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Design and Implementation of Automatic Steering Control

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***Abstract*: The main aim of using active steering control is to increase safety and to reduce both accidents and drivers work load. The objective of this project is to design and develop a steering control system for the path tracking of autonomous vehicle & to understand the stability of the vehicles on curved road. An autonomous vehicle that can drive itself to a destination without its driver have to recognize the driving Environment. In this paper, a steering control system for the path tracking of autonomous vehicles is described. The steering controller controls the steering actuator to follow the desired steering angle. A servo motor is installed to control the steering handle. GPS shows the geographical coordinates which specifies any given location on the earth surface as latitude and longitude. Ultrasonic sensor used for detecting the obstacles. A magnetometer compass shows the quadrants. Arduino UNO board is used like a mother board in this project.**

Keywords: Steering control, GPS, Magnetometer, Ultrasonic sensor, Arduino UNO.

I. INTRODUCTION

An autonomous vehicle, also known as a driverless vehicle, self-driving vehicle is a vehicle capable of fulfilling the human transportation capabilities of a traditional vehicle. As an autonomous vehicle, it is capable of sensing its environment and navigating without human input. Today is a world of mechatronics; if you talk on automation machines in industries may be CNC machines or manufacturing processes or automations in vehicles or automobiles i.e. Autotronics. Autonomous car has been a dream for mankind for a long time. Everything is controlled by various electronics devices which may be a small IC or microcontroller or microprocessor or now PLCs and various mechanical and other processes. Presently thought has been given about driverless car is that by April 2016 the driverless vehicle will run on road of United Kingdom same is proposed to be done in Germany and rest of the part of developed nations. In this project a prototype of a driverless car has been proposed, designed and developed a model of driverless car. It requires to understand the various electronics systems and its interface with automotive systems. All the vehicles are equipped with navigation system, its connected with satellites, GPS system which shows the position of the vehicle exactly when it is being navigated and the engine management system is completely controlled by electronics devices either microcontroller, PID, or microprocessor. Steering control depends upon the speed of the vehicles, curvature of the road or turning radius and on the banking of the road also. Similarly the steering mechanism involves various terminologies like caster, camber, and toe in, toe out; if these angles are proper then vehicle can be navigated with stability on a curved or turning road.

II. LITRATURE REVIEW

A. Automatic Steering Method for Autonomous Automobile Path Tracking [2009]:

This paper is written by Jarrod M. Snider, Robotics Institute Carnegie Mellon University 2009. This paper presents solutions to the path tracking problem for many applications and provided some insight into the choice and implementation of path tracking algorithms.

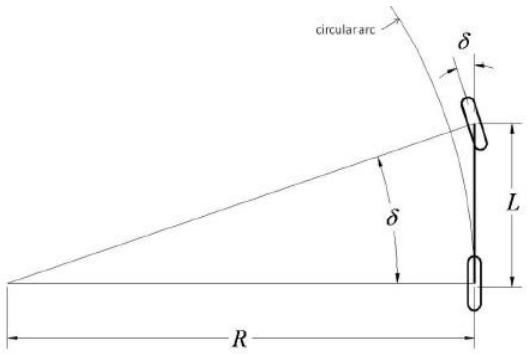

Figure 1: Geometric based model[a]

We used Ackerman principle for geometric path tracking in our project. The purpose of geometric path

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tracking, it is only necessary to state that the vehicle model simplifies the four wheel car by combining the two front wheel together and the two rear wheels together to form a two wheel model.

B. Design of Automatic Steering Control and Adaptive Cruise Control of Smart Car [2011]:

This paper is written by D. Sivaraj writes K.R.Radhakrishnan asst. professor, Dept. Of ECE, PSG College, international conference on VLSI, communication & instrumentation 2011, published by international journal of computer applications. In This paper PID controller is used. Instead of this controller, we use Arduino board.

