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Conversion Of Carbureted Fuel Supply Into Electronic Fuel Injection System

Durgeshwar P Singh[1] *, Nishant Negi[1], Prajwal Bhatt[1], Shiv Kumar Arora[1], Bhuvanyu Mall[1], Neeraj Sengar[1], Ms Himadri Vaidya[2]

[1]Department of Mechanical Engineering, Graphic Era Deemed to be University, Dehradun, Uttarakhand, India.
[2] Assistant Professor, Department of Computer Science and Engineering, Graphic Era Hill University, Dehradun .

* durgeshwar.me@geu.ac.in

Abstract. One of the most pressing issues confronting the automobile industry is the provision of the most recent technological advancements in this industry to an increasing number of people on a daily basis. Many experts from around the world are working on this issue. Billions of dollars are spent in this industry on research, which benefits the average citizen. With major advancements in the field of automobiles, several methods have been introduced that have had limited success. This research is dedicated to address this issue while also tapping the market for vintage cars. As cars age, some of them gain "vintage" status, increasing their value by hundreds of times. The market is currently worth billions of dollars, and with this project, we may be able to keep them running for a longer period of time. This project will also deliver packages for different types of engines, such as people who want greater fuel efficiency, while people who want performance out of their engine will have a different product. Also, for vintage cars, every car will require a custom one that fits it without ruining or disturbing its original shape. This paper is divided into two parts first, the control unit, which includes the E.C.U. and wiring, and the second one is a physical unit, which includes the runner length and other physical components.

Keywords:

INTRODUCTION

For the running of an engine the correct amount of fuel and air should be present in the combustion chamber. If the correct portion of these two things is not achieved then the engine is likely to misbehave and under many conditions simply won't run. The two

components that have been used over the years for transferring fuel to combustion chambers are carburetor and electronic fuel injection system.

Working with a carbureted engine, this research paper explains about the know-how of designing a carburetor and how it functions under different conditions of air and fuel pressure. The results produced from this paper show a consistency in the given experimental data and the modelling that has provided us a better look of the flow details. Mr Anil T R, P.G. Tewari, N.K.S. Ranjan (1) As a part of focus of this project lies in cost cutting we came across this research paper, we were looking for a suitable material which can replace the timely used metal for runner length, the material that this paper suggested is Poly Butylene Teraphthalate. Deepthi et al (2), To study the downsides of a carburetor over fuel injection system this paper helped us when a carburetor is modified in which fuel tubes are installed there was reduction of mass flow rate by 69.7% in case of the bigger 6mm fuel tube and by 56.2% in the smaller 3mm fuel tube. As in case of throttle plates they also didn't do much and cause a further dip in mass flow rate. Palanisamy et al (3), for this conversion the full knowledge of working of the fuel injection system was to be taken in this book by the Russian author and professor takes us through the full workings of the electronic injection system from the start of it from the fuel line to the delivery of fuel under certain conditions. This book also took us through the behaviour of fuel injector working under different pressure conditions of the fuel. Dziubinski (4), As most research papers online on fuel injection system were mainly for either diesel engines or multi cylinder petrol engine it was a bit difficult for the single engine procedure until we came across this research paper, here the authors discuss the development of fuel injection system on single cylinder internal combustion engine. Here they give us a basic idea of how to design a runner length and how to place a fuel injection on it. Their system composed of fuel tank, injection sensor, fuel pump, 12V AC-DC inverter, fuel ball valve and a fuel pressure regulator, we gained a lot from this research paper as it was really close to out project. Mustafa et al (5), One of the main problems we are currently undergoing is the placement of all the sensors and the fuel injection on the runner length as the injection point needs to be within a good range of the intake as it can severely affect the working of the engine, the placement tells in what condition will fuel reach and mix with the air, this research paper proved to be quite useful in this matter and helped us to gain good result. Vinoth et al(6), While working we are always open to any new ideas that come our away, while going through several papers we found this gem, this research paper tells us about ways to lower fuel consumption and also in turn lower exhaust emissions. This paper and our project have basically the same goal i.e. retrofit fuel injection system (FIS) in a conventional carbureted vehicle, giving a low-cost alternative in an effort to lessen air pollution and fuel costs. Muslim (7)

METHODOLOGY (COMPONENTS AND SOFTWARE)

Electrical components

The electronic control unit (ECU) for this project is to be made on Arduino therefore several small components are required given below is a list of all the parts that are required for the ECU and their quantity. This need to be put together with the help of a soldering iron and the diagram for connecting these components together (circuit diagram) is given in the implementation section of this project report. For this to work various sensors are required like the map sensor, tps sensor etc. and ECU reads their values and then processes it, it is the most time consuming and hardest part of this project.

