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Innovation In Cohesive Stock ECU Tuning And Turbocharging

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Abstract: **Cutting edge business autos have been outfitted with Engine Control Unit (ECU) which permits more exact and precise running of an engine. ECU controls the measure of fuel infused, start timing A/F proportion with input from different sensors. These sensors are mounted at various zones (MAP, TPS, Lambda, and so on) show diverse values and send them to the ECU, it then peruses information preloaded by the producer and capacities likewise to the qualities got. Presently by utilizing constrained acceptance either by turbocharging (exhaust driven) or supercharging (crankshaft driven) we can show signs of improvement efficiency and power picks up from 50bhp up to 1000bhp. The principle issue emerges while turbocharging a normally suctioned engine since it not intended for such power picks up. The principal contrast is the pressure proportion which ought to in a perfect world lower to permit huge support weight; this can be accomplished by fitting fashioned low pressure cylinders. Different frameworks which must be altered incorporate fuel pump, injectors, remapping of the start timing. Through this project, we will perceive how this should be possible**.

Index Terms: **Stock ECU; Turbocharging; ECU Remap; Piggyback Tuning;**

I. INTRODUCTION

Internal combustion engines are mechanical devices in which a blend of fuel and air join to discharge a specific measure of vitality which additionally moves the piston down with unfathomable power.

Further internal combustion engines are catergorised in two types:

- Spark Ignition or SI: In the Spark ignition engine, the blend is ignited by a start plug or spark plug.
- Compression ignition or CI: During a compression stroke the air that enters is packed and achieves TDC and further it consolidates with fuel to create the power.

Spark ignition and compression engine work on two cycles:

- Four stroke cycle: It has two cycles for each engine cycle.
- Two stroke cycle: It has one insurgency for every engine cycle.

1.1 Engine control unit and various linked sensors:

Controlling the motor is the most processor-escalated work on your auto, and the motor control unit (ECU) is the most intense PC on generally autos. The ECU utilizes shut circle control, a control plan that screens yields of a framework to control the contributions to a framework, dealing with the emanations and mileage of the motor (and in addition a large group of different parameters). Gathering information from many distinctive sensors, the ECU knows everything from the coolant temperature to the measure of oxygen in the fumes. With this information, it performs a huge number of counts every second, incorporating looking into qualities in tables, ascertaining the aftereffects of long conditions to settle on the best start timing and deciding to what extent the fuel injector is open. The ECU does the greater part of this to guarantee the most reduced outflows and best mileage.

List of sensors related to the ECU:

- *MAP sensor, Manifold Absolute Pressure*, used in regulating fuel metering.
- *Mass flow sensor, or mass airflow (MAF)sensor*, used to tell the ECU the mass of air entering the engine.
- *Oxygen sensor*, used to monitor the amount of oxygen in the exhaust.

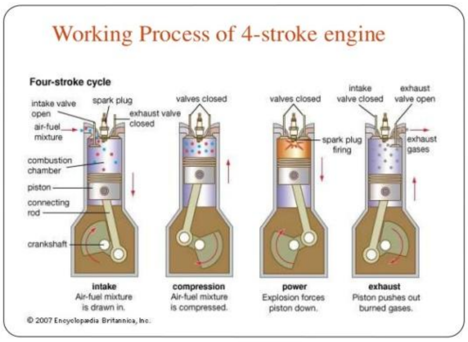

Fig. 1.1 Figure showing working of 4-stroke engine

1.2 Engine management system:

An **engine control unit** (**ECU**) is a electronic control unit that controls a series of actuators on an internal combustion engine to ensure proper running of an engine. It does this by reading values from multiple sensors mounted across the engine bay.

The computer processes all of the voltage readings from the various sensors to govern the engine running conditions at that moment and delivers the correct pulse width to the injectors. If engine airflow increases by 20%, the pulse width is also increased by about 20% to keep the air-fuel ratio constant. If the rpm is doubled from 2000 to 4000 rpm, the number of injections is also doubled to double the fuel flow.

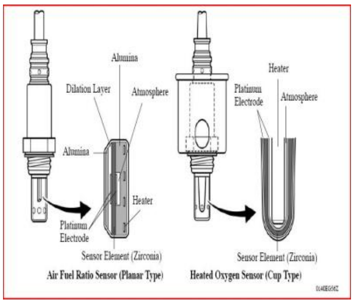

Fig. 1.2 Schematic diagram for Air Temperature sensor

The ECU searches for any changes in the readings in sensor inputs every few milliseconds so that it is ready to alter the pulse width if any parameter changes.

