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Arduino Powered GPS Motor Vehicle

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Abstract*: This whole study helps us in implementing and making an obstacle avoidance car. This robot is a mobile platform robot that navigates through each and every designated waypoints while trying to avoid any obstruction which comes in the way of the vehicle. We can move the vehicle from one point to another with the help of designated waypoints. This car is based on commonly used RC cars and are made with some modifications and advancements. We can do potential future enhancements by adding a SD card for logging GPS track. We can also add a camera for taking photos and videos. The arduino board acts as a controller which help us to control the speed and change the speed. It also controls the steering of the car to achieve automatic obstacle avoidance. The vehicle's speed is controlled with the help of pulse wave modulation (PWM) provided to us by the Motor shield. GPS helps us in providing global coordinates of the current location that where the vehicle is present in real time and it also tell us that where that vehicle is heading towards. With the combination of hardware and software we can easily navigate the vehicle and guide it towards right direction..

Keywords* : *Arduino Car, obstacle avoidance car, Ultrasonic sensors

I. INTRODUCTION

In today's world science and technology have developed a lot of things in the field of metallurgy, electronics, transport, defence and many more. In these recent years robots and machinery intelligence level has improved a lot. In this paper we are discussing about an aurdino powered GPS motor vehicle which is made with the help of many different components. We use a very advanced method which helps us to track and monitor the remote vehicle with help of the software. It is equipped with a software unit so that it can receive and transfer signals through the GPS satellite and this method is known as Automatic vehicle location. With the help of vehicle tracking system we can integrate the use of automatic vehicle location in each vehicle. We can say that Automatic Vehicle Location(AVL) is a combination of global positioning system (GPS) and geographic information system (GIS).GPS based passive vehicle tracking system is discussed in [1] and paper [2] discusses on the topic of Implementation of an Arduino obstacle avoidance car for automatic drawing a road map.

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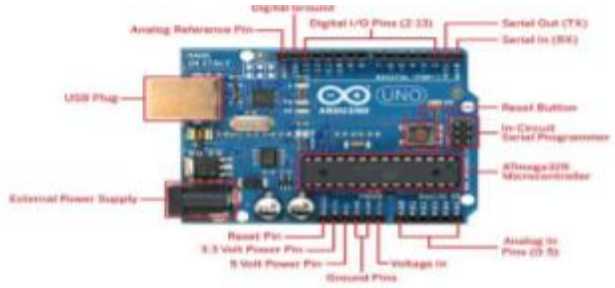
This helped us and motivated us to use GPS and other low cost devices for passive vehicle tracking which help the company to track the travelled path by the vehicle,and it also reduce fuel cost and optimize the misuse of official vehicles.

There are mostly two most common types of system which are GPS based and signpost based. The signpost based Automatic Vehicle Location is used in early times but with the development of technology modern satellites GPS technologies are also invented and are more used now because helps us to track the vehicle and monitor the vehicle and much more. Automatic vehicle location system is used to tell about the real time location of the vehicle. In the vehicle there is a hardware device which is installed in it and there is also a remote tracking server. RF transmitter if the distance between tracking server and vehicle to be track is less. In the vehicle there is also a tracking server that has an RF receiver that receives the vehicle location information and it also stores that important information in the database.

Fig.1.Automatic Vehicle Tracking

The whole focus of this paper is on hardware and software and with the combination of hardware and software and the programming we will make an RC model based car. In this we will use an arduino software IDE and will upload the code in the arduinoUNO board. GPS module provides data which includes time, date, latitude, longitude, altitude, speed etc. and this GPS data will be read by the Arduino board and stored in a SD card.



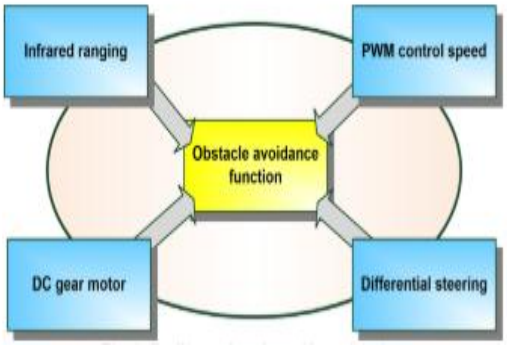
The Arduino Uno uses a low power microcontroller board which is of 8-bits. The arduino board has 14 digital input/output pins, a 16 MHz ceramic resonator, 6 analog inputs, a power jack, a USB connection port. It has a Circuit Serial Programming (ICSP) header. It also has a reset button.