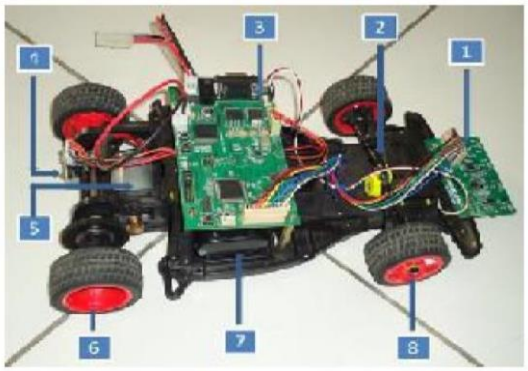

Figure 2: Design of Automatic Steering Control and Adaptive Cruise Control of Smart Car[b]

The Smart car structure is shown in the figure, which consist of Controller board with 16bitMC9S12x microcontroller(3), driven by the battery (7) and interfaced with IR Sensor array(1), Servo motor (2) and Front axle (8) for front wheel steering mechanism and DC motor (5), Rear Axle (6) and Encoder (4) for rear wheel drive mechanism.

C. Autonomous Vehicle Navigation and Mapping System [2014]:

This paper is written by Dhanasingaraja R, Kalaimagal S, Muralidharan G of K.L.N. College of Engineering and Technology, Madurai, Tamil Nadu, India in International Conference on
Innovations in Engineering and Technology (ICIET'14). In this paper gps and gprs is used for navigation and mapping system. From this we used gps in our project.

Figure 3: Autonomous Vehicle Navigation and Mapping System[c].

D. Development of Steering Control System For Autonomous Vehicle Using Geometry Based Path Tracking Algorithm [2015].

Myungwook Park, Sangwoo Lee and Wooyong Han write this paper. With the advancement in information and communication and vehicle techniques, the competition to develop and commercialize intelligent and autonomous vehicles has intensified. This paper describes the method of path tracking and the development of a steering control system using techniques applied to intelligent and autonomous vehicle. From this paper, we have use concept of autonomous vehicle and steering algorithm.

Figure 4: Development of Steering Control System for Autonomous Vehicle Using Geometry-Based Path Tracking Algorithm[d]

III. DESIGN METHODOLOGY

The design methodology of this prototype based on steering control of driverless car. It consists of designing basic circuits as shown in bellow figure. Signals are passes from one circuit to another and necessary signal conversions are carried out by each circuit.

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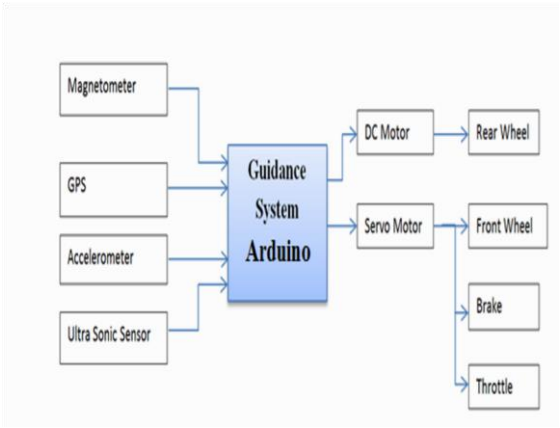

Figure 5: Block diagram

Here we are using three ultrasonic sensor for path detecting and also work for a obstacles while driving. It will sense the obstacle and accordingly change the path. Magnetometer works as compass. It is a directional sensor. It converts any incident magnetic field in the sensitive axis. To determine the position, GPS is used. The working of GPS is too different. It receive the signal from satellite and that signal is received by Arduino from GPS.GPS reads the geographical coordinates of a place with the help of the signals received from a number of satellites orbiting the earth. An ultrasonic sensor necessarily consists of transducer for conversion of one form of energy to another. Ultrasonic sensor transmits ultrasonic waves into the air and detects reflected waves from an object. Magnetometers, GPS, ultrasonic sensor are all work simultaneously. These give the signal to Arduino. Arduino is processing and give the output to DC motor and servo motor. Steering is using for changing turning angle to avoid dash. Servo motor is using for controlling the working of steering and DC motor is using for controlling speed of wheels.

