IFERP connecting engineers... developing research

ISSN (Online) 2394-6849

International Journal of Engineering Research in Electronics and Communication Engineering (IJERECE)
Vol 3, Issue 12, December 2016

Adaptive Cruise Control

[1] Aditya Badave, [2] Vivek Gondil, [3] Devank Joshi
[1] [2] [3] [1] First Author Affiliation, [2] Second Author Affiliation, [3] Third Author Affiliation
[1][2][3] MAEER's MIT Polytechnic, Pune-38

Abstract: **Adaptive Cruise Control (ACC) is Assistive Control System used in a vehicle, to explain the concept of Adaptive Cruise Control; we designed a prototype which is based on microcontroller. This helps to understand the working of Adaptive Cruise Control. This paper gives brief information about Adaptive Cruise Control and how it works.**

Keywords:- **Adaptive Cruise Control, Microcontroller, Ultrasonic Sensor, SONAR.**

I. INTRODUCTION

There are several embedded projects out there. They gives us more functionality to work with our devices. The device may be anything; like automatic machines, industrial machines our car, installing such embedded system in a car provides some helpful features to the driver as well as passengers. They also helps to eliminate problems such as driver fatigue reduction, accident prevention, traffic flow smoothening.

We are going to discuss one of such systems, which is Adaptive cruise control system. Adaptive Cruise Control is also known as Autonomous Cruise Control or simply ACC. It is an optional cruise control system which adjusts the speed of vehicle automatically to maintain a safe distance from vehicles ahead.

II. EXPLANATION

To understand this system let us take a look at Cruise Control system. When the Cruise control system in a car get activated; the system takes control of the accelerator and keeps the speed of the vehicle constant. While this system is active, the driver can remove feet from the accelerator and just keeps focusing on steering control. It helps to get rid of driving fatigue. But when the speed of your vehicle is slightly more than the car in front of you, then the distance between both vehicles is going reduce gradually and at some point your car is going to ran off on the other car.

In this situation Adaptive control helps a lot; Adaptive behavior is a type of behavior that is used to adjust to another type of behavior or situation. We can say that Adaptive Cruise Control system adjusts the Cruise Control system according to the distance between your car and the car in front of you. It keeps monitoring and reduces the speed of cruising as any obstacle comes in the way.

III. DEFINATIONS

ACC vehicle – The subject vehicle equipped with the ACC system.
Active brake control – A function which causes application of the brakes without driver application of the brake pedal.
Clearance – Distance from the forward vehicle's trailing surface to the ACC vehicle's leading surface.
Forward vehicle – Any one of the vehicles in front of and moving in the same direction and travelling on the same roadway as the ACC vehicle.
Set speed – The desired cruise control travel speed set by the driver and is the maximum desired speed of the vehicle.
Target vehicle – One of the forward vehicles in the path of the ACC vehicle that is closest to the ACC vehicle.
Time gap – The time interval between the ACC vehicle and the target vehicle. The 'time gap' is related to the 'clearance' and vehicle speed by:
Time gap **= Clearance / ACC vehicle speed**

IV. WORKING

We are using the microcontroller to implement this project. It is easy to use this system in electric car as we can control the speed of vehicle by PWM technique. This system works on the principle of 'SONAR'. It uses ultrasonic waves to detect the object in front of it.

The ultrasonic sensor is mounted in front of the car, which transmits the ultrasonic waves and then the timer in microcontroller starts the timer and stops counting when the waves are received back to the ultrasonic sensor. With the following formula, the microcontroller converts the time into distance.

The formula for calculating distance is given by

$$D = 330 \times {}^{T}/_{2} \ meters$$

Where,

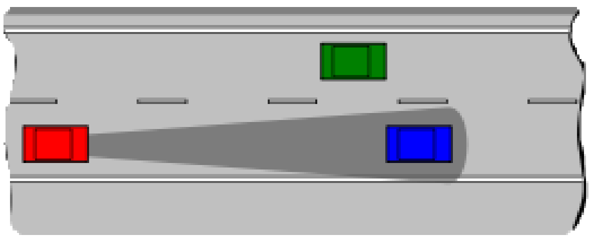
D is distance between 2 cars
T is time required receiving the transmitted wave

IFERP
connecting engineers... developing research

ISSN (Online) 2394-6849

International Journal of Engineering Research in Electronics and Communication Engineering (IJERECE)
Vol 3, Issue 12, December 2016