Mechanical Components

For the transformation of the carburetor to fuel injection several physical components are required namely:

- **Fuel injector/'s**
  The fuel injector is the basic component of this project after the removal of the carburetor this component is what will supply the fuel to the combustion chamber. Several parameters have to be considered before the installation of the injector.
- **Runner length**
  The runner length is the extra intake length that is attached onto the inlet side of the combustion chamber. This length is very important as this is the part where the fuel injector and the M.A.P. sensor is mounted, the runner length should be made carefully as it has to place the crucial components at the right angles for proper functioning of the engine intake.
- **Manifold absolute pressure sensor**
  This sensor is also placed on the runner length; this sensor determines the engine's mass flow rate by calculation of air density this sensor directly sends information to the engines ECU. This helps it regulate the fuel injection
- **Throttle body**
  This conversion requires a separate throttle body as it has to ridden with sensors for the ECU. this new throttle body keeps track of the air flow into the engine
- **Throttle position sensor**
  The throttle position sensor can be found on the throttle body it is basically the sensor which determines how much throttle is being given by the driver by reading the position of the butterfly valve on the throttle body. This sensor the sends this information to the control unit and the air intake and fuel pressure is regulated.
- **Fuel pump**
  A fuel pump is a device which is required to prime up the fuel up to the pressure of 3 to 5 bars. This component helps with the easy delivery of fuel to the fuel injectors.