Most EFI"s come with 6 basic inputs:

- RPM
- Airflow
- Manifold pressure
- Water temperature
- Throttle position
- Air temperature Oxygen sensor

1.2.1 Tuning Systems:

- **Piggy-back tuning**: It utilizes the stock ECU and screens specific engine parameters from the stock ECU and sends a changed ignition yield to accomplish a preferred air/fuel or ignition timing. Piggy-back system can usually have poor running conditions because it "deceives" the ECU into accomplishing something it was not planned to do.

  Ex: AEM, Emanage.

- **Modified stock engine control unit (ECU)**: This system is a very common one where the stock ECU is taken and a chip is installed. This chip provides a gateway which can help the tuner alter different parameters. This is comparatively cheaper giving out good output, efficiency and overall smooth running of the engine since it takes direct control over all the parameters of the stock ECU.

  Ex: Hondata KPro.

- **Flashing the stock ECU**: Most recent current cars can be "flashed" through the stock OBD2 port. This a very simple process compared to the others. One can directly tune the ECU without removing or altering it from its place. It is best recommended since it is cheap and has the ability to control emissions. One drawback is that it has less flexibility in tuning all the parameters.

  Ex: COBB, FlashPro.

- **Standalone ECU**: It is an immediate substitution of the stock ECU. It performs all the functions that the stock ECU did beforehand, however intermittently includes more flexibility or functions that the stock ECU would not generally have the capacity to give. Standalone ECU's regularly give the most control over tuning of an engine; however, they are the priciest.

  Ex: Haltech, Motec.

1.3Remapping and Tuning parameters:

Ignition Timing:

Ignition timing is the measurement of degrees of crankshaft rotation when exactly the spark should fire in each cylinder. It is measured after or before Top Dead Centres (TDC) of the compression stroke. The spark is usually initiated before TDC because the fuel takes time to burn. When the engine is at idle, the timing advance is normally set to 5^{o}. As the engine speed increases, the piston moves up and down faster so there is less time for fuel to burn.

Air-fuel Ratio:

The air-fuel ratio of an engine is measured by a “wideband” air/fuel ratio sensor. This is usually an oxygen (lambda) sensor mounted on the exhaust. This sensor reads the amount of carbon content in the exhaust gases from the engine; accordingly, the ECU varies the amount of fuel to be sprayed in the manifold. For every part of fuel to burn, it requires 14.7 parts of air which is called stoichiometric ratio

Variable valve timing:

VVT is a mechanism where the timing of valve lift is altered to improve performance, fuel efficiency or emissions. There are many versions of VVT developed by different car manufacturers.

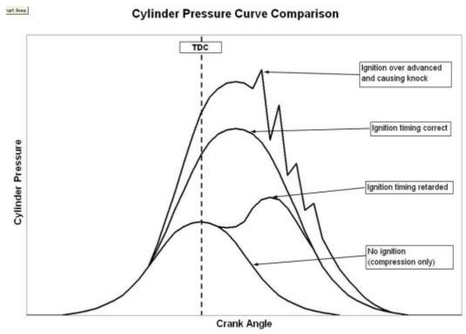

Fig 1.3 Ignition Advancement

II. LITERATURE SURVEY

- Prof Ivan Dunđerski, **'Active numerical vehicle acceleration control along acceleration function with maximum engine torque efficiency':**

This paper presents study results of vehicle acceleration control by numerical engine torque control in function of acceleration. Inevitable formula of torque reduction and throttle response delay for acceleration control a and acceleration rate is applied. However, the approach is different: Maximum engine torque efficiency used at relation accelerator pedal movement – number of revolutions – engine torque. With this approach, the loss of the vehicle's performance is minimal. Regulation of torque impairment is single stage, continuous and progressive: Vehicle performance and responsiveness to accelerator pedal position change increase as engine speed increases. This takes two important influential factors into account:

- Reducing vehicle performance due to reduced engine torque caused by inertia resistance.

- Engine effectiveness decrease due to of variable engine working speed.