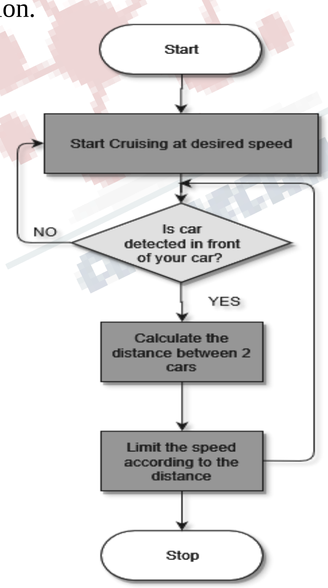
And ‘330 m/s’ is the speed of the ultrasonic wave. The transmitted wave bounces on the front car and reflects back to be received by receiver. Therefore the time requires reaching transmitted wave, is double the time required to reach the car in front of it. Hence it is divided by 2 and multiplied with the speed of ultrasonic sound to get the distance between both cars.



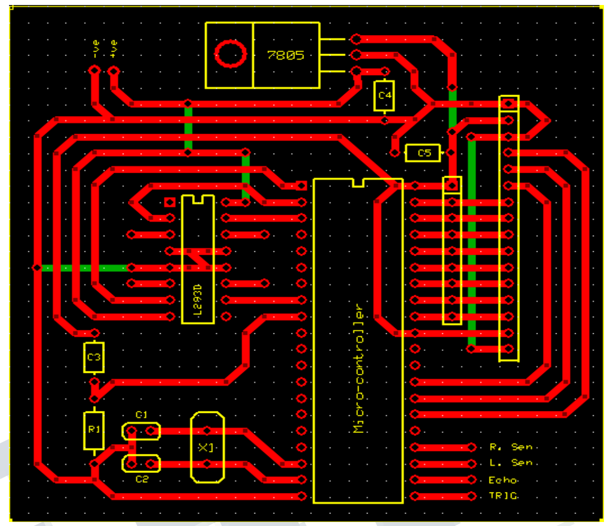
According to this distance the micro controller controls the speed of motor using the PWM technique to control the speed of motors. If the distance between cars is more, then microcontroller will not limit the cruising speed. As the distance between cars decreases, microcontroller will start to reduce the cruising speed. If distance reduces to very small value then microcontroller will stop the motors and hence the car will stop.

V. FLOW CHART

The flow chart used while creating the software is shown below. It gives batter idea about the software implementation.



VI. PCB LAYOUT



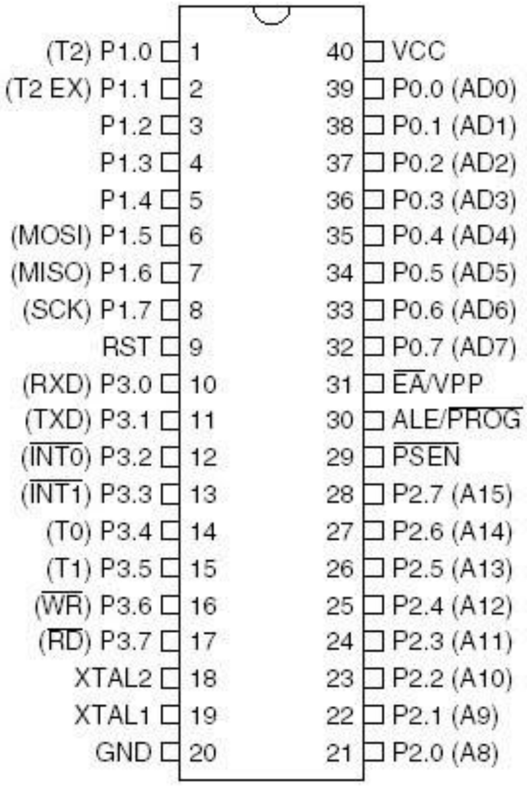
VII. COMPONENTS ULTRA SONIC SENSOR (HC-SR04)

Power Supply: 5v DC
Quiescent current: <2mA
Effectual angle: <15°
Ranging distance: 2cm – 500 cm
A short ultrasonic pulse is transmitted at the time 0, reflected by an object. The senor receives this signal and converts it to an electric signal. The next pulse can be transmitted when the echo is faded away. This time period is called cycle period. The recommend cycle period should be no less than 50ms. If a 10μs width trigger pulse is sent to the signal pin, the Ultrasonic module will output eight 40 kHz ultrasonic signal and detect the echo back. The measured distance is proportional to the echo pulse width and can be calculated by the formula above. If no obstacle is detected, the output pin will give a 38ms high level signal.