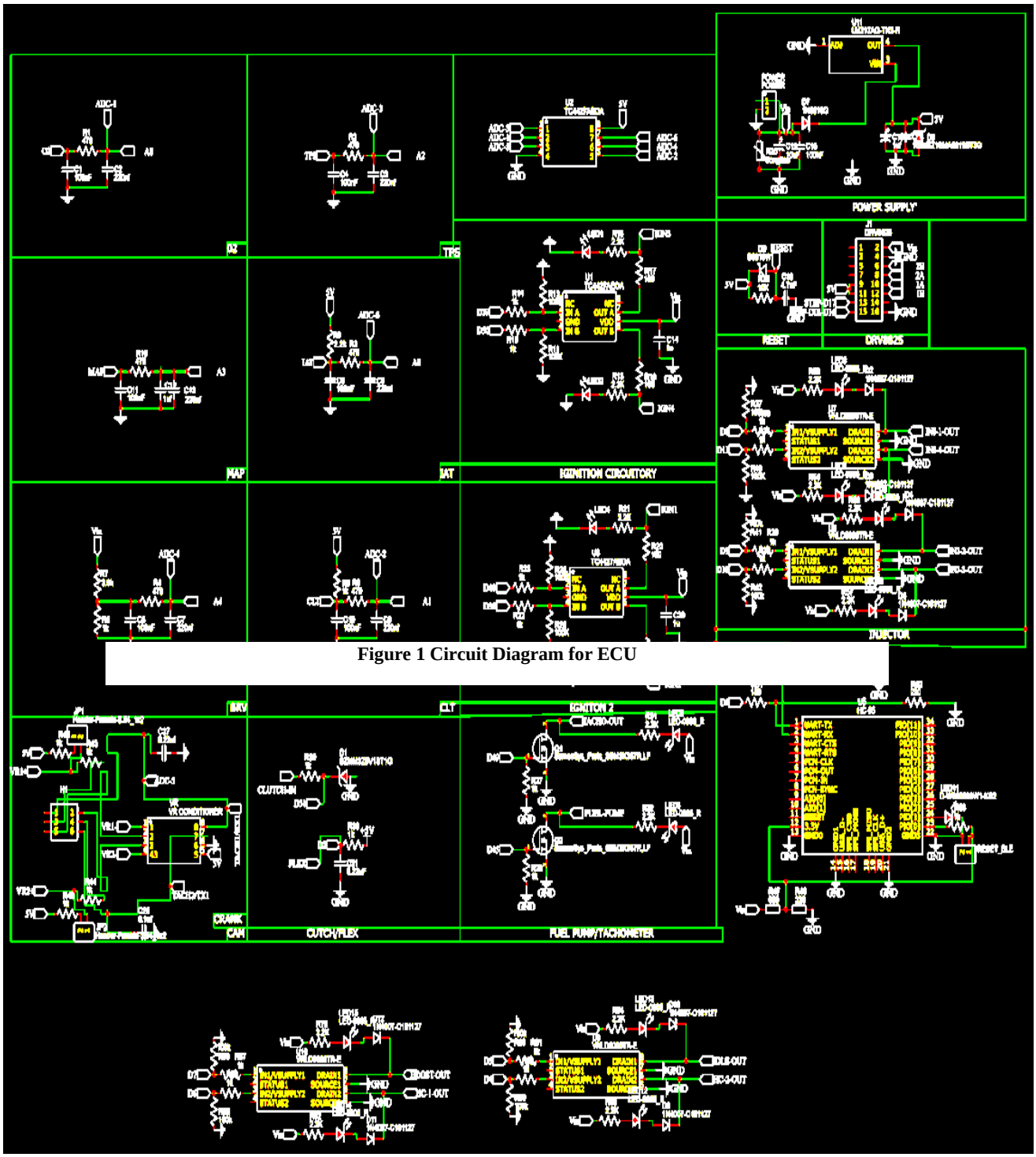


Figure 1 Circuit Diagram for ECU

Software

In order to adjust the settings of the new ECU a software is required the software used in this particular project is named TUNER STUDIO and it lets us take up the entire control of the

ECU. We can control basically everything we like ranging from the amount of fuel that is introduced by the injector to the rpm of the engine and various other factors.
It also presents us with the data that various sensors are capturing; the use of number of sensors may vary according to the size and capacity of the engine. For an example lighter engines from up to 150cc are air cooled and hence do not require extra cooling equipment which in turn eliminates the use of sensors used in cooling such as the coolant temperature sensor. This software can work for almost any range of vehicle and give out amazing results weather it is in regard of performance or simply efficiency.

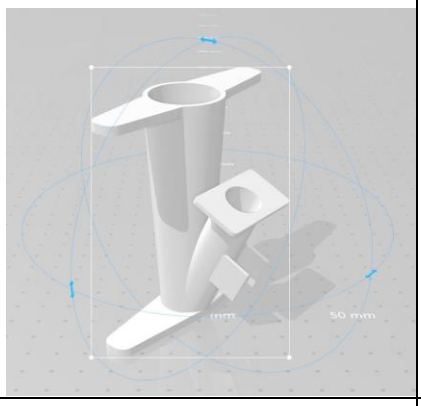
Working

In a carbureted fuel supply system, the fuel and air are mixed inside the carburetor to a ratio of 7-10 parts air to 1-part fuel which is enough for the engine to sustain its idle condition. The higher limit is made up of 19-20 parts air and 1-part fuel while the ratio obtained for cruising of the vehicle at normal speed is 15-17 parts of air to 1 part of fuel. While in case of a requirement of a rich mixture for maximum power output the ratio needs to be 12-13 parts of air to 1 part of fuel. Since the engine needs varying amount of air fuel mixture according to needs of the driver and the surroundings the carburetor is unable to process all demands efficiently as it is not an electronically controlled device but a mechanically controlled one.
While in the electronic fuel injection system the ECU keeps track of different aspects going on in the engine and is able to deliver the precise amount of fuel that at the moment is required by the engine hence allowing it to be on its peak performance throughout its life cycle while also saving up fuel. And also, in the condition where extra power is needed out of the engine the ECU can be tuned to instruct the system to inject more fuel into the cylinders.

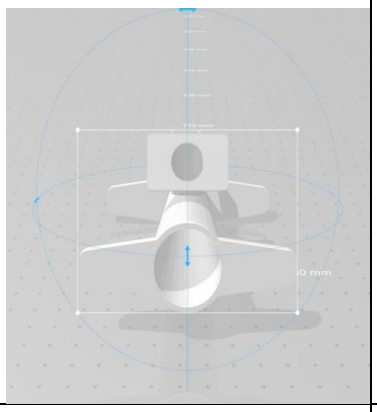
Implementation

This conversion can be followed by some basic steps ECU, Production of new parts, fitting of components, assembling new parts, Tuning.

