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SELF-DRIVING CAR FUTURE OF MOBILITY FOR DISABLED PEOPLE

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Abstract - *A self-driving car could be a vehicle that's capable of sensing its environment and moving safely with little or no human input. Since the 1920s, experiments have been conducted on self-driving cars but promising trials took place in the 1950s, and work has proceeded since then. In this project, we present an optimal approach, whose major objective is to accomplish the complete and safe journey from source to destination. Our aim is to design a system that detects the environment using sensors. The sensor is capable of detecting obstacles that comes across the way within a particular distance. The aim is to provide a secure and efficient solution for physically disabled people. Our project focuses on the intelligent car which can make more reliable judgments, and for a safer journey.*

***Key Words*: Micro-controller, Obstacle detection, Distance Measurement, Arduino UNO, Ultrasonic Sensor.**

1. INTRODUCTION

Globally speaking, nearly 1.35 million people die in road crashes each year, on average 3,287 deaths a day. An additional 20 to 50 million peoples are injured or get disabled [1]. In India, there were about five lakh people. The top reason behind these accidents is speeding up, drink and drive, talking over the phone while driving, and breaking the traffic rules. These statistics are raising day by day which is becoming an alarming issue. Also, the lack of access to transportation is the key obstacle to full life participation, especially for 25% of Indians living with disabilities [2]. 11 million medical appointments are missed each year because of the transportation barrier leading to greater health care expenses later on, but this new technology could be a serious solution to the problem. The usage of vehicles around the globe is rising. So we have to modify our manual cars into smart cars. This will happen only with the help of new technologies like AI and machine learning algorithms. With the help of these algorithms, the automated car will provide the ease, security, and safety to all humankind. To avoid road accidents, researches and developers are wording on the self-automated car.

2. LITERATURE REVIEW

The most basic problem in self-driving cars is the detection of an obstacle. In a self-driving car, sensor selection is important, otherwise it may fail to work even if all hardware and software are working properly. Therefore the sensor should be selected according to the constraint characteristics. There have been many successful attempts at designing barrier prevention systems. These parameters are different from the algorithms that apply to the selection of sensors, the path mapping process, and the operational parameters. Distance measurement is about getting and comparing in the real world. There are several types of infrared distance measurement systems, and infrared (IR) methods [3] are one of the most common methods of detection. We leave environmental interference through circuit work and allow low-cost IR sensors to accurately identify target locations. The most accurate and reliable application of ultrasound is found in the determination of viscosity, pressure, stains, destructive testing, and noise emission. [4] Ultrasonic generator is a transmitter that transmits ultrasound to the surrounding air using a medium. Level addition is used as a depth measurement of ultrasonic addition. An ultrasonic range detector using Parallax Ping Ultrasonic Sensors provides improved performance and is ready to detect a range of two cm to 2.5 meters with an accuracy of 0.1 cm [3]. Despite all the limitations of ultrasonic sensors, the technology is still good. Sonar is a good safety net sensor. If other detection sensors lose the barrier, or for some reason, the vehicle stops short enough to trigger the sonar, the shutdown is triggered and the vehicle stops immediately [5].

3. ARCHITECTURAL DETAILS

The self-driving car consists of the following components shown in fig 1 assembled on chassis. Arduino Microcontroller(ATMegal6U2, ATMEGA328P), capacitors, and resistor rest on a PCB. HC-SR04 sensor and servo motor sensor which is further interfaced with ATMEGA328P. L293D and four D.C motors are interconnected via 8 connecting wires and L293D are further connected to the ATMEGA328P microcontroller.

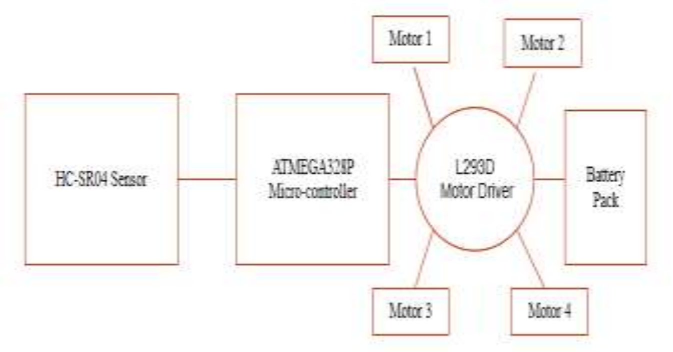

Fig -1: Block Diagram of self driving car

The Components:

A.Microcontroller section:
High-Performance Microchip PicoPower 8-bit AVR RISC-based Microcontroller Coupled with a comfortable combination. Comparison mode, timer/counter with internal and external interrupts. The device is made using Atmel's high-density memory. Its operating range is 1.8 volts to 5.5 volts. It features a watchdog timer programmed with an internal timer and five software selectable power saving modes. [8]

B.Servo Motor SG90:
Small and lightweight with high output power. The servo can rotate 180 degrees (90 in each direction) and works just like the standard type but smaller. You can use any servo code, Hardware, or built-in packages to control these servers. It is good for beginners who want to move objects with feedback and gearbox without a motor controller because it fits in small spaces. It comes with 3 horns (weapons) and hardware.

