A Prototype on Design and Development of Self-Driving Vehicle

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Abstract - *Self –driving car is one of the most significant area in technology that nowadays many car manufacturing industries invest on it. Self-driving car uses dozens of sensors and CPUs instead of driver's sense and mind to drive the car from point A to point B.*

In this stage of this paper we have used Arduino Mega as controller and implemented only various modules on the car like color sensor, Ultrasonic sensor, Infrared sensor, GPS receiver, Wi-Fi module to collect information from surrounding. Motors are used to drive the car according to the collected data.

Ultrasonic sensor senses the distance between car and any hurdle that come across, the minimum distance is set 12cm. If the distance is less than 12cm then the car will stop. Infrared sensor is used for the car to give the path for the car so that not to get out of the road and meanwhile color sensor is used to get some street signs and traffic light. Motor is used with motor driver, motor driver controls speed of the motor and direction of the motor according to the data collected by sensor and command given by Arduino.

Key Words*: *Arduino mega, TCS2300 color sensor, ultrasonic sensor, infrared sensor, GPS module, Wi-Fi module and motor driver.

1. INTRODUCTION

Today technology is developing day by day and influences on each and every area like science, medical, agriculture, automation, transportation and etc…

Nowadays technologists are striving to implement on transportation to develop transportation method. In which smart driving car or self-driving car is one of them because they are trying to make it faster, to make it more efficient and most important to reduce treacherous gases produced by vehicles and many other transportation devices, the car industries typically rate self-driving technology on a scale from level 0 (no automation) and level 5 (full automation). Since long time ago many companies have been struggling to improve the level of self-driving technology including Tesla, General Motor, Ford, Toyota, Uber, Volvo, Volkswagen and many more

1.1 Components

A self-driving car must sense 360 degree around it to avoid accident and navigates its path and reach to its destination so various components are used for computerization, sensing fusion, navigation receiving and transmitting data and path planning. Some of the main components are listed below

- Arduino Mega
- L298N 2 motor driver
- TCS2300 color sensor
- Ultrasonic sensor
- Infrared sensor
- GPS module
- Wi-Fi module
- 12V power supply