- Hiep Hoang Tran, Bryn Richard, Kevin Gray, Michael Bassett,**' Developing a Performance Specification for an Electric Supercharger to Satisfy a Range of Downsized Gasoline Engine Applications'.**

This paper states an electric supercharger to be matched with a conventional turbocharger to create a new type of two stage boosting system and a simpler downsized gasoline engine usable in mainstream vehicle segments. Whereas most electric pressure charging devices are capable of transient output to alleviate turbo lag. The electric supercharger is capable of steady-state air delivery. This makes the electric supercharger a dual-function device, alleviating turbo lag and also supplementing the compressor map of the turbocharger or main boost device. The electric supercharger thus acts as a conventional mechanical supercharger in addition to a conventional electric pressure charging device.

- Steven Lewis **'A short explanation of the modifications made in a poor-quality ECU remap'**

This paper has been composed for those anticipating to utilize a low quality remap. In some cases, these are utilized by major organizations who charge heavily for their 'remaps'. The ECU record looked at in this paper is from a Peugeot 306 HDI. This vehicle accompanies a 2.0HDI common rail diesel motor fit for creating 205 Nm of torque and a peak power output of 90 BHP. This paper also introduces the topic of common rail diesel engines and continues about it in detail. As the name describes, the common rail diesel engines control the fuel injection which remains common to all the injectors by a high pressurized fuel rail. This completely rejects the help of a fuel pump timing, as now the injectors fire is directly monitored by the ECU. The paper further describes how this short injection time has created the opportunity for numerous injections during only one stroke of the piston.

- **Jenelle Pope, 'Analysis of a turbocharger system for a diesel engine'**

The reason for this paper is to examine a turbocharger framework in a diesel motor. The

turbocharger is utilized to uplift the power of the engine. The Chevrolet Suburban diesel motor accompanies a stock turbocharger. Keeping in mind the end goal to acquire more power from the motor, another what's more, bigger turbocharger is being utilized. The new turbocharger is coupled to an air-water intercooling framework to diminish the gulf air temperatures. This task investigated the intercooling framework and tried the last plan in the vehicle. The outcomes demonstrate that the cooling framework parts obtained are satisfactory for this framework. The perfect turbocharger configuration would be littler than the framework obtained. The outcomes examine the genuine estimated heat exchanger required for the perfect framework.

III. CONCLUSION

After hundreds of dyno runs and misfires, incorporating the turbo involved major modifications to the engine components.

- Firstly, it involved choosing the right turbo with constant boost throughout the rpm range by reading the compressor maps provided by manufacturers.
- Next step involved choosing an intercooler large enough to cool the compressed air and not to have any pressure loss.

- Adding extra harness wiring was also required to support different sensors across the turbo setup.
- Exhaust manifold and headers have been modified or changed to suit the turbocharger housing and limiting exhaust back pressure which can damage the turbocharger components.
- When the engine is at idle, the timing advance is normally set to 5^o. As the engine speed increases, the piston moves up and down faster so there is less time for fuel to burn. Therefore, the timing is set way before TDC (5^o to 50^o). In older cars, this was controlled by distributers but nowadays there are various sensors (speed sensor and MAP sensor) which give feedback to the ECU and from the ECU preloaded tables are read and ignition occurs.
- When the engine is required to develop power the mixture is rich whereas at light loads the mixture is lean. Rich mixtures are usually in the range 12.5:1 to 14.1:1 to develop good power. Maximum fuel economy is achieved between 16.2:1 to 17.6:1.
- VTEC engines have an extra cam profile which opens longer than the other cam profile. The extra cam profile opens the valves prior to the intake stroke allowing more air to enter the cylinder, this happens at high engine speeds.

IV. FUTURE SCOPE

In today's commercial cars, most manufacturers have down-tuned their cars for the long life and reliability.

- As a tuner, one can easily extract performance from an engine by learning the art of ECU tuning. This can be done by purchasing reflash software which is easily available.
- Optimum reflashing can give power gains of up to 40hp and up to 20% better fuel efficiency on a naturally aspirated engine without any change to the engine components.
- As well as any problems, which are affecting the engine for example: check engine light can be rectified by connecting any device to the OBD2 port which is located inside your car usually above the driver's legs and running a diagnostic scan. This will save you thousands of Dollars instead of going to your local dealer which can drain out your wallet.

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