Automatic Speed Control and Accident Avoidance of vehicle

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Abstract – *The main aim of the project to develop a system automatic speed control of vehicle and accident avoidance using ultrasonic sensor. Whenever any obstacle is detected in running vehicle depends on distance automatically control the speed of vehicle.*

The ultrasonic sensor system continuously sends signals and monitors any car or other obstacles are in front of car. The distance up to which ultrasonic sensor can work may be up to 4meter. When any obstacle or vehicle detected by ultrasonic sensor system it will send signal to the embedded board.

After receiving this signal embedded board sends a signal to the motor to reduce the car speed automatically which can control car speed immediately. Vehicle is controlled automatically without any manual operation when the vehicle is
at 4meter distance away from the front vehicle. Also give alarm to alert to the driver.

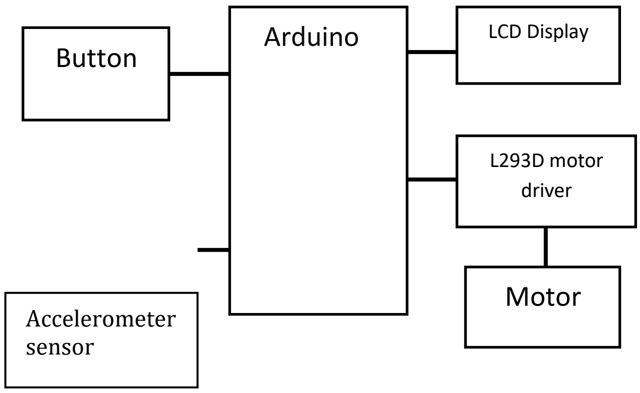
Many accidents at High-ways are taking place due to the close running of vehicles, all of sudden, if the in front vehicle driver reduces the speed or applied breaks, then it is quite difficult to the following vehicle driver to control his vehicle, resulting accident. To avoid this kind of accident, the warning system, which contains alarm and display system can arrange at rear side of each and every vehicle.
***Key Words*: Arduino[1]**

1.INTRODUCTION

A accident avoidance system is an automobile safety system designed to reduce the severity of an accident. Also known as precrash system, forward collision warning system or collision mitigating system, it uses radar and sometimes laser and camera sensors to detect an imminent crash. Once the detection is done, these systems either provide a warning to the driver when there is an imminent collision or take action autonomously without any driver input (by braking or steering or both)

Collision avoidance features are rapidly making their way into the new vehicle fleet.

1.1. BLOCK DIAGRAM



2. COMPONENTS

2.1. ARDUINO

The Arduino Uno is a microcontroller board based on the ATmega328. It has 20 digital input/output pins (of which 6 can be used as PWM outputs and 6 can be used as analog inputs), a 16 MHz resonator, a USB connection, a power jack, an in-circuit system programming (ICSP) header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features an ATmega16U2 programmed as a USB-to-serial converter. This auxiliary microcontroller has its own USB bootloader, which allows advanced users to reprogram it.

The Arduino has a large support community and an extensive set of support libraries and hardware add-on "shields" (e.g. you can easily make your Arduino wireless with our Wixel shield), making it a great introductory platform for embedded electronics. Note that we also offer a SparkFun Inventor's Kit, which includes an Arduino Uno along with an assortment of components (e.g. breadboard,

sensors, jumper wires, and LEDs) that make it possible to create a number of fun introductory projects.
This is the 3rd revision of the Uno (R3), which has a number of changes:

- The USB controller chip changed from ATmega8U2 (8K flash) to ATmega16U2 (16K flash). This does not increase the flash or RAM available to sketches.
- Three new pins were added, all of which are duplicates of previous pins. The I2C pins (A4, A5) have been also been brought out on the side of the board near AREF. There is a IOREF pin next to the reset pin, which is a duplicate of the 5V pin.
- The reset button is now next to the USB connector, making it more accessible when a shield is used..

Choosing the right controller

The table below compares the Arduino Uno, Leonardo, and our A-Star 32U4 Prime controllers. The A-Star Primes are based on the same ATmega32U4 AVR microcontroller as the Leonardo and ship with Arduino-compatible bootloaders. The Primes also offer many advantages, including superior power management that enables efficient operation from 2.7 V to 11.8 V (LV version) or 5 V to 36 V (SV version).