1.2 Circuit Diagram

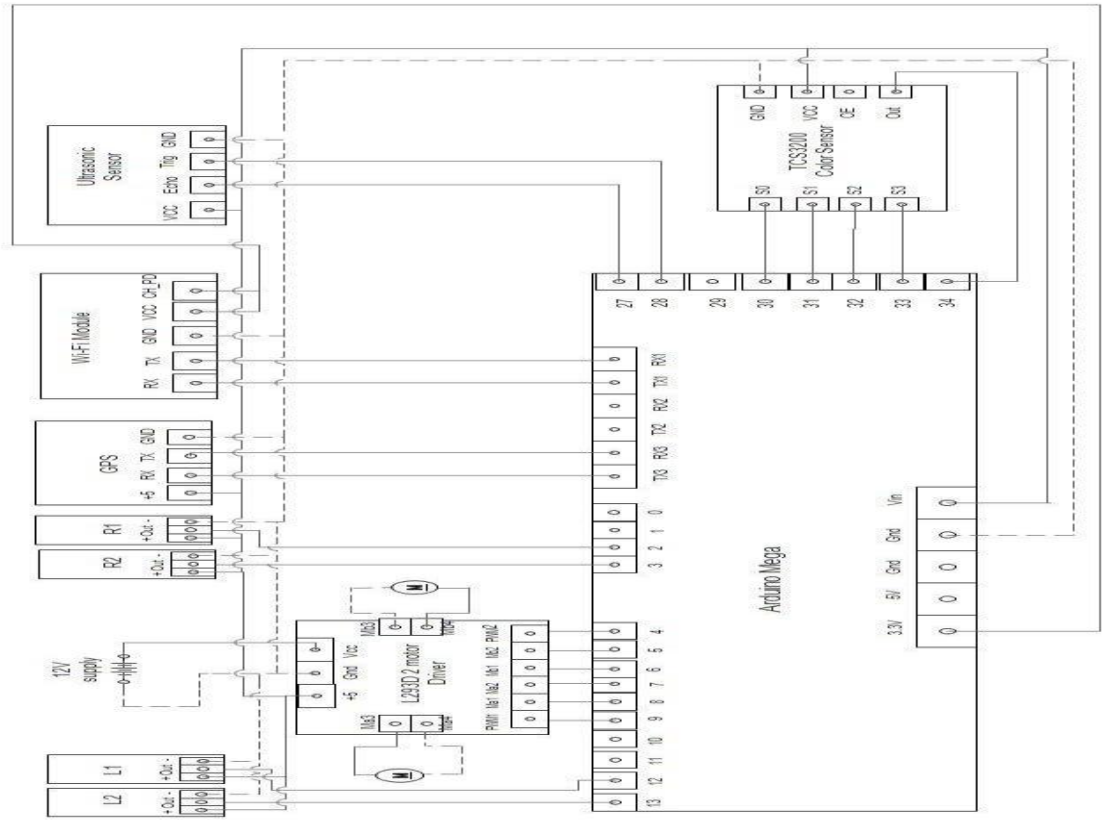


Fig 1. Illustrate the pin diagram of the proposed prototype

2. METHODOLOGY

Self-driving cars use various automotive technologies to provide an effortless mode of transportation. Providing this type of transportation requires a harmonious synchronization of advanced sensors gathering information about the surrounding Environments, sophisticated algorithms processing that data and controlling the vehicles, and computational power processing it all in real time

The following Technologies are the core components of self-driving cars:

1-Radar sensors: Autonomous cars typically have bumper-mounted radar sensor units (two in front and two in back) this helps the vehicle detect road dynamics such as traffic delays, vehicle collisions and other obstacles

2-GPS (Global positioning software): it is a vital part of self-driving car`s technology the self-driving car requires the GPS to navigate it. It looks all the roads and chooses the best path and is often better than people doing it GPS is important because it defines the mission of self-driving car by setting starting and end point of the driver and it works in conjunction with radars, sensors, LIDAR etc

3-Processors: self-driving cars have mini-computers on board to make sense of all of the cars instruments with some cars running more than 20 different processors and al the processes are taken in real time for example, actions such as steering accelerating and hitting the brakes are all controlled by the processed information.

2.1. TCS2300 color sensor

TCS2300 is a color sensor which consists of 8 pins, power supply, S0, S1, S2, S3, out and OE which can detect red, blue and green color. According to the state of S2 and S3 type of color will be detected and according to state of S0 and S1 the frequency will be set. Table below shows all the possible states of S0 and S1 to set frequency and S2 and S3 to read color.

For each color infrared light is emitted and detected the reflected light from the surface hence every color reflects different light density so red, blue and green can be detected and other colors are the combination of this three colors

S0	S1	Output Frequency scale
Low	Low	Power down
Low	High	2%
High	Low	20%
High	High	100%

Table 1. Input data with respective output frequency status

S2	S3	Color
Low	Low	Red
High	High	Green
Low	High	Blue
High	Low	Clear (no color)

Table 2. Input data which detect different color

2.2. Ultrasonic sensor

Ultrasonic sensor is used to measure distance between two objects. It is widely used in different applications robotics, cars and etc. Ultrasonic sensors emit short high frequency pulses at regular interval of time from trigger pin. If they strike on an object they are reflected back as echo signal to the sensor. The sensor calculates the time taken by the signal when emitted and received back.

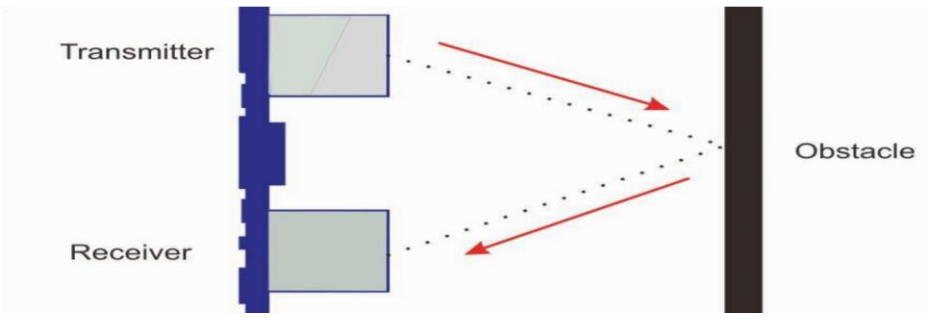


Fig 2. Ultrasonic sensor

Speed of sound at a dry air and 20 degree temperature is 343m/s or 1,125 ft/s or 767. mile/hour The time taken for a sound which is produced by the sensor to come and reach the sensor is double the distance between the obstacle as we have formula