We just simply has to plug in to a computer with a USB cable and upload the code to perform the functions.

II. RELATED WORKS

In today's world the cars in the market are distinguished by their functions and some of the certain functions and features are:

1. Intelligent obstacle avoidance car: Nowadays cars are so intelligent that they avoid any obstacle which comes in front of the car and has given the open to the world for self-driving.



2. Automatic tracking car: With the help of tracking sensor, we can track the car and find the car that where it is in the real time. Auto inspection can also be done.
3. Automatic following the car: With the help of infrared obstacle avoidance sensor, it automatically maintain its distance from other vehicles and perform obstacle avoidance function.
4. Wi-Fi control car: Wi-Fi helps us to monitor the video in real time and we can even stream the video. We can also control the movements of the car as according to our needs.

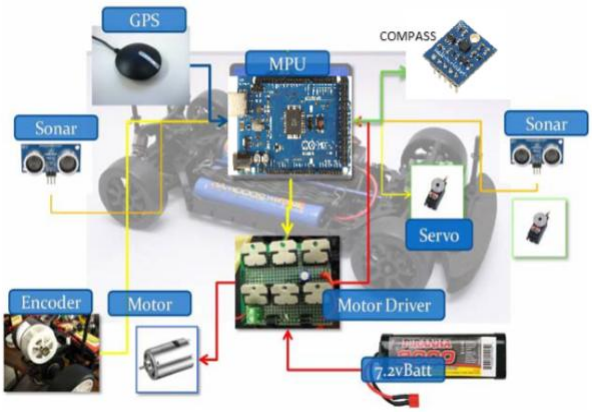


Fig: core hardware design

A. *Design of autonomous gps vehicle*

The autonomous GPS vehicle is composed of arduino UNO, MPU, compass, servo, motor driver, 7.2v battery, sonar.The above figure shows the hardware design. We can connect the power supply to arduino so that we can power the entire car. This car is also based on regular RC car and its entire components including microprocessor and the sensors are platformed on the same base. We don't need a driver because the microcontroller is almost equivalent to brain of a driver and it will process all the data and take decisions. The decisions are performed by giving signals to its actuators.

B. *Underbody design of the car*

In order to understand the underbody design of the autonomous GPS vehicle we will have a 3D look generated by the 3D printer and try to understand underbody design.
In the figure given below the point from 1 to 4 is used to set an Arduino control board.
The points from 5 to 8 is Used to set up a L298N driving motor.
The point 9 is used in to fit the infrared sensors in the car. The point 10 is used for installation of speed sensor.
The point from 11 to 14 is used to fit in the DC gear motor.
The point 15 help us to connect the motor through the board.
This point16 is used for the installation of the battery.

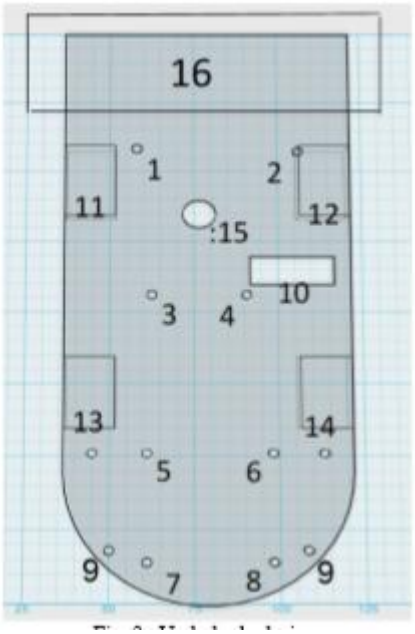


Fig: Underbody Design of autonomous GPS vehicle

C. *Implementation of autonomous GPS vehicle*

Table 1 shows the list of hardware's and other parts list with its prices and quantity. We use some of the hardware which is used in making of the autonomous GPS vehicle. Arduino UNO is the main control board. The IR sensors helps the car to detect the distance of other car that how far it is and avoid it from crashing with the other vehicle. Some of the features which are in the Arduino control board are:

1. The control board has an Open source code circuit design and the program development interface is also free to download. We can modify it as according to our needs.
2. We should use a low cost Microprocessor controller and it can be powered by USB interface and we also don't need any external power supply.
3. We can easily connect the arduino board with the sensors and a number of other electric components.
4. Arduino's interface is completely based on open source code and is completely free for everyone.
5. With an USB interface there is no need of external power supply.

