iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 12 Issue: IV Month of publication: April 2024

DOI: https://doi.org/10.22214/ijraset.2024.60437

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 12 Issue IV Apr 2024- Available at www.ijraset.com

Development and Modification in IC Engine for Supra Kart (Review Paper)

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Abstract: The design of the transmission system for a student formula styled racecar using a KTM RC 390 bike engine is one of the best choice for the engineering students who design the motorsport vehicles for all the student race car competitions. As there are many rules and restrictions on engine usage such as capacity, type of fuel usage permitted, maximum power allowed of engine and many more. In addition, this report emphasize on the suitable type of drivetrain system, type of transmission and diffrential drivetrain. The present report shows the analysis and various parametric data's of stock KTM RC 390 Engine and the drivetrain of the car.

I. INTRODUCTION

The FSAE (Formula Society of Automobile Engineering) is a interdisciplinary student made, formula car designing competition held at national and international level. In this competition, students from various organizations /institutions design & build a formula car. The driver of the car should be one of the members of the team and therefore it becomes essential that the vehicle needs to be manageable and safe for the driver. The FSAE puts rules and limitation on the car. Event management also provides the rule book.

The system transmits the power developed by the engine of automobiles to the wheels of the motor vehicle to move the motor vehicle forward or backward. Power train is also called drive train/transmission. It consists of a group of components in a vehicle that delivers power to the driving wheels. Components present in the motor vehicle are engine, clutch, gear box, drive shaft, differential, axles, and cooling system. The vehicle's reliability was improved as a result of the power train simulation in this study. After knowing the requirements of the power train system, looking at both advantages and disadvantages of different parts, with the careful selection of the engine platform, KTM 390 was selected. Fuel efficiency is also a key role in racing events for that design of air intake with the restrictor diameter of 20 mm. The purpose of designing the power train without compromising the driver safety precautions is achieved and the power train of formula student race cars has been designed by following the SAE International rules.

II. DESIGN CONSIDERATIONS OF ENGINE

The heart of a vehicle is the engine, which converts chemical energy (fuel energy) into mechanical energy. According to the competition regulations, the engine used to power the automobile must be a four-stroke cylinder with a displacement of no more than 710 cc per cycle. If more than one engine is utilized, each engine's displacement must be less than 710 cc, and all engine's intake air must flow via a single air intake restrictor. Two-wheeler motorcycle engines such as the KTM390, CBR600, and Royal Enfield 350 are available for engine choice.

In the proposed paper for the design of power train, various parameters were taken into consideration. As per the rules of SAE and formula imperial engine was selected on the basis of high-power output under 710 cc segment considering less about the torque. Speed transmissions have been selected for the gear, train, and RPM and torque was evaluated for different gears and accordingly. There are multiple mechanisms available like belt, pulley drive, direct mesh gear system, and chain drive. Various drags such as aerodynamic drag as well as friction resistance were taken into consideration and their empirical relations according to the aerodynamics of the vehicle were evaluated. Apart from torque and power, the fuel efficiency factor was considered and the air intake runner was designed accordingly.

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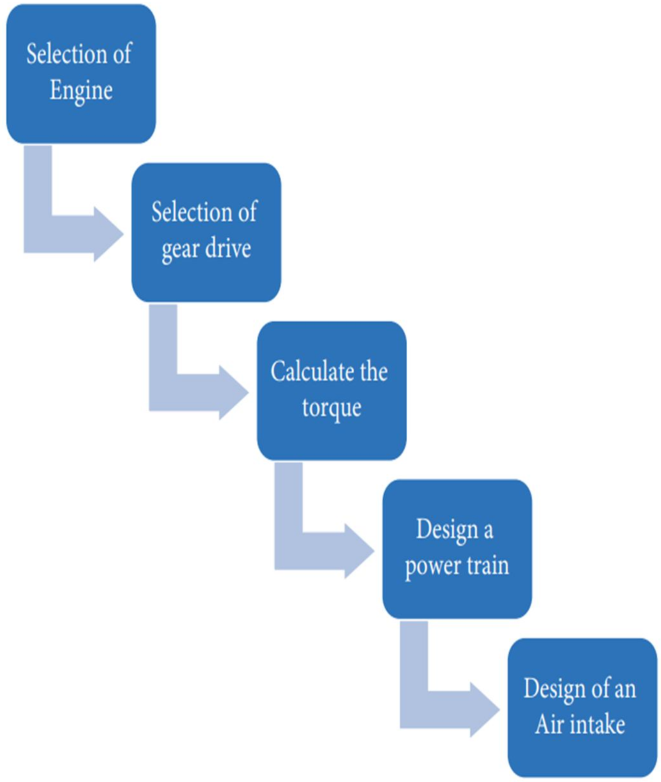

Figure 1: Block diagram for the design procedure for power train.

A. Reason behind selection of KTM RC 390

By considering the budget and availability of spare parts for better maintenance of the engine, the engine displacement is under 710 cc, which will satisfy the rule. It contains a single cylinder, so it may not be that much complicated in the design of air intake. KTM390 cc engine is an oversquare engine, so it produces more power compared to the torque which is required in racing conditions. +e KTM RC 390 model is a sports bicycle made by KTM. In this form, sold from the year 2020, the dry weight is 149.0 kg (328.5 pounds) and it is outfitted with a single-chamber, four-stroke engine. The motor delivers the extreme pinnacle yield force of 44.00 HP (32.1 kW)) and a greatest force of 35.00 Nm (3.6 kgf-m or 25.8ft. Lbs).