V=d/t => d=vt d=vt/2 d is the exact distance between sensor and obstacle and v is the speed of time and t is the time taken for the sound to reach back to the sensor

2.3. Infrared sensor

It is a device which emits infrared light and detects the reflected light therefore it can detects different between black and white color because white color reflects most of the light but black color absorbs most of the light. It returns 1 when white is detected and 0 when black is detected. Infrared sensors consist of a potentiometer which is used to adjustment, we can vary the potentiometer to use for long distance or for short distance but it can't work more than thirty to forty centimeter and minimum distance of millimeters. So we have used four infrared sensor so that the car is driven to the specific path and doesn't leave the path. Two infrared sensors at the middle which is on black color at normal or forward condition and two infrared sensor at the most left and right side of the car to check if the car is out of the path. One middle sensor and most right sensor used to detect if the car is going out from right side and on the other hand one middle and left most sensor to detect if car is going out from left side The car is driven left and right at two conditions, one is smooth turn and the next one is sharp turn. Smooth turn is taken if there is only less diameter curves and sharp turn is taken when there is large diameter curves or edges.

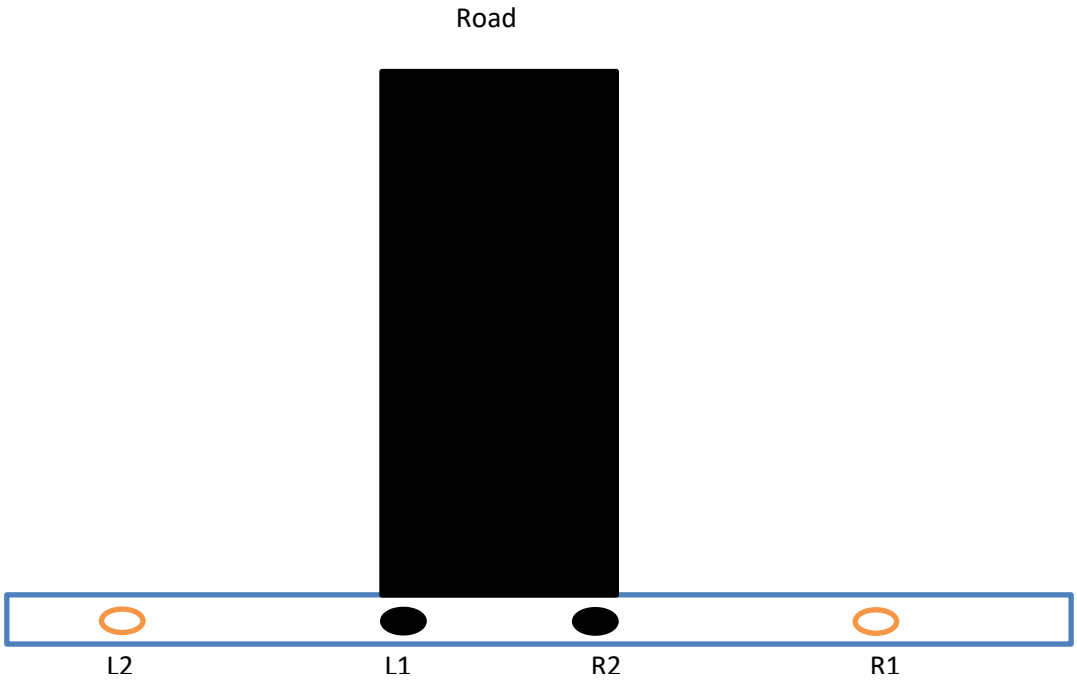


Fig 3. Road for infrared sensor

At forward condition R2=0, L1=0, R1=1 and L2=1 so the car is driven forward.

At two conditions smooth turn is taken. One if L1=1, L2=1, R1=1, R2=0 smooth right turn is taken and if L2=1,L1=0 R2=1,R1=1 smooth left turn is taken. At two other conditions sharp turn is taken and that is when L2=0, L1=1, R2=1, R1=1 sharp left turn is taken and when L2=1, L1=1, R2=1 and R1=0 sharp right turn is taken.

