the GPS data & producing the various errors based on this. In the guidance part, the program computes the distance between two different points. It draws an imaginary line between them and then vehicle approches to the final destination.

Keywords: Autonomus, Self driving vehicle, Navigation, Guidence, Megnatometer, Bluetooth, Artificial intelligence.

I. INTRODUCTION

A Few decades from present, a child from nowadays will barely accept that individuals used to drive vehicles physically. The march toward autonomous vehicles or self-driving cars is well underway and though it may be a few years until we get there, the destination may be closer than most people think. The usefulness of Autonomous Vehicle (AV) in such a wide area of applications motivated us to undergo with the development of such a system. This paper examines the promises and challenges in the development of Self-Driving Vehicle (SDV) technology. We begin with the assumption that the combination of diverse computing innovations inserted in SDVs could be a capable apparatus for proficiency in communications, information gathering, processing, and storage. However, by focusing on efficiency, SDVs provide a new mode of industrialized transportation [4]. SDVs also promise increased safety, speed and convenience, as well as reduced energy consumption. Researches about autonomous vehicles technology could just be the solution to our traffic problems and traffic jam, reduce the number of road accidents and save the time that people engage themselves while driving for some other task [1,2].

To accomplish certain task the AV must be equipped with relevant sensors and actuators. However, to serve any useful purpose the AV must move autonomously based on the data of navigational sensors. The control system must know at least two things, its own current position and direction of travel in order to navigate a vehicle autonomously. Position can be decided either from an exterior source with innovation such as the Global Positioning System (GPS) [8], or by calculating a travelled way from a known beginning point with the utilize of electronic compasses, inclinometers, and rotational counters. However, under any scheme, the outcome is to somehow generate the positional information of the vehicle so that the vehicle could be guided to follow a path and reach the target. In addition of this, the direction sensing devices are also used for getting the values of current heading of vehicle so that it could be steered to move towards target point. GPS has advantage over other position detection tool that it moreover gives an estimate of vehicle's current heading based on the past two positional coordinates. Whereas the current heading given by GPS isn't precise occasionally, it is imagined to suit GPS as the sole sensor for directing the autonomous vehicle to take after the direction in exterior applications.

II. METHODS AND PROCEDURE

We have under taken to design and develop an "Prototype of Autonomous Vehicle based on GPS navigation" with the aim of developing navigation & guiding program for ATMega2560 microcontroller which could be used as control unit for exhibiting the autonomous behavior of AV. In this research work the necessary data is extracted from the GPS and

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send it to the mobile phone which is connected to the vehicle via Bluetooth module. The first data is being the coordinates of the point where the vehicle is located and second data is the destination point which is continuously acquired by the controller with the help of GPS sensor. The Navigational & Guidance Program developed under this project is responsible for collecting & parsing the GPS data. As GPS starts, it locates the vehicle and sends the information to the Mobile phone. After this, vehicle wait till the user (Mobile phone) respond. Mobile user can decide the destination location and can change it further. In the guidance part, the program computes the distance between these two points and draws an imaginary line between them. After this process micro controller calculate angle to destination coordinate and set angle of vehicle. After computation of the destination coordinates, it will start to move forward towards destination. A Driver circuit [9] which takes power supply from Micro controller will be responsible for speed and alignment of the motors. We have used four motors, in all one for one wheel. As it is proposed under this research work, the vehicle can be moving in obstacle presented surface hence obstacle avoidance mechanism is implanted [5].