The position is between "0" (1.5 ms pulse), "90" (ms 2 ms pulse), all on the right, and "-90" (ms 1 pulse) on the left. [6]

C.L293D:
An H-bridge 16-pin IC serves as an interface between the D.C motors and the ATMEGA328P microcontroller. It drives four d.c. motor synchronously in any direction as per the instruction from ATMEGA328P microcontroller with power supply in the range of 5V to 36V at VCC pin.

Fig -2: L293D H-Bridge

D.HC-SR04 Ultrasonic module:
HC-SR04 is an ultrasonic ranging module designed for embedded system projects. Ultrasonic ranging module HC-SR04 provides 2cm - 400cm non-contact measurement function [7], the ranging accuracy can reach to 3mm. The modules includes ultrasonic transmitters, receiver and control circuit.

HC-SR04 has four pins:

- ✓ 5V supply
- ✓ Trigger Pulse Input
- ✓ Echo Pulse Output
- ✓ 0V Ground

Fig -3: Pin Diagram of HC-SR04 ultrasonic sensor

4. INTERNAL CIRCUIT DETAILS

The circuitry of the self-driving car includes an atmega AT328P microcontroller, one HC-SR04 ultrasonic sensors consisting of transmitter and receiver module, L293D motor driver, and four electric direct current driven motor that rotate the wheels according to the instructions by L293D motor driver. The ultrasonic sensor is interfaced with the microcontroller through pins 8 and 9 of port 1. L293D motor driver is interfaced with AT328P via pins 7,6,5 and 4. Further four D.C motor are connected to the motor driver through its 4 pins. The circuit diagram of the project is shown in figure 3 below.