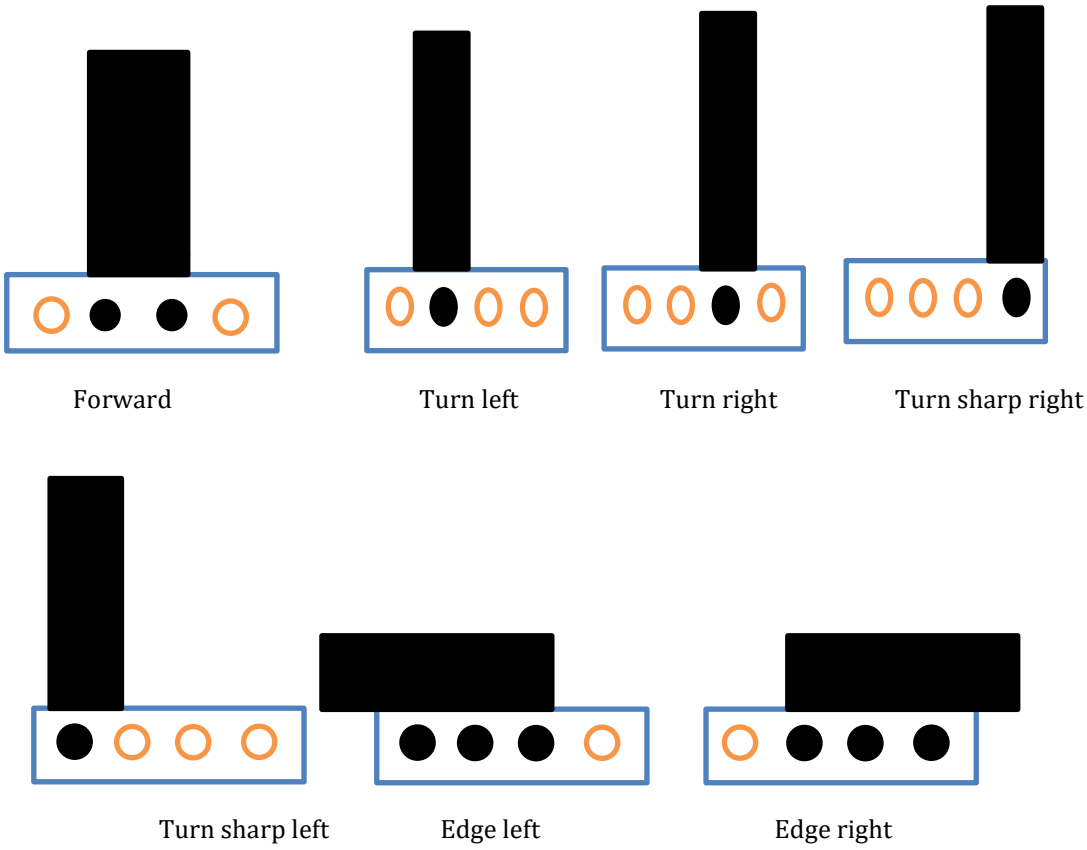
Brief infrared sensor states and motor direction is shown at tabular form below

S/N	L2	L1	R2	R1	Turn
1	0	0	0	0	Stop
2	1	1	1	1	Stop
3	1	0	0	1	Forward
4	1	1	0	1	Right
5	1	0	1	1	Left

6	1	1	1	0	Sharp Right
7	0	1	1	1	Sharp left
8	1	0	0	0	Edge Right
9	0	0	0	1	Edge Left

Table 3. The input and output data of infrared sensor

The following figures illustrate the pictorial representation of the above the table



3. CONCLUSION

In this paper self-driving vehicle prototype is implemented so as the ultrasonic sensor used to detect any hurdle faced by vehicle, infrared sensor provide line following ability, color sensor used to detect traffic sign, GPS module is used to give the exact position of the vehicle and Wi-Fi module is implemented to control the vehicle, collect data and update the position of vehicle where it is located.

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BIOGRAPHIES

Alijan Ranjbar obtained my Bachelor's Degree in Electrical Engineering from Lovely Professional University (LPU) in 2019, now I am pursuing last semester of my Master Degree in Electrical Engineering at Chandigarh University, Punjab, INDIA.

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