MICROCONTROLLER (89S52)

ISSN (Online) 2394-6849

International Journal of Engineering Research in Electronics and Communication Engineering (IJERECE)
Vol 3, Issue 12, December 2016



VCC Supply voltage.

GND Ground.

Port 0 Port 0 is an 8-bit open drain bidirectional I/O port. As an output port, each pin can sink eight TTL inputs. When 1s are written to port 0 pins, the pins can be used as high impedance inputs. Port 0 also receives the code bytes during Flash programming and outputs the code bytes during program verification. **External pull-ups are required during program verification**.

Port 1

P1.0 -T2 (external count input to Timer/Counter 2), clock-out
P1.1- T2EX (Timer/Counter 2 capture/reload trigger and direction control)
P1.5 -MOSI (used for In-System Programming)
P1.6 -MISO (used for In-System Programming)
P1.7 -SCK (used for In-System Programming)

Port 2

Port 2 is an 8-bit bidirectional I/O port with internal pull-ups. The Port 2 output buffers can sink/source four TTL inputs. When 1s are written to Port 2 pins, they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 2 pins that are externally being pulled low will source current (IIL) because of the internal pull-ups.

Port 3

P3.0 -RXD (serial input port)
P3.1 -TXD (serial output port)
P3.2 -INT0 (external interrupt 0)
P3.3 -INT1 (external interrupt 1)
P3.4 -T0 (timer 0 external input)
P3.5 -T1 (timer 1 external input)
P3.6 -WR (external data memory write strobe)
P3.7 -RD (external data memory read strobe)

RST

Reset input. A high on this pin for two machine cycles while the oscillator is running resets the device. This pin drives high for 98 oscillator periods after the Watchdog times out. The DISRTO bit in SFR AUXR (address 8EH) can be used to disable this feature. In the default state of bit DISRTO, the RESET HIGH out feature is enabled.

ALE/PROG

Address Latch Enable (ALE) is an output pulse for latching the low byte of the address during accesses to external memory. This pin is also the program pulse input (PROG) during Flash programming. In normal operation, ALE is emitted at a constant rate of 1/6 the oscillator frequency.

PSEN

Program Store Enable (PSEN) is the read strobe to external program memory. When the AT89S52 is executing code from external program memory, PSEN is activated twice each machine cycle, except that two PSEN activations are skipped during each access to external data memory.

EA/VPP

External Access Enable. EA must be strapped to GND in order to enable the device to fetch code from external program memory locations starting at 0000H up to FFFFH.
EA should be strapped to VCC for internal program executions. This pin also receives the 12-volt programming enable voltage (VPP) during Flash programming.

XTAL 1

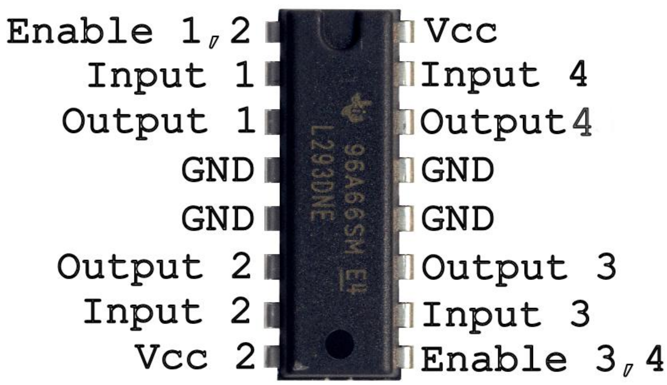
Input to the inverting oscillator amplifier and input to the internal clock operating circuit.

ISSN (Online) 2394-6849

International Journal of Engineering Research in Electronics and Communication Engineering (IJERECE)
Vol 3, Issue 12, December 2016

XTAL 2
Output from the inverting oscillator amplifier.