	 Arduino Uno R3	 Arduino Leonardo	 A-Star 32U4 Prime LV	 A-Star 32U4 Prime SV
Microcontroller:	ATmega328P	ATmega32U4	ATmega32U4	
Clock:	16 MHz resonator	16 MHz crystal	16 MHz crystal	
User I/O lines:	20	23	26	
PWM outputs:	6	7	7	
Analog inputs:	6	12	12	
Ground access points:	4	4	43	
User LEDs:	3	3	3	
User pushbuttons:	—	—	3	
Reset button:	✓	✓	✓	
Power switch:			✓	
Buzzer option:			✓	
microSD option:			✓	
LCD option:			✓	
Arduino-compatible bootloader:	✓	✓	✓	
USB connector:	B	Micro-B	Micro-B	
USB/regulator power selection:	partial	partial	TPS2113A	
High-performan			✓	

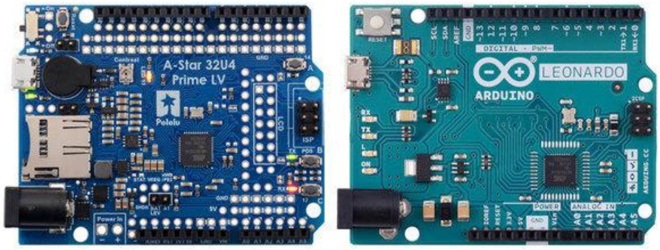
ce reverse-voltage protection:					
Recommended input voltage:		7 V to 12 V	7 V to 12 V	2 V to 16 V	5 V to 36 V
Regulator type (5 V):		linear	linear	switching step-up/step-down	switching step-down
Available 5 V output current:	at 3 V in	—	—	0.75 A	—
	at 5 V in	—	—	1.5 A	0.2 A
	at 7 V in	1.0 A	1.0 A	1.9 A(1)	1.0 A
	at 9 V in	0.5 A	0.5 A	1.9 A(1)	1.0 A
	at 11 V in	0.35 A	0.35 A	1.8 A	1.0 A
	at 24 V in	—	—	—	1.0 A
	via USB connector	0.5 A(2)	0.5 A(2)	1.9 A(3)	1.9 A(3)
Weight:		28 g	20 g	13 g to 33 g	

Price:	$24.95	$24.95	$19.95 to $34.95

1 There is more available 5 V output current via VREG, see maximum regulator output current graph for details.

2 With sufficient USB power supply.

3 Nominal current available through power MUX with sufficient USB power supply.



Side-by-side comparison of the A-Star 32U4 Prime LV microSD to the Arduino Leonardo.

2.2. SENSOR ADXL335 Accelerometer Module

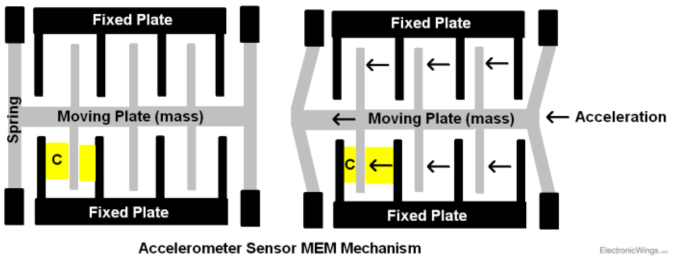
An accelerometer is an electromechanical device that will measure acceleration force. It shows acceleration, only due to cause of gravity i.e. g force. It measures acceleration in g unit.

On the earth, 1g means acceleration of 9.8 m/s2 is present. On moon, it is 1/6th of earth and on mars it is 1/3rd of earth. Accelerometer can be used for tilt-sensing applications as well as dynamic acceleration resulting from motion, shock, or vibration.

ADXL335 module

- The ADXL335 gives complete 3-axis acceleration measurement.
- This module measures acceleration within range ±3 g in the x, y and z axis.
- The output signals of this module are analog voltages that are proportional to the acceleration.
- It contains a polysilicon surface-micro machined sensor and signal conditioning circuitry.