IV. COMPONENT DESCRIPTION

A. Arduino Uno Board:

Arduino is an open source prototyping platform based easy- to- use hardware and software. Arduino boards are able to read input to light on sensor and turn it into an output to activating a motor, turning on an LED, publish something online. It also simplifies the process of working with microcontroller**.** The Arduino Uno is based on ATmega328 microcontroller and it also has ATmega16U2microcontroller. The specification are, It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 Analog input pins, 16 MHz clock period, 5V operating voltage ,40mA DC Current per I/O pin,32KB flash memory,1KB EEPROM, a USB connection, a power jack, an ICSP header, and a reset button . The Arduino programming language is a simplified version of C/C++. An important feature of the Arduino is that it can create a control program on the host PC, download it to the Arduino and it will run automatically.

Figure 6: Arduino Uno board

B. Motor Driver IC – L293D:

This prototype uses two dc geared motors, in order to control and drive them. The DC motors need the voltage of 12V. The motor driver regulates in such a way as to provide speed and acceleration to the vehicle. L293D is a dual H-Bridge motor driver as shown in figure, so with one IC we can interface two DC motors, which can be controlled in both clockwise and anticlockwise direction. L293D has output current of 600mA and peak output current of 1.2A per channel. Moreover, for protection of circuit from back EMF output diodes are included within the IC. The output supply (VCC2) has a wide range from 4.5V to 36V, which has made L293D a best choice for DC motor driver.

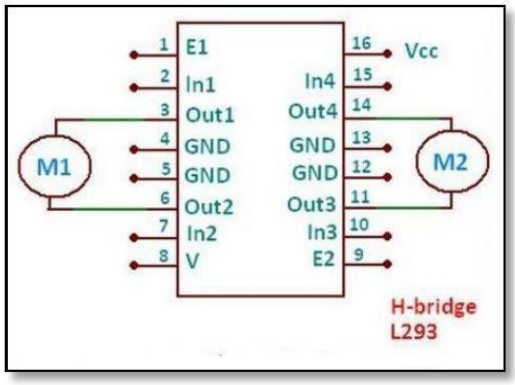

Figure 7: Motor Driver IC – L293D

C. GPS:

GPS shows the geographical coordinate. It is a system which specifies any given location on the earth surface as latitude and longitude. There are devices which can read the geographical coordinates of a place with the help of the signals received from a number of satellites orbiting the earth. The devices which can read the geographical coordinates of a place with the help of at least four GPS satellites are called GPS Receiver or simply GPS module. The GPS module continuously produces a set of data regarding the position of the earth surface where it is situated which includes the current position with respect to the equator of the earth in terms of Latitude and Longitude. This

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data can be decoded and printed into the readable format with the help of a microcontroller only. In this project the data regarding the geographical coordinate is extracted from the GPS output with the help of the Arduino.

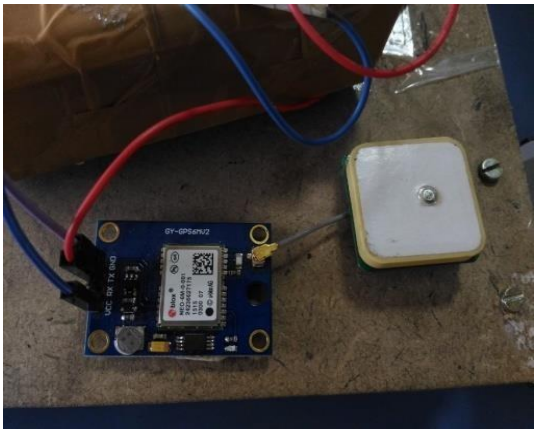

Figure 8: GPS module

D. Magnetometer:

The HMC5883L magneto resistive sensor circuit is a trio of sensors and application specific support circuits to measure both the direction and the magnitude of Earth's magnetic fields. Based on the HMC5883L, the GY-273 sensor module used as a compass in our project.

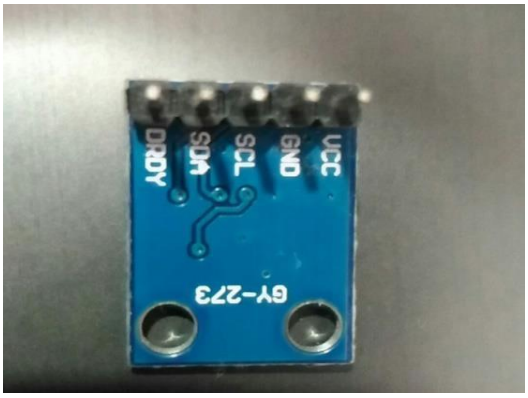

Figure 9: GY-273 sensor module

With power supply applied, the sensor converts any incident magnetic field in the sensitive axis directions to a differential voltage output. The output of magnetometer received by the Arduino.