MOTOR DRIVER (L293D)

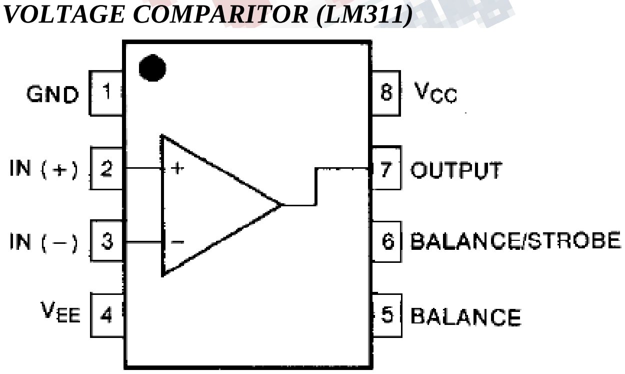


The Device is a monolithic integrated high voltage, high current four channel driver designed to accept standard DTL or TTL logic levels and drive inductive loads (such as relays solenoids, DC and stepping motors) and switching power transistors.

This device is suitable for use in switching applications at frequencies up to 5 kHz. The L293D is assembled in a 16 lead plastic package which has 4 center pins connected together and used for heat sinking.

- Outlet current capability per channel: 600mA
- Peak output current per channel: 1.2A
- Enable facility
- Over-temperature protection
- Logical '0' input voltage up to 1.5V
- High noise immunity

VOLTAGE COMPARITOR (LM311)



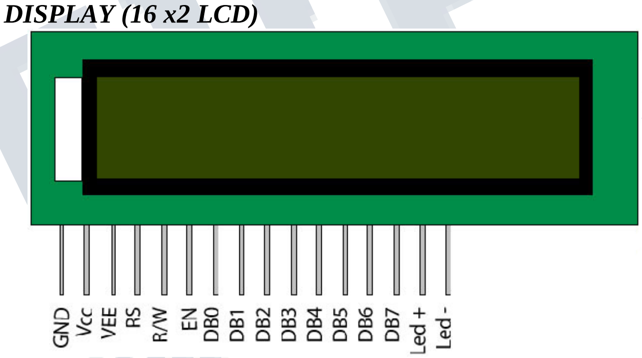
LM311 PINOUT

The LM311 series is a monolithic, low input current voltage comparator. The device is also designed to operate from dual or single supply voltage.

They are also designed to operate over a wider range of supply voltages: from standard ±15V to 5V used for IC logic.

- Low input bias current : 250nA
- Low input offset current : 50nA
- Differential input voltage : ±□ □ □ V
- Power supply voltage: single 5V supply to±15V
- Offset voltage null capability
- Strobe capability

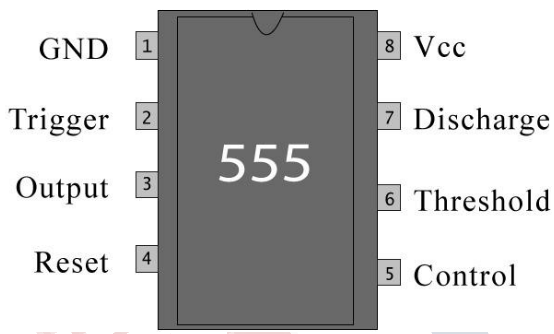
DISPLAY (16 x2 LCD)



VSS: Ground Pin
VCC: Power supply pin of 5V
VEE: Used for adjusting the contrast commonly attached to the potentiometer.
RS: RS is the register select pin used to write display data to the LCD (characters), this pin has to be high when writing the data to the LCD. During the initializing sequence and other commands this pin should low.
R/W: Reading and writing data to the LCD for reading the data R/W pin should be high (R/W=1) to write the data to LCD R/W pin should be low (R/W=0).
EN: Enable pin is for starting or enabling the module. A high to low pulse of about 450ns pulse is given to this pin.
DB0-DB7: Data pins for giving data (normal data like numbers characters or command data) which is meant to be displayed.
LED+ve: Back light of the LCD which should be connected to Vcc.
LED-ve: Back light of LCD which should be connected to ground.