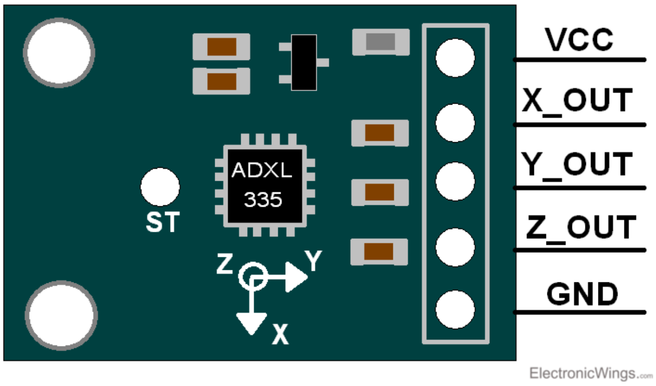
Working Mechanism



Accelerometer Sensor MEM Mechanism

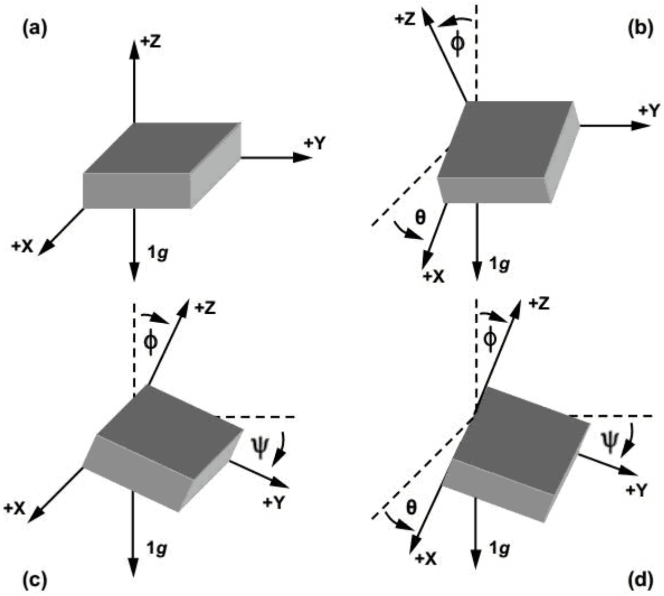
- As we can see from the above figure, basic structure of accelerometer consists fixed plates and moving plates (mass).
- Acceleration deflects the moving mass and unbalances the differential capacitor which results in a sensor output voltage amplitude which is proportional to the acceleration.
- Phase-sensitive demodulation techniques are then used to determine the magnitude and direction of the acceleration.

Accelerometer ADXL335 Module



VCC: Power supply pin i.e. connect 5V here.
X_OUT: X axis analog output.
Y_OUT: Y axis analog output.
Z_OUT: Z axis analog output.
GND: Ground pin i.e. connect ground here.
ADXL335 accelerometer provides analog voltage at the output X, Y, Z pins; which is proportional to the acceleration in respective directions i.e. X, Y, Z.
Angles using ADXL335
We can calculate angle of inclination or tilt by using X, Y, Z's value. Also, we can calculate Roll, Pitch and Yaw angles with respect to X, Y and Z axis. So first we need to convert 10-bit ADC values into g unit.
As per ADXL335 datasheet maximum voltage level at 0g is 1.65V and sensitivity scale factor of 330mV/g.

Above formula gives us acceleration values in g unit for X, Y and Z axis as,
Axout = (((X axis ADC value * Vref) / 1024) – 1.65) / 0.330
Ayout = (((Y axis ADC value * Vref) / 1024) – 1.65) / 0.330
Azout = (((Z axis ADC value * Vref) / 1024) – 1.65) / 0.330
Note that, practically we get slightly different voltage at 0g. So, put the practical value of voltage at 0g.
Angle of Inclination
- Angle of inclination means by how much angle the device is tilted from its plane of surface.
- Angle of inclination are shown in below figure.
- To calculate angle of inclination of X, Y, Z axis from its reference, we need to use below formulas.

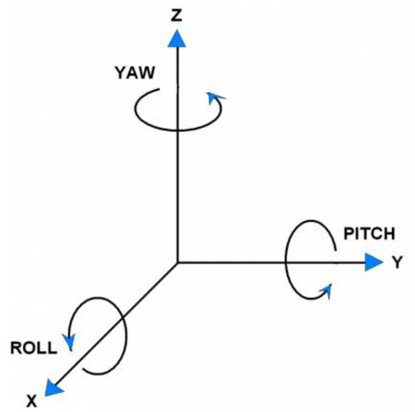


Angle of inclination can be calculated as,

We get these angles in radians. So, multiply these values by (180/π) to get angle in degrees within range of -90° to +90° each axis.
Angle of Rotation
Now let's find a complete angle of rotation (0° to 360°) around X, Y, Z axis, which we can also call as,

- Roll - Angle of rotation along the X axis
- Pitch - Angle of rotation along the Y axis
- Yaw - Angle of rotation along the Z axis

All of them are shown in below conceptual diagram.