Item	Desec.	Price	Qty	Sub Total	Remark
MCU	Arduino Mega 2560R3	725	1	725	Amazon.in
Motor Driver	Adafruit Motor Controller L293D	220	1	220	Amazon.in
GPS	u-Blox Neo-6M-0-001	1100	1	1100	Snapdeal.com
Compass	GY-271 HMC5883L	328	1	328	Amazon.in
Ping Sensor	Adafruit HC-SR04	164	4	656	Amazon.in
RC-Car	Cross Country*	-	1	-	Pre owned
Battery	Li-Po 1800mAh	500	3	1500	Ebay.in
Servo	Tower-Pro SG-90	200	1	200	Amazon.in
Motor	Brushed RS-540SH	175	1	175	Amazon.in
Misc. Stuff	Wire, Jack, etc.*	-	-	-	Pre owned

The open-source Arduino environment makes our work very easy and flexible. We just have to write the code and upload it into the I/O board with the help of the arduino IDE software. This module used TinyGPS++, Memory Free, SDFat libraries. TinyGPS++ is a library function which is mainly required to extract the GPS data which includes position, date, time, altitude, speed, course etc. from GPS receivers. It provides easy-to-use method to extract the data. SDFat library is mainly used to read and write data to SD cards.

III. PROPOSED WORK

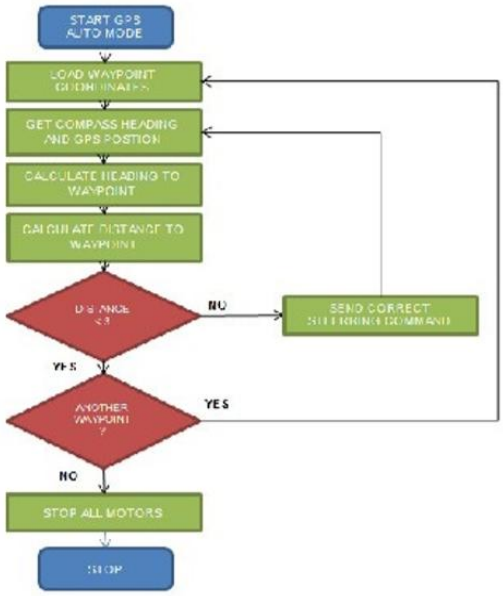
In this proposed system there is a lot of proposed work which is done in this field so that the cars can be more advanced and useful. The functions which are added in these car is tracking the vehicle and locking the vehicle with the help of GSM and GPS technology. It can be accessed by only its authorized user and nobody else.

If someone else try to open the door forcefully then the IR sensors senses the signals and send an SMS to the owner of the car that where the car is present at the moment and saves the owner car from the theft. These helps us in tracking and adding advance features like self-driving and are intelligent to avoid obstacle by itself.

There are Wi-Fi control cars which helps us in monitoring the car in real time and the movements of the car and save our vehicles from any theft.

Block diagram

1. We will tell you about the steps which is performed in the navigation mode
   1. At first we will initialize the GPS.
   2. We will then Boot up the GPS module and find the current coordinates.
   3. We will now set the pathway.
   4. We will now load all the designated waypoints into the list and we will select the first waypoint and the car will turn to the direction in which we have selected the waypoint.
   5. we will start setting the next waypoint so that it can travel to the next waypoint and we will again and again set the waypoints so that it can reach to its end point. The end point is the final destination of the vehicle
2. Obstacle avoidance
   1. With the help of sensors we can detect the vehicle and the sensors also find the distance that how far is the obstacle from our vehicle.
   2. Microcontroller is the brain of the car and it helps us to decide whether the object is in left or right.
   3. Microcontroller gives command to correct actuator signal and perform the function.



A. GPS

Nowadays every vehicle has a global positioning system (GPS) inside it. This navigation system is developed by the united states of defense department and is maintained and managed by the United States air force 50th space wing. This vehicle tracking system has a GPS which works with the help of global navigation satellite system. It is now used in all the vehicle so that we can keep a track of the vehicle.

B. Working of GPS

GPS satellite transmits the signals to the devices or equipment present on the ground and one of the most important devices in them are the GPS receivers. GPS receiver requires an unobstructed view of the sky so that it can receive the signals properly. They are kept in the outdoors where there is no tall buildings and have a clear view of the sky without any objects surrounding it. GPS operations depend on a very accurate time reference, which is provided by atomic clocks. The signals moves with the speed of light and is received by the GPS receiver. These signals sometimes arrive at different time because of the distance.

