# Designing of Automotive Engine Electronic Throttle Control valve.

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***Abstract***— **Automotive engine electronic throttle mainly has an advantage of low fuel consumption and high torque. The throttle's butterfly valve angle is changed by Engine Control Unit (ECU) Signals. In some cases physical model of Electronic Throttle is needed for engine optimization in automotive industrial. In this paper physical parameters of the special engine electronic throttle has been gotten and estimated. After this research, a controller has been designed and constructed. Software simulation results show the controller works correctly.**

***Keywords— Engine Electronic Throttle, Physical Model, Parameter Estimation, Controller.***

## I. INTRODUCTION

New Automotives Engines Electronic Throttle has been used to reduce fuel consumption and increase the torque. In many situations, the car does not need to use the maximum engine power. Therefore torque and power output must be controlled. It is the duty of the throttle valve in internal combustion engines. The valve controls the amount of input air to engine by butterfly valve then fuel injection will fade and torque and power [1]. This paper, for the precise control of the throttle physical model implementation is using and later for measuring unknown parameters will carried out by simulation.

[1] Mentions the Practical solution for automotive electronic throttle control based on FPGA. The throttle valve or electronic throttle valve is one of the critical parts of car power-train control. It plays an important role in improving motor vehicle dynamic characteristics, safety and comfort, reducing pollution discharge. This paper introduces a practical solution for automotive electronic throttle control (ETC) based on Xilinx-FPGA, in which analyses the characteristic of the throttle valve, develops the system process model and researches the control strategy.

[2] Mentions the electronic throttle body is a nonlinear device that includes effects on dead time, transmission friction, throttle plate friction and return spring limp-home. The effects are problem to precisely control of electronic throttle regulation. In recent year, various control designs have been proposed. This paper presents a simple yet effective nonlinear controller to enhance the regulator

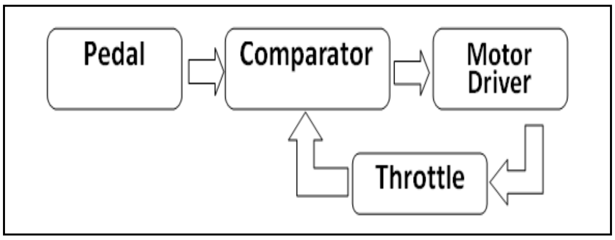
[3] Mentions the modeling, parameters identification, and control of an electronic throttle control system**.** The modeling, parameters identification, and linear and nonlinear feedback control designs of an electronic throttle control (ETC) system is considered. A commercially available ETC system made by Bosch is selected for our investigation. The unknown parameters identified are used in designing linear and nonlinear controllers. Simulations and extensive experiments were conducted. The techniques and methodology developed are applicable to similar and/or other types of systems.

[4] Mentions the Adaptive Servo Control Strategy for Automotive Electronic Throttle and Experimental Validation. In order to achieve higher precise positioning of the throttle plate, an adaptive servo control strategy is presented for the electronic throttle control system. Compared with the existing results on the electronic throttle control schemes, in this paper, the throttle valve reference tracking controller comprises a proportional-integral-derivative-type feedback controller with adaptive gain parameters, an adaptive feed forward compensator, and adaptive nonlinearity compensators for friction, limp-home (LH), and backlash. The closed-loop controller is realized by only utilizing the information of the throttle valve position measured by a cheap potentiometer of low resolution. The theoretical proof and analysis show that the designed throttle control system can ensure fast and accurate reference tracking of the valve plate angle in the case of the uncertain parameters related to production deviations, variations of external conditions and aging, and the effects of transmission friction, return-spring LH, and gear backlash nonlinearity with uncertain parameters.

## II. METHODS

1. Designing of controller for physical model

The designing of controller for physical model contains a pedal, comparator, motor driver and a throttle. This controller is one of the electronic control circuit (ECU).




It is illustrated in the figure 1.here the car driver pushes the pedal then the signal is transmitted to ECU.this pedal signal is the reference signal. the comparator compare the this reference signal and ECU unit butterfly angle signal.

Following an error signal is produced. This signal is sent to DC motor driver. The butterfly angle generates an PWM signal. This angle may be positive or negative. So two important portion of this controller is comparator and motor driver. The explanations will follows

*A. Designing of Comparator portion:*

It includes 2 comparators. Comparators input as symmetry and output signal as a PWM signal. In continues output PWM signal multiply to positive or negative gain because we need positive or negative voltage for DC motor direction.

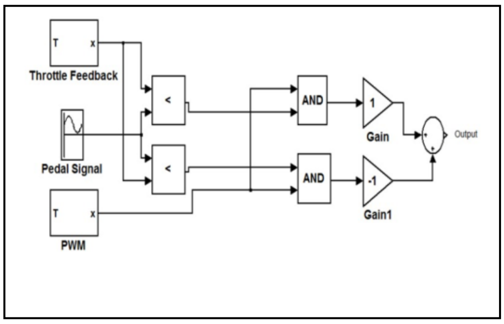



Figure 2: The comparator portion

*B. Designing of PWM portion*

The PWM method used to control of the motor speed. To produce PWM signal the error magnitude and a reference signal (saw tooth wave) are compared. The frequency of saw tooth signal is 25 kHz. The complete model of controller has been demonstrated following figure. The 2 important portions exist in the figure.