These angles are in degrees and can give readings of a complete rotation.
Now let's calculate these angles. As we get Θ, Ψ and Φ in the range of -90° to +90°. Here we need to make these values in the range of -180° to +180° so that we can calculate complete 360° angle of rotation. Let calculate these with arc tangent function which can be expressed as,

$$\operatorname{atan2}(y,x) = \begin{cases} \arctan(\frac{y}{x}) & \text{if } x > 0, \\ \arctan(\frac{y}{x}) + \pi & \text{if } x < 0 \text{ and } y \geq 0, \\ \arctan(\frac{y}{x}) - \pi & \text{if } x < 0 \text{ and } y < 0, \\ +\frac{\pi}{2} & \text{if } x = 0 \text{ and } y > 0, \\ -\frac{\pi}{2} & \text{if } x = 0 \text{ and } y < 0, \\ \text{undefined} & \text{if } x = 0 \text{ and } y = 0. \end{cases}$$

This function will produce the result in the range of -π to π. These values in radians we can convert into degree by multiplying it with (180/π ≈ 57.29577951) factor. So here we get values in -180° to +180°, and we can convert it to complete 0° to 360° by just adding 180° to range.
Hence, we get roll, pitch and yaw angles as,

Roll = (atan2(Ayout, Azout)) *57.29577951+180

Pitch = (atan2(Azout, Axout)) *57.29577951+180

Yaw = (atan2(Axout, Ayout)) *57.29577951+180

Note that, rotation along X (roll) and Y (pitch) axis will produce change in acceleration but rotation along with Z axis (yaw) will not produce any change in acceleration as it is perpendicular to the plane of surface. Hence using only accelerometer, yaw cannot be calculated.
We can also see this effect on X and Y axis when these axes are made perpendicular with plane of surface.

2.3.LCD DISPLAY

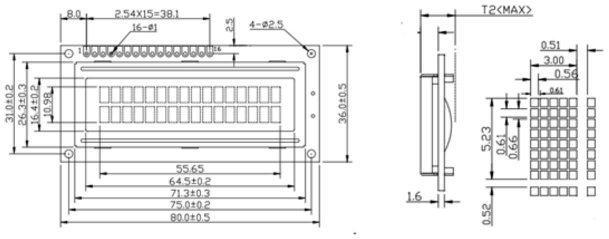
LM016L

LCD modules are very commonly used in most embedded projects, the reason being its cheap price, availability and programmer friendly. Most of us would have come across these displays in our day to day life, either at PCO's or calculators. The appearance and the pinouts have already been visualized above now let us get a bit technical.

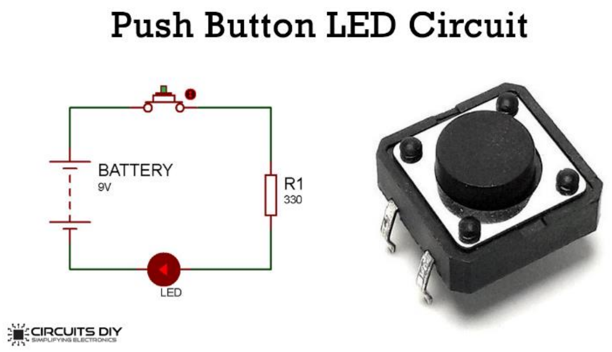
16×2 LCD is named so because; it has 16 Columns and 2 Rows. There are a lot of combinations available like, 8×1, 8×2, 10×2, 16×1, etc. but the most used one is the 16×2 LCD. So, it will have (16×2=32) 32 characters in total and each character will be made of 5×8 Pixel Dots. A Single character with all its Pixels is shown in the below picture.