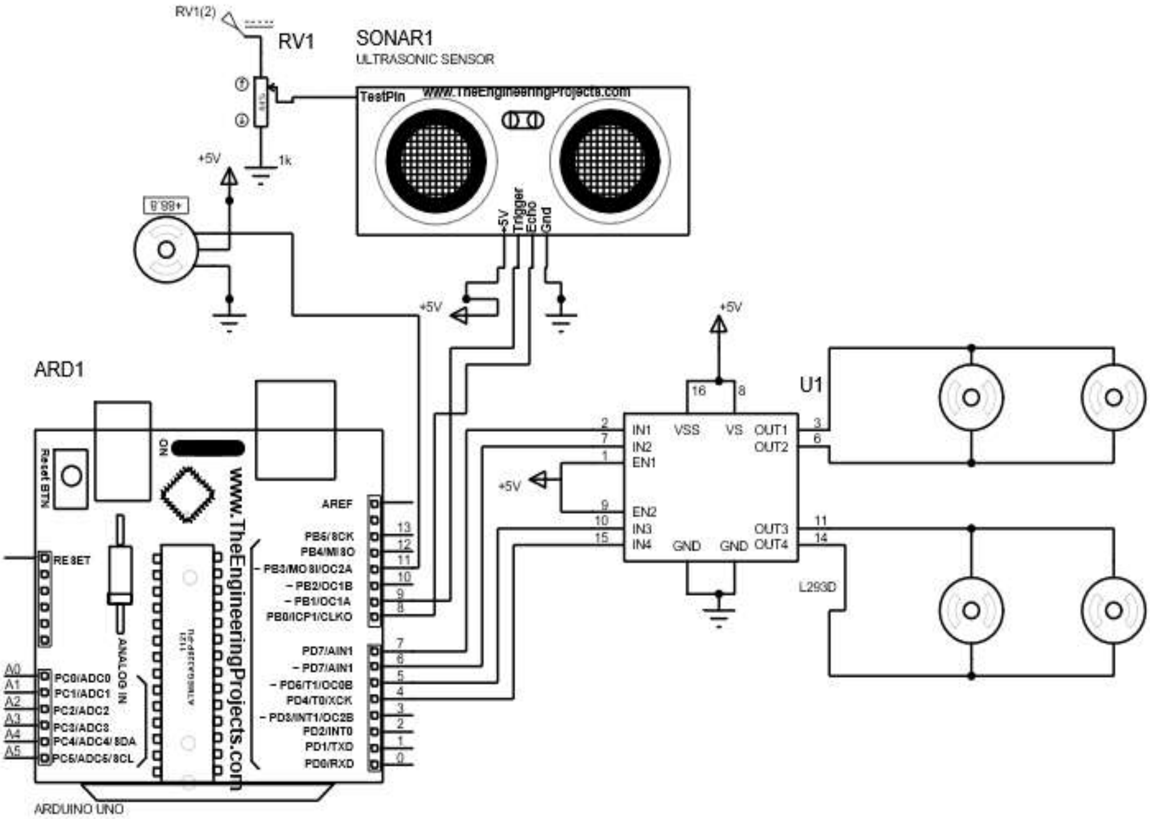

Fig -4: Internal Circuit of Self Driving Car

5. PRINCIPAL OF OPERATION

The single HC-SR04 sensor corresponding to the front of chassis is interfaced with the pins 8 and 9 respectively of port 1 of AT328P. When transmitter emits ultrasonic waves at a frequency of 40KHz. These waves travel through the air and when they are blocked by an object they get reflected or bounced back to the sensor. These reflected waves are absorbed by the receiver of the sensor. So the total time taken by the ultrasonic waves to travel from the transmitter of the sensor to the object and again from object to the receiver is given by the output of the sensor. Distance between the object and the sensor is calculated by using the formula i.e.

Speed = Distance / Time where speed = 340 m/s.

From this we can calculate the distance:

Distance = Time taken to receive * speed of the wave

Since the calculated distance is that the gap traveled from the ultrasonic transducer to the item and back to the transducer, it a two-way trip. By dividing this distance by 2 we are able to determine the particular distance from the transducer to the item.

$$distance = \frac{time\ taken\ x\ speed\ of\ sound}{2}$$

The system work-flow is shown in figure 5.

Fig -5: System Work-flow

Figure 5 shows the system work-flow. Initially, it checks for obstacles within 20 cm. If there is an obstacle it stops growing and returns to the left, checking if an object is more than 20 cm. The check has two consequences, yes or no. Yes, this means that some object is actually closer than 20 cm. No, that means no object was found within 30 cm. If there is nothing within 20 cm, the robot can move because the path is clear. If anything is close to 20 cm, the robot must avoid the obstacle. The first step to stopping the obstacle is to stop the robot! If you don't fire the robot right away, it will crash! After turning off the robot it remains to be seen which way to go. The way you do this when crossing the road is to do this by looking at both directions. First, the robot turns to the left, the reading takes off, and the right turns and takes a reading. Another test is the best way to go in which direction. If there is a way to go to the left, it should turn left and then go forward. If there is a way to the right, the robot will move forward because it is already in the right direction.

Some important points are summarized in the next list:

- � The H L293D bridge has 16 pins. This element is accountable for amplifying the voltage and current pulses that offers us the Arduino has 4 drivers.
- �Pins 1 and 9 are the enables these are connected to positive and also pin 1 is connected to five V that's provided by the Arduino.
- �Pins 4,5,12 and 13 are connected to negative or ground.
- � Pins 3 and 6 are connected to motor 1. Pins 11 and 14 are connected to motor 2. The power supply that the gear motor operates on is connected to pin 8
- �Pin 16 is connected to 5V provided by the Arduino.
- �The Arduino controls the motor left, right, back, front, supported ultrasonic signals. so as to manage the speed of every motor pulse width modulation is employed (PWM).
- �When the ultrasonic sensor detects the item which is kept inside the track it'll send the signal toward the Arduino UNO and in line with that it'll rotate the motor.
- �M3 & M4 in the forward direction and rotate the motor M1 & M2 in reverse direction such a way that the car starts out the left direction.
- � Similarly in each time whenever an obstacle is found to be in the path of car it'll detect it and rotate the car in the left direction to avoid the obstacle. Pin 7 and a couple of or A and B within the table control motor 1.

TABLE I

TRUTH TABLE THAT CONTROLS THE ENGINE 1.

A	B	Function
0	0	Motor shuts down
0	1	Turn Left
1	0	Turn Right
1	1	Motor shuts down

- Pins 10 and 15 or C and D in table control motor 2.

TABLE II

TRUTH TABLE THAT CONTROLS THE ENGINE 2.