E. Ultrasonic sensor:

Ultrasonic HC-SR04 is used in this project for detecting the obstacles on the path. Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules include ultrasonic transmitters, receiver and control circuit.

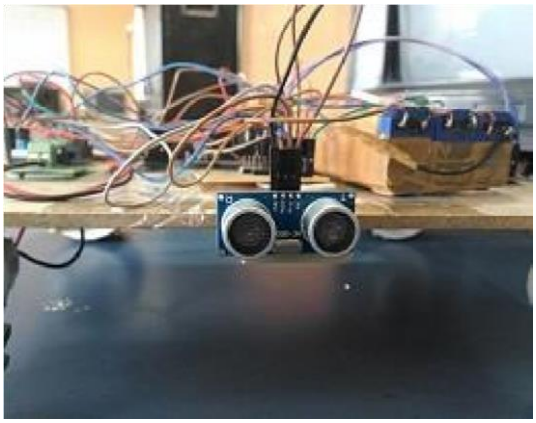

Figure 10: Ultrasonic Sensor

V. WORKING

The number of satellites orbiting the earth sends the signal to the GPS module which can read the geographical coordinates of a place. The GPS module continuously produces a set of data regarding the position of the earth surface where it is situated which includes the current position to the equator of the earth in terms of latitude and longitude. This latitude and longitude distance is converted into meters. Also from meters to rotation.

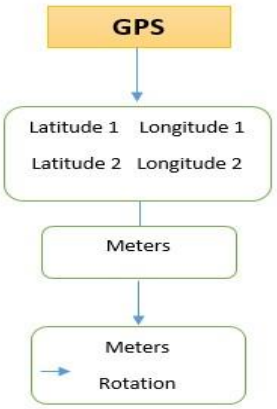

Figure 11: Flowchart of GPS

A magnetometer working as a compass. It is a directional sensor. The HMC5883L magneto resistive circuit is a trio of sensors and application specific support circuits to measure magnetic fields. When the power supply is applied, the sensor converts any incident magnetic field in the sensitive axis directions to a differential voltage output. It has following four conditions:

As given in the flowchart of magnetometer which having its 4 condition:

1st condition: When the vehicle is present in between 340<->360 degree the vehicle goes in east direction otherwise it goes to check the 2nd condition.

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2nd condition: When the vehicle is present in between 70<->110 degree the vehicle goes in east direction otherwise it goes to check the 3rd condition.

3rd condition: When the vehicle is present in between 160<->200 degree the vehicle goes in east direction otherwise it goes to check the 3rd condition.

4th condition: When the vehicle is present in between 250<->290 degree the vehicle goes in east direction otherwise it goes to the 1st condition.

Here we are using three ultrasonic sensor for path detecting and also for avoiding obstacles while driving. It will sense the obstacle and accordingly change the path. The three sensors are S1 (Front), S2 (Left), S3 (Right) sensors. When the vehicle is running on the road; first it will check that is there any obstacle in the path or not?

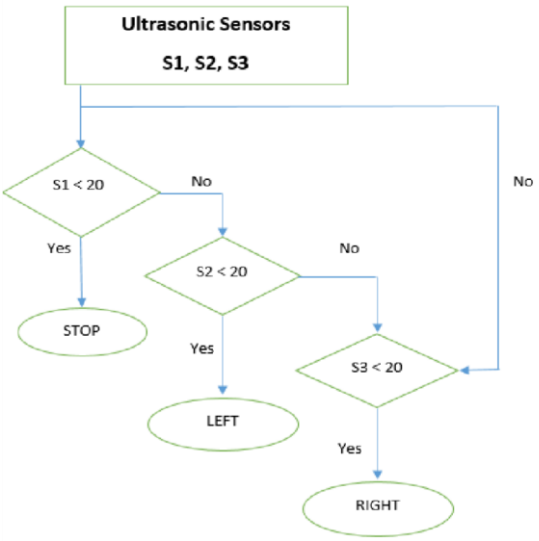

Figure 12: Flowchart of Ultrasonic Sensor

The front sensor sense the obstacle up to 20cm from the position of the vehicle, if S1 gives 'No' signal it means there is obstacle in the path then it will check another condition of sensor S2. If it does not found any obstacle then S2 gives 'Yes' signal and the vehicle will take a turn from left side. If S2 found obstacle in 20cm range then the sensor gives 'No' signal then it will check another condition for S3 right sensor.