Now, we know that each character has (5×8=40) 40 Pixels and for 32 Characters we will have (32×40) 1280 Pixels. Further, the LCD should also be instructed about the Position of the Pixels. Hence it will be a hectic task to handle everything with the help of MCU, hence an **Interface IC like HD44780**is used, which is mounted on the backside of the LCD Module itself. The function of this IC is to get the **Commands and Data** from the MCU and process them to display meaningful information onto our LCD Screen. If you are an advanced programmer and would like to create your own library for interfacing your Microcontroller with this LCD module then you have to understand the HD44780 IC is working and commands which can be found its datasheet.

1) *2D model of 16×2 LCD module*

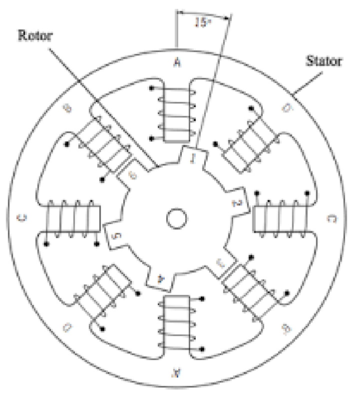


2.3. BUTTON



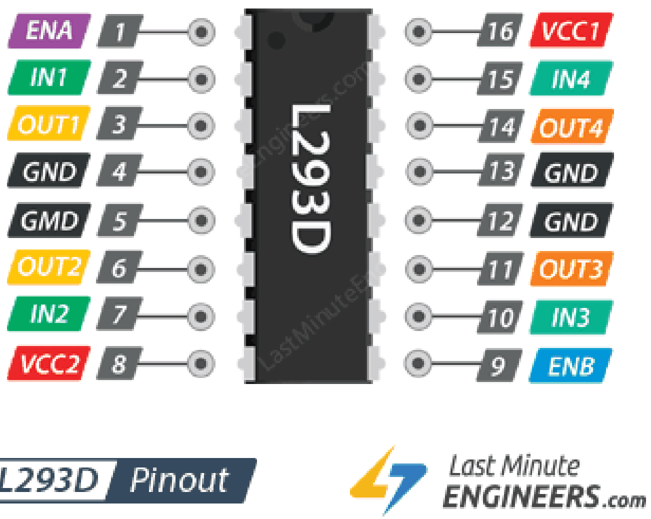
A **Push Button** switch is a type of switch which consists of a simple electric mechanism or air switch mechanism to turn something on or off. ... The **button** itself is usually constructed of a strong durable material such as metal or plastic. **Push Button** Switches come in a range of shapes and sizes.

2.5. MOTOR

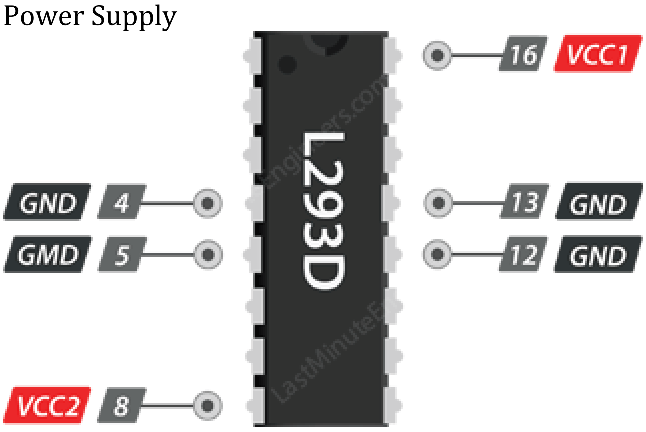


The **motor** or an **electrical motor** is a device that has brought about one of the biggest advancements in the fields of engineering and technology ever since the invention of electricity. A motor is nothing but an electro-mechanical device that converts electrical energy into mechanical energy. It's because of motors, life is what it is today in the 21st century.

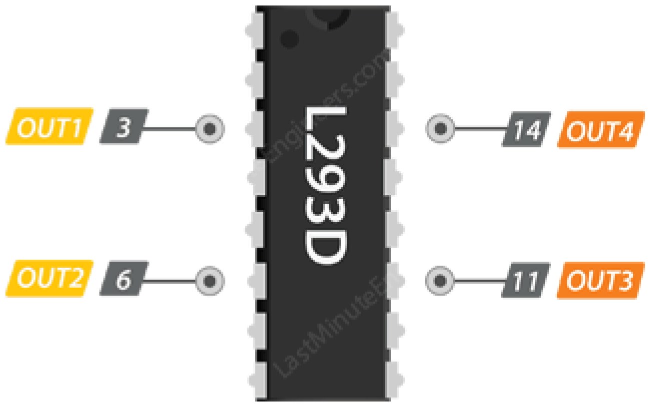
2.6. L293D Motor Driver IC



The L293D is a dual-channel H-Bridge motor driver capable of driving a pair of DC motors or one stepper motor.
That means it can individually drive up to two motors making it ideal for building two-wheel robot platforms.
Power Supply