C	D	Function
0	0	Motor shuts down
0	1	Turn Left
1	0	Turn Right
1	1	Motor shuts down

It is also needed the use of 2 batteries for powering the system. The first battery is connected to the Arduino and ultrasonic sensor module, the second battery is connected to the motors. The ultrasonic sensor placed in the front of the chassis, the Arduino placed upward of the car along with servomotor and ultrasonic sensor. The H bridge are connected throughout the center of the board as shown in the figure 6.

Code: https://github.com/yearfinalsem8

6. REAL TIME PICTURE

The final prototype looks as follows:

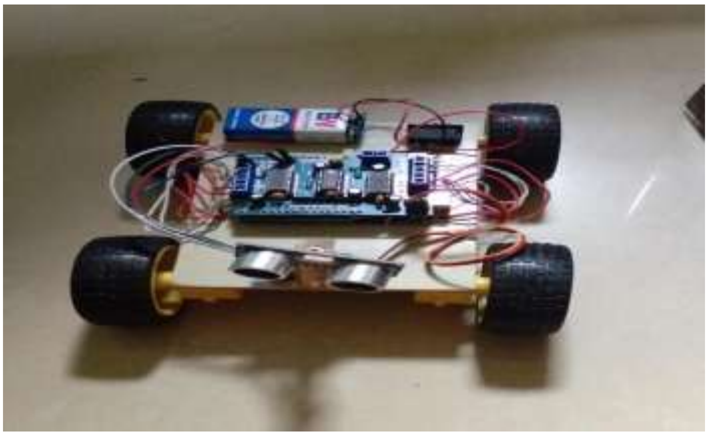

Fig -6: Real Time Picture

7. EXPERIMENTAL RESULT

The experimental result for distance measurement is shown in the table. For distance calculation using this tool, the objective of measuring distance must always be perpendicular to the plane of the propagation of ultrasonic waves. Where the actual distance is measured by tape or scale and the distance measured is the distance measured by the ultrasonic sensor.

STEP	ACTUAL VALUE (CM)	MEASURED VALUE (CM)	ERROR	ERROR%
1.	20	22.40	2.4	12
2.	40	43	3	7.5
3.	60	63.50	3.5	5.8
4.	80	84.07	4.07	5.08
5.	100	101.30	1.3	1.3
6.	120	120.80	0.8	0.66
7.	140	141.31	1.31	0.93
8.	160	160.60	0.6	0.375
9.	180	180.26	0.26	0.144
10.	200	200.20	0.2	0.1

TABLE III

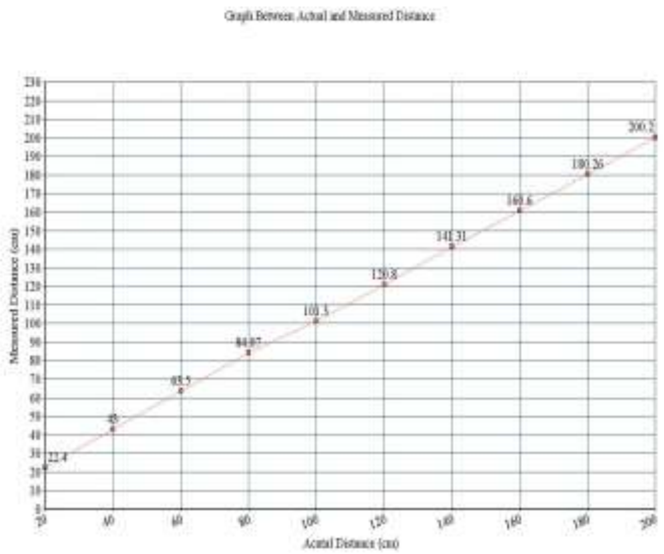

Fig -7: Graph

The value between actual value and estimated value are approximate. We have noticed that there is a huge error in the measured distance compared to the actual distance. Percent error column shows the same result. The error is greater in the lower level of the obstacle. The graph is sorted between the actual distance and the estimated distance.

8. CONCULSION

The goal of our project is to form an autonomous robotic car that intelligently detects the obstacle in its path and navigate per the action we set for it. It's a handy system for non-contact measurement of distance. For calculating the distance the target should always be perpendicular to the plane of the propagation of the ultrasonic wave. The device calculates the gap with suitable accuracy and determination. The bigger the object stronger will be the reflected signals. Thanks to this our project give a decent lead to the sensing of an obstacle, and also it changes the direction as soon because of it in counters any object ahead of the trail. A future enhancement may be done by attaching more sensors like Bluetooth module for more security, reliability and safe journey.

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