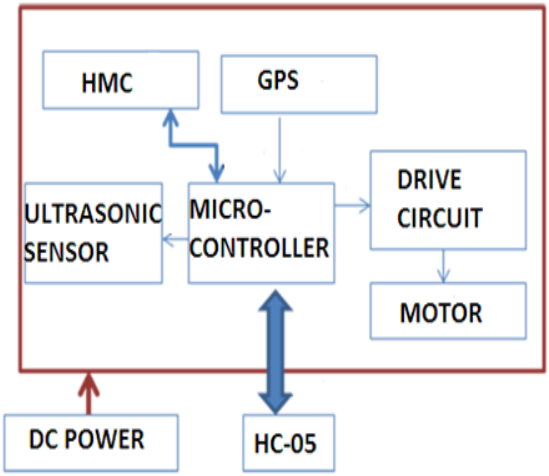

Figure 1: Block diagram of Autonomous vehicle system

The software developed under this research is responsible for exhibiting autonomous behavior of the vehicle. Software development is done using the Arduino IDE [9] which is a cross compiler for ATMega2560 microcontroller on windows platform. As shown in figure1, the modules developed under this project is mainly consist of;

- Interfacing of GPS and other sensors to Micro controller for data extraction.
- Connect micro controller to the mobile user via Bluetooth Module.
- Check current coordinate of vehicle and transfer it to the Bluetooth Module.
- Give further instructions through mobile like destination coordinate to the vehicle.
- Calculate angle to destination coordinate and set angle of vehicle which is shown in fig.2.
- Vehicle sense the obstacle with help of ultra-sonic and avoidance task will be performed with the help of magnetometer.
- Lab testing of AV.
- Stopping the vehicle once it has reached in vicinity of desired point till the next command.

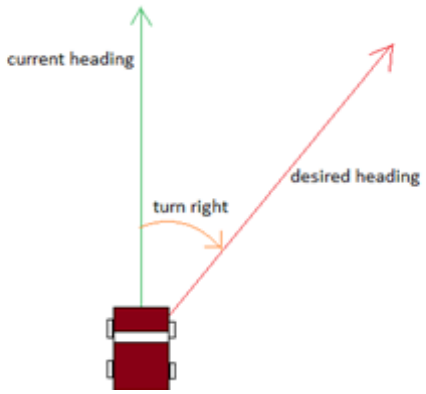

Figure 2: Direction finding diagram

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III.RESULTS AND OBSERVATION

The outcome of this whole research work would be a GPS based AV which could be able to travel to a destination point without any intervention of human and a try to develop the artificial intelligence [6] in the vehicle. In our research work, several test drives have been conducted to find the output of the program which led to a lot of bug fixes. The output of the program depended on a few external things, like- electromagnetic field from the motor of the Autonomous vehicle, the GPS signal quality, the phone's operator signal. Because of these things the output fluctuated from time to time, than the fact that for the initial time while it is on course, the vehicle is able to steer towards the desired heading keeping it on track. Indoor test drives have also been conducted. The target was to test the obstacle detection functionality of the vehicle. It was able to move freely indoors, avoiding obstacles, even coming out of corners. Sensor for obstacle detection worked properly. Though fixed sensors handled the job of obstacle detection pretty well, the vehicle still had some blind spots; the total 360o surrounding was not covered. This problem can be overcome by having a rotating sonar sensor that take a rotational 360o scan of the environment. And with more precise sensing of the velocity and displacement of the vehicle's movement, the vehicle could be able to perform more precise driving while Global Control is uncertain. We faced some problems during testing of the Autonomous vehicle. While the vehicle receiving the GPS, we used an Android phone to get the GPS. But there is always an error and some fluctuation occurs. We stored the coordinates of desired destination path and when the vehicle running through this path, some problem occurred due to the fluctuation of GPS reading, because the vehicle always compare between its current position(GPS position) and the coordinates of the path. Also the GPS not respond or showed the position as quickly as we need. It took time to update and also sometimes the GPS unable to find the current location. There is some problem regarding the steering control. It was observed that at low speeds some oscillation resulted due to the significant time-lag introduced into the control system as a result of the lack of available torque even when already moving. It is expected that with increased torque and better tuning this control system will operate in the required fashion.

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IV. CONCLUSION

The aim of the research paper is to design an autonomous vehicle driving system and to develop the artificial intelligence that would be able to make a driver less automobile safe enough to drive on the road. The goal was to develop a program that would run in an android operated environment and will be able to control the vehicle, thereby taking the responsibilities of the driver, providing a more manageable control over it.

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