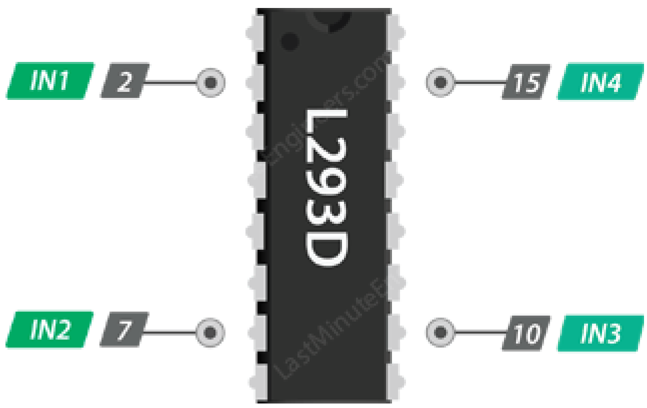


The L293D motor driver IC actually has two power input pins viz. 'Vcc1' and 'Vcc2'.
Vcc1 is used for driving the internal logic circuitry which should be 5V.
From Vcc2 pin the H-Bridge gets its power for driving the motors which can be 4.5V to 36V. And they both sink to a common ground named GND.
Output Terminals



The L293D motor driver's output channels for the motor A and B are brought out to pins OUT1,OUT2 and OUT3,OUT4 respectively.
You can connect two DC motors having voltages between 4.5 to 36V to these terminals.
Each channel on the IC can deliver up to 600mA to the DC motor. However, the amount of current supplied to the motor depends on system's power supply.
Control Pins
For each of the L293D's channels, there are two types of control pins which allow us to control speed and spinning direction of the DC motors at the same time viz. Direction control pins & Speed control pins.

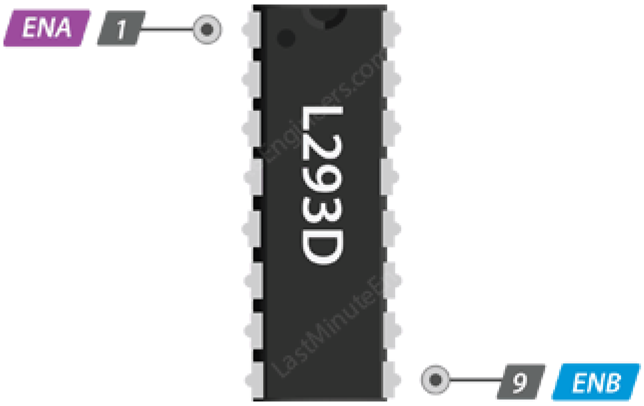
[2] Direction Control Pins



Using the direction control pins, we can control whether the motor spins forward or backward. These pins actually control the switches of the H-Bridge circuit inside L293D IC.
The IC has two direction control pins for each channel. The IN1,IN2 pins control the spinning direction of the motor A while IN3,IN4 control motor B.
The spinning direction of a motor can be controlled by applying either a logic HIGH(5 Volts) or logic LOW(Ground) to these pins. The below chart illustrates how this is done.

IN1	IN2	Spinning Direction
Low(0)	Low(0)	Motor OFF
High(1)	Low(0)	Forward
Low(0)	High(1)	Backward
High(1)	High(1)	Motor OFF

[3] Speed Control Pins



The speed control pins viz. ENA and ENB are used to turn ON, OFF and control speed of motor A and motor B respectively.

Pulling these pins HIGH will make the motors spin, pulling it LOW will make them stop. But, with Pulse Width Modulation (PWM), we can actually control the speed of the motors.

3. CONCLUSIONS

The project "Automatic Speed Control Of Vehicle Using Ultrasonic Sensors, Eye Blink Sensor." has been successfully designed and tested. Integrating features of all the hardware components used have developed it. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. Secondly, using highly advanced IC's and with the help of growing technology the project has been successfully implemented.

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