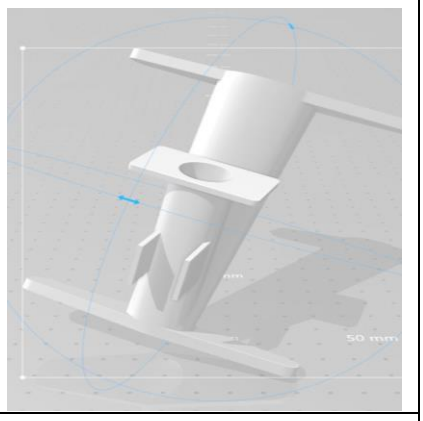
Designing of Parts



(a)



(b)



(c)

Figure 2 Running Length design

CHANGES TO THE EXISITING SYSTEM OF VEHICLE

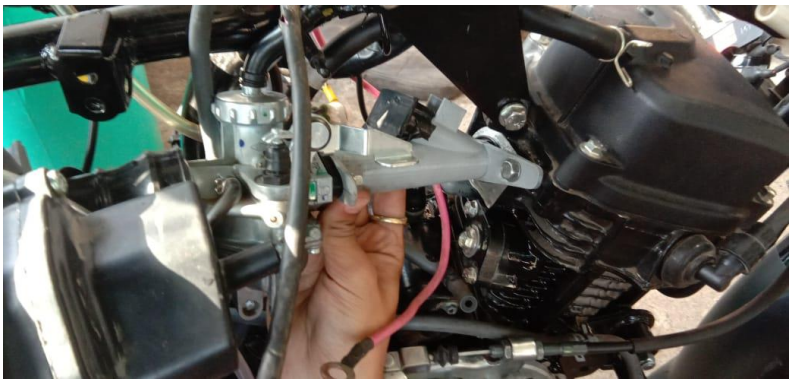


Figure 3 Fitment of runner length on engine

RESULTS AND DISCUSSION

Finalized materials

For the production of the runner length the material that made the final cut was T6 Aluminium as compared to the early choice of steel as it was cheaper but it was quite heavy and had lower heat absorbing capacity.

Figure 4 Final production piece (1)

Figure 5 Final production piece (2)

Instead of using rubber seal and clamps to join the pats together nut bolt and anabond were used as the nut bolt system is more secure in keeping the parts together and anabond was used because it performs well under the heat coming from the engine and is more efficient. The final software that is being used for tuning is tunerstudio as it provides a better interface than ecocal.

Result of First Test Runs

The first test runs were completed with the different options of runner length design
The main pointers that we were able to gather from the results were:

- Choose the correct value for the amount of fuel being injected into the runner length.

Figure 6 Tuner studio readings

- As the angle of the fuel injector plays a major role in performance of the system. Also it is very necessary to recheck all the measurements before the final install.
- It is important that at all the points where the connections are made for ex. The connection on runner length to the engine and the connection of throttle body to the runner length should be put together in such a way that there is no other way for the air to escape in or out of the system as it can jeopardize the results.
- During the test runs keep increasing the working time of the system bit by bit instead of putting it under work immediately for long period of time, it helps with the life and working of the system and prevents any miss happening.

Outcome

The main purpose of this project was to produce a cheaper and more user-friendly system with wider range of options to a product that is already available on market. A new system of this calibre from Ecotronics has a price tag of around ₹ 90,000 but in contrast to this we were able to achieve it for a little more than quarter of this amount. This system is not totally perfect yet we feel that a little more runtime and tuning is required but with what we have available at the moment we think we have done a pretty good job at it.

CONCLUSION

The incorporation of various technologies under one roof has given us the path to achieve goals which have never been realized in such an efficient manner in past. The use of this system over the traditional carburetor will provide a better efficiency and longer life for the engine. The initial investment has to be done while more of it can be recovered in fuel costs etc. it is easy to operate and gives full control to its owner instead of spending money on it.

It provides more of precise control and it makes better fuel atomization and also the better flow of air-fuel mixture above the piston.

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