Some of the satellites are far away from the other satellites so that's why there is a time difference between the two signals. The GPS data of the path travelled by the vehicle is collected using a GPS receiver. The receiver collects the data from the satellites. Here it uses the principle of trilateration and locates the point on the earth.

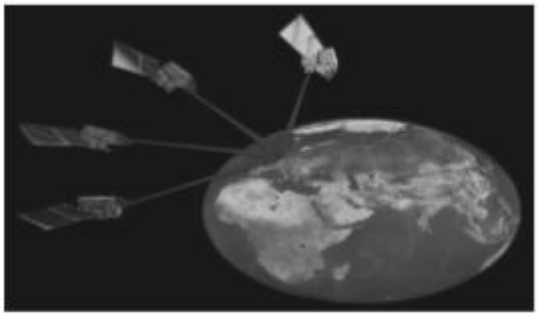


Fig: signals from multiple satellite

C. Determining position through GPS

The location of the satellite is always known by the GPS receiver because satellite information is included in its transmission. With the help of estimation that how far a satellite is we can find out where is the satellite located. The receiver knows that it is located somewhere on the imaginary sphere surface. It determines the size of several spheres and there is one for each satellite and wherever the sphere intersects the sphere is located there.

D. GPS accuracy

GPS accuracy is one of the important factor that totally depends on the type of receiver that we are using. Most of the hand held GPS have 10-20 meter accuracy but if we need better accuracy we can use differential accuracy which is one the method used in receivers. For higher accuracy in Differential GPS we should fix an additional receiver at a known location nearby.

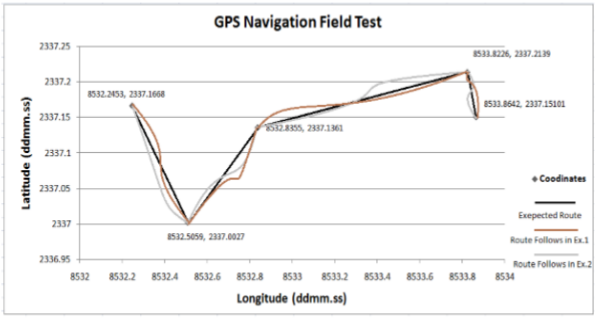
E. Timing of signal

All GPS satellite have atomic clocks. There is a pseudo random code which helps us in sending different signal and these signal vary from each other. These random sequences are repeated internally in a continuous manner and it is also known by all the GPS receivers.

IV. EXPERIMENTAL RESULTS

The actual GPS navigation test are conducted on the roads of Noida. The experiments are conducted on the roads and we also put some obstacle in the pathway of the car to check that the car is avoiding vehicles or not. We recorded each point on the externally attached logger module. We saved all the data as a text file and processed it with the spreadsheet package. We didn't performed and filtering and smoothing while data processing. The distance of the first way point from the starting point was approximately 75 meters.

With the help of this experiment we found out that our car can go through the waypoints or not. This experiment shows us that how accurately it can travel through the waypoints. At first we faced several problems such as instability in tracking and it was caused due to disorientation in navigation. We faced some problems when we stop the car for a while and start again then there is problem with the GPS. We attached a compass module in the car which helps us determine orientation of the robot.



V. CONCLUSION

This was quite an interesting project and I also studied and researched about this project on the internet. It inspired me and made me do the work on this interesting project. Some people have done their works to make an excellent RC car but some of them didn't get the satisfied result. GPS navigation system gained my interest and I wanted to make my RC car on the GPS technology and receiving the data was the highest goal in my project.

At first, it was a very difficult task to control the robot and to Process the GPS signal. It took me almost a month to get a reliable data from the receiver and after that I started writing the code and I tried it for two weeks but I was unsuccessful. I asked my seniors that anyone has made this project or any research and they helped me with suggestions and I got the source code from a researcher who has already done the project. It helped me a lot. His work help me in changing that useless GPS receiving code with his one which worked very smoothly and I got the data which I needed. Now we have to test the car that it is working properly or not and after a countless number of tests it started working properly. We tested the vehicle in our campus and at roads to so that we can check that the car is working properly or not. The car was avoiding vehicles and almost giving good results.

At last I want to say that I was quite satisfied with my work and I made this project with a very limited number of components. I tried to keep the hardware mechanism as simple as possible.

The car will look like this after all the hardware get attached to it.The figure of the car is given above.

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