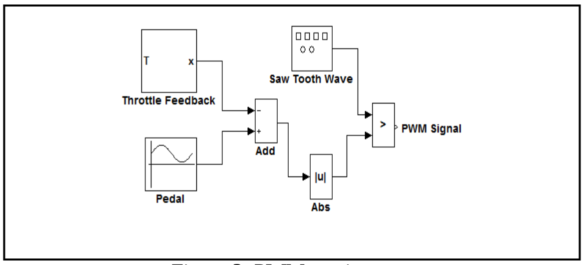
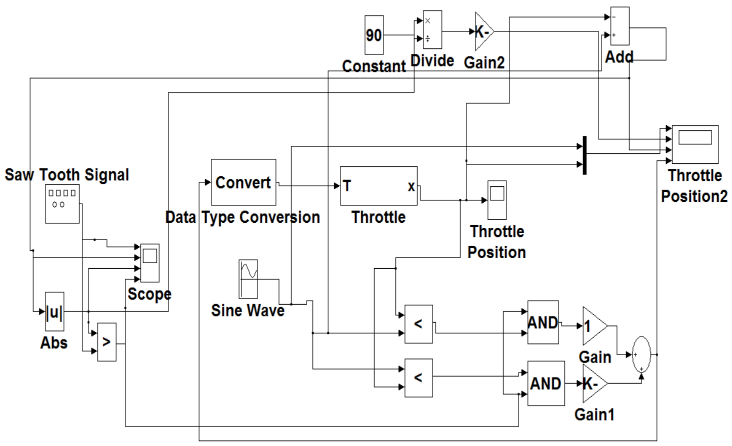



Figure 3: PWM portion

***C. Complete controller diagram.***




III. SIMULATION RESULTS

The result for the simulation as a reference we taken as a pedal signal in figure 4 is send to controller and butterfly valve position signal in figure 5 is illustrated. Some vibrations have been existed in up and down border sides of butterfly signals. The mixing of figure 4 curve and 5 curves is accommodated in figure 6.the error signal as demonstrated in figure7.

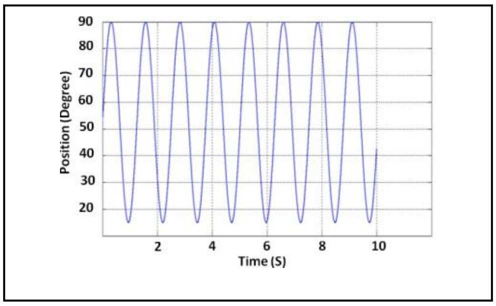



Figure 4: Reference Signal

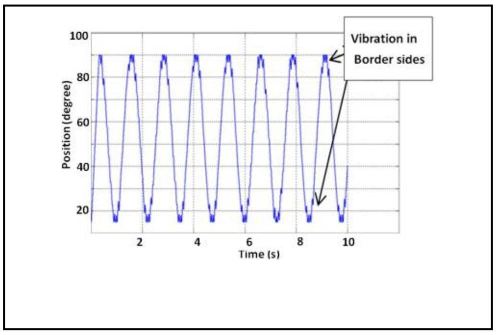



Figure 5 : Butterfly Portion

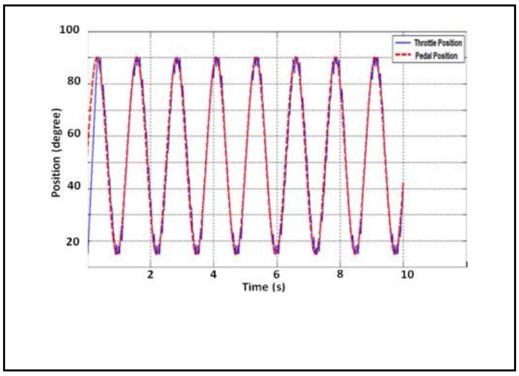



Figure 6: Accomodation of Signals

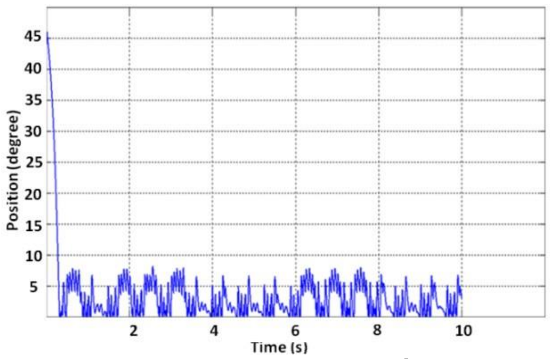


Figure 7: Error signal

## III. CONSTRUCTION OF CONTROLLER

Mainly the controller circuit has 2 portions. They are controller and driver .controller is a microcontroller. In this structure at first the Microcontroller receives the pedal and butterfly position signals then transmits proper comments to bipolar chopper portion. In the bipolar chopper portion the positive or negative PWM signals are produced to D C motor driving. It is illustrated in figure 8

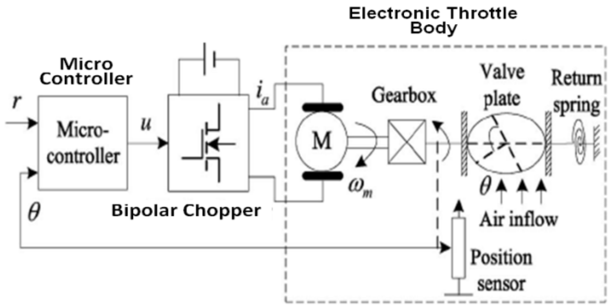


Figure 8:Construction of controller .