International Journal of Engineering Research in Electronics and Communication Engineering (IJERECE)
Vol 3, Issue 12, December 2016

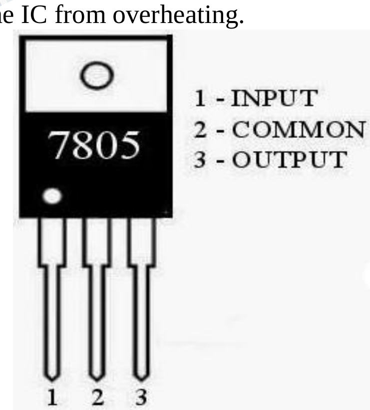
TIMER (IC 555)
The 555 timer IC is an integrated circuit (chip) used in a variety of timer, pulse generation, and oscillator applications. The 555 can be used to provide time delays, as an oscillator, and as a flip-flop element.
The LM555 is a highly stable device for generating accurate time delays or oscillation. Additional terminals are provided for triggering or resetting if desired. In the time delay mode of operation, the time is precisely controlled by one external resistor and capacitor. For astable operation as an oscillator, the free running frequency and duty cycle are accurately controlled with two external resistors and one capacitor.
The circuit may be triggered and reset on falling waveforms, and the output circuit can source or sink up to 200 mA or drive TTL circuits.



GND: Ground reference voltage, low level (0 V).
TRIGGER: The OUT pin goes high and a timing interval starts when this input falls below 1/2 of CTRL voltage (which is typically 1/3 V_{CC}, CTRL being 2/3 V_{CC} by default if CTRL is left open). More simply we can say that OUT will be high as long as the trigger is kept at low voltage. Output of the timer totally depends upon the amplitude of the external trigger voltage applied to this pin.
OUTPUT: This output is driven to approximately 1.7 V below $+V_{CC}$, or to GND.
RESET: A timing interval may be reset by driving this input to GND, but the timing does not begin again until RESET rises above approximately 0.7 volts. Overrides TRIG which overrides THR.
CONTROL: Provides "control" access to the internal voltage divider (by default, 2/3 V_{CC}).
THRESHOLD: The timing (OUT high) interval ends when the voltage at THR ("threshold") is greater than that at CTRL (2/3 V_{CC} if CTRL is open).
DISCHARGE: Open collector output which may discharge a capacitor between intervals.
VCC: Positive supply voltage, which is usually between 3 and 15 V depending on the variation.
FEATURES:

- Timing from microseconds through hours
- Operates in both astable and monostable modes
- Adjustable duty cycle
- Output can source or sink 200 Ma
- Output and supply TTL compatible

VOLTAGE REGULATOR (IC 7805)
The LM7805 series of three terminal regulators is available with several fixed output voltages making them useful in a wide range of applications. One of these is local on card regulation, eliminating the distribution problems associated with single point regulation. The voltages available allow these regulators to be used in logic systems, instrumentation, HiFi, and other solid state electronic equipment.
Although designed primarily as fixed voltage regulators these devices can be used with external components to obtain adjustable voltages and currents.
The LM7805 series is available in an aluminum TO-3 package which will allow over 1.0A load current if adequate heat sinking is provided. Current limiting is included to limit the peak output current to a safe value. Safe area protection for the output transistor is provided to limit internal power dissipation.
If internal power dissipation becomes too high for the heat sinking provided, the thermal shutdown circuit takes over preventing the IC from overheating.



Input: Input voltage (5V)
Common: Ground (0V)
Output: Regulated output 5V (4.8V-5.2V)

FEATURES:

- Output current in excess of 1A
- Internal thermal overload protection
- No external components required
- Output transistor safe area protection
- Internal short circuit current limit
- Available in the aluminum TO-3 package

VIII. ADVANTAGES

- As there is no use of satellite or roadside infrastructures the cost is less.
- Useful for long driving.
- More safety is provided to passengers.
- Reduction in accident rate.
- Easier driving for learner.

IX. CONCLUSION

The adaptive cruise control improves the safety of the driver and passengers by keeping the safe distance between 2 cars. It is also provides relaxation to drivers on the long drives. It makes no use of satellite, roadside infrastructures or of any co-operative support from other vehicles. Hence the cost is very low compared to other safety systems. It is going to be a key component of the future cars.

REFERANCES

[1] D. Corona and B. De Schutter, "Adaptive cruise control for a SMART car: A comparison benchmark for MPC-PWA control methods,"- IEEE Transactionson Control Systems Technology, vol. 16, no. 2, pp. 365–372, Mar. 2008.

[2] Nancy G. Leveson, "System Safety in Computer-Controlled Automotive Systems"-, SAE World Congress 2000(Conference Proceedings)

[3]The 8051 Microcontroller And Embedded Systems by Mohammad Ali Mazidi