Year	2020	2015	2014	2011	2010	1989
Engine model	Yamaha YZF R6	Yamaha YZF R3	KTM RC390	Honda CBR250R	Yamaha WR250R	Royal enfield 500
No. of cylinders	Inline 4	2	1	1	1	1
Displacement	599 cc	321 cc	373.3 cc	249.66 cc	249 cc	499 cc
Stroke	42.5 mm	44.1	60	55 mm	53.6 mm	90 mm
Bore	67 mm	68	89	76 mm	77 mm	84 mm
C.R	13.1 : 1	11.2 : 1	14.5 : 1	10.7 : 1	11.8 : 1	8.5 : 1
Transmission	6 speed	6 speed	6 speed	6Speed	6 speed	5 speed
Torque	61.7 Nm @10500 rpm	29.6 Nm @9000 rpm	35.3 Nm @7000 rpm	22.9 Nm @7000 rpm	23.7 Nm @8000 rpm	41.3 Nm @4000 rpm
Power	63.9 kW @14500 rpm	42 kW @10750 rpm	32 kW @9500 rpm	19.4 kW @ 8500 rpm	22.6 kW @10000 rpm	20.2 kW @5250 rpm
Cooling system			Liquid cooling			Air cooled
Fuel supply			Fuel injection			

Table 1 : Comparative analysis of various combustion engines.

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Model	KTM RC390
Engine	Four-stroke, single cylinder
Capacity	373.4 cc
Bore × stroke	89 × 60 mm
Cooling system	Liquid cooled
Spark plug	Bosch VR 5 NE
Ignition	Fully electronic ignition system
Starting	Electric
Maximum power	32 kw/43.5 HP @9500 rpm
Maximum torque	35.3 Nm/26 ft-lb @7000 rpm
Clutch	Wet multidisc clutch

Table 2 : KTM RC 390 engine specifications as per manufacturer.

Figure 2 : KTM RC 390 engine

B. Development of engine control unit (ECU) for engines

As technology advances, computer control systems that were once common in large-scale industrial systems are now increasingly used in everyday commercial products. The automotive industry continuously follows technological and technological developments and contributes to development trends through numerous innovations. A good example is the all Control Erall of automotive technology, which started in the 90s and aimed to make cars easier to use. It is clear that this offers many benefits not only to users but also to the environment. Some of these benefits include improved vehicle safety and reliability, increased engine power, reduced fuel consumption, and significant reductions in harmful exhaust emissions. This is achieved through numerous sensors and actuators controlled by the vehicle's ECU, as well as precise control logic that processes data at high speeds and does not require large resources.

Engine management is very complex as it involves stringent emission standards and reducing fuel consumption without compromising engine performance. To achieve this, the ECU must quickly process data input from the engine and vehicle sensors and adjust the positions of various output actuators to meet the driver's needs and the required power delivered by the engine. Additionally, the process must comply with established environmental standards and achieve all of the above with optimal fuel consumption.

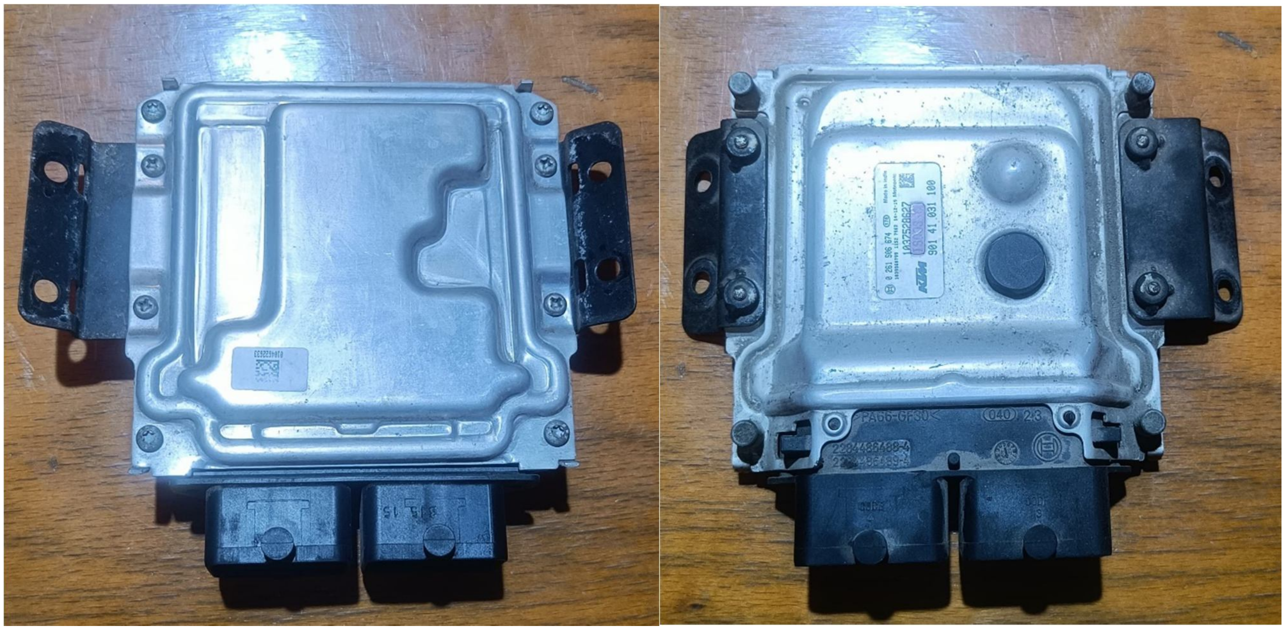

Figure 3 : Engine Control Unit (ECU) of KTM RC 390