## IV. HARDWARE CIRCUIT

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It works on the concept of H-bridge. H-bridge is a circuit which allows the voltage to be flown in either direction. As you know voltage need to change its direction for being able to rotate the motor in clockwise or anticlockwise direction, Hence H-bridge IC are ideal for driving a DC motor.

In a single l293d chip there two h-Bridge circuit inside the IC which can rotate two dc motor independently. Due its size it is very much used in robotic application for controlling DC motors. Given below is the pin diagram of a L293D motor controller.

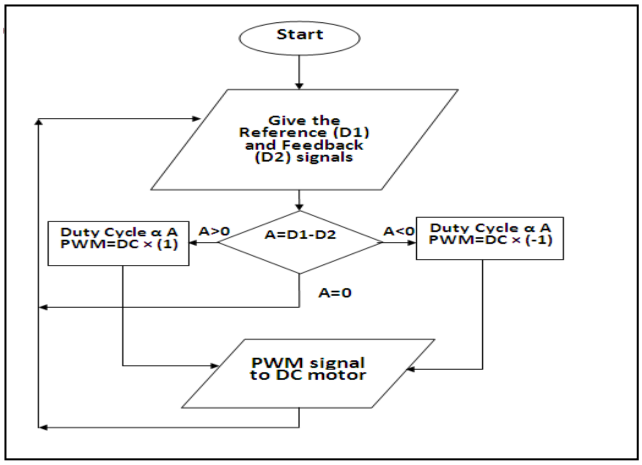


Figure 9: Controller Flowchart.

There are 4 input pins for l293d, pin 2,7 on the left and pin 15 ,10 on the right as shown on the pin diagram. Left input pins will regulate the rotation of motor connected across left side and right input for motor on the right hand side. The motors are rotated on the basis of the inputs provided across the input pins as LOGIC 0 or LOGIC 1.In simple you need to provide Logic 0 or 1 across the input pins for rotating the motor.

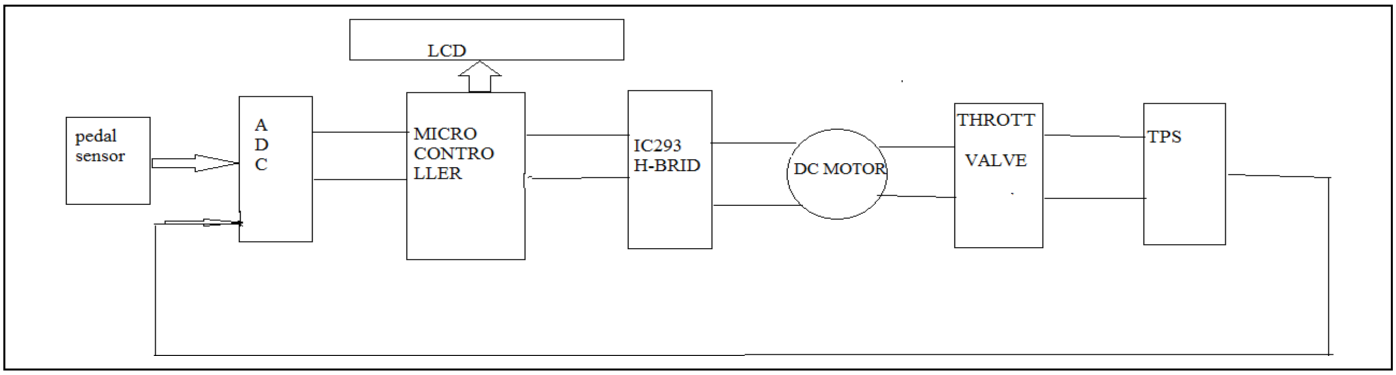


Figure-10: Hardware Circuit

In the hardware circuit using two sensors as pedal sensor and a throttle control sensor. The 2input giving to ADC.The output from the ADC is given to the microcontroller. Here using as a ARM series.IC293 is as a H-bridge circuited motor is connected to throttle valve. It will open and close according to the angle. From the microcontroller it's connected to LCD.

## CONCLUSION

In this paper a physical model of special Electronic Throttle Controller has been approximated and then based on the need, we have designed and constructed a controller for it. From our observations the maximum error of this controller in software simulation is 7 percents and maximum error in experiment set is 8 percents. Errors between Simulation results and laboratory results are 1 percent and this subject shows the controller works correctly.

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