Magnetometer, GPS, Ultrasonic sensor all are work simultaneously. They give the signal to Arduino. Then Arduino is processed and gives the output to DC motor and servo motor. DC motor is used for controlling the speed of vehicle while taking a turn. Servo motor is used for controlling the working of steering. Steering control mechanism is depends on the Ackerman principle

VI. RESULT

Finally project comes to physical existence and looks as below.

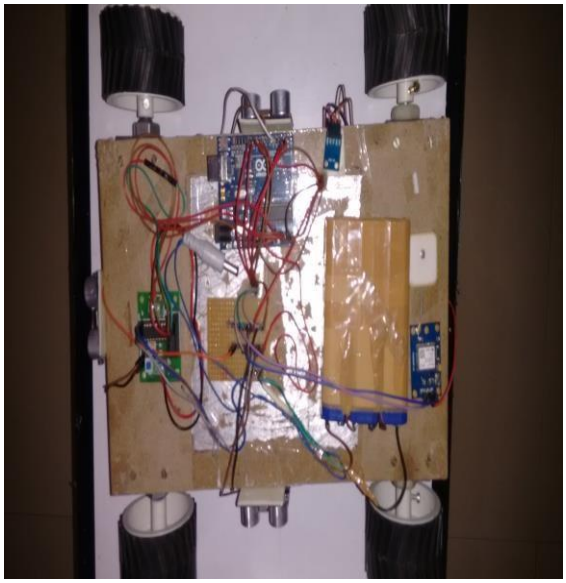

Figure 13: Project Prototype view

VII. CONCLUSION

The objective of this project was to analyses the automatic steering mechanism for driverless car. It is observed that the efficiency of the driverless car can be increased using different algorithms for steering control. The basis of various parameters like speed, distance, time, direction, ranges; the algorithm was compared. Ackerman's principle proved to be efficient in term of steering stability. The problems of collision detection and avoidance system were solved. The GPS cannot understand the position of the vehicle; where it is on earth or space; to overcome this problem a plotted map was design. The straight line calculated problem faced by conversion function. In GPS, one point covered very large area, hence problem faced. The proposed design lacks which makes it difficult to control the accuracy of the vehicle. If PID is used, one can easily monitor the accuracy of steering. The proposed project can future is implemented for parking driverless vehicle in the allotted space by sensing that lane.

VIII. REFERANCES

[1] Myungwook Park, Sangwoo Lee and Wooyong Han , "Development of Steering Control System for Autonomous Vehicle Using Geometry-Based Path Tracking Algorithm", June 2015
[2] Wireless Sensor Network Based Autonomous Vehicle by Appam Nihar, Dr. R. Uday kumar in 2015
[3] Dhanasingaraja R, Kalaimagal S, Muralidharan G, "Autonomous Vehicle Navigation and Mapping System" K.L.N. College of Engineering and Technology, Madurai, Tamil Nadu, India in 2014
[4] International Conference on VLSI, Communication & Instrumentation 2011.
[5] Jarrod M. Snider," Automatic Steering Method for Autonomous Automobile Path Tracking", Robotics Institute Carnegie Mellon University 2009.
[6] "Using Fuzzy Logic In Automated Vehicle Controlled" by Jose E. Naranjo, Carlos Gonzalez, 2007
[7] "THEORY OF MACHINES" by R.S. Khurmi & J. K. Gupta
[8] Massimo Banzi cofounder of Arduino "Getting started with Arduino", 2nd Edition.
[9] "Automobile Engineering" by Krupal Singh.
[10] "The Ackermann Principle of Steering" by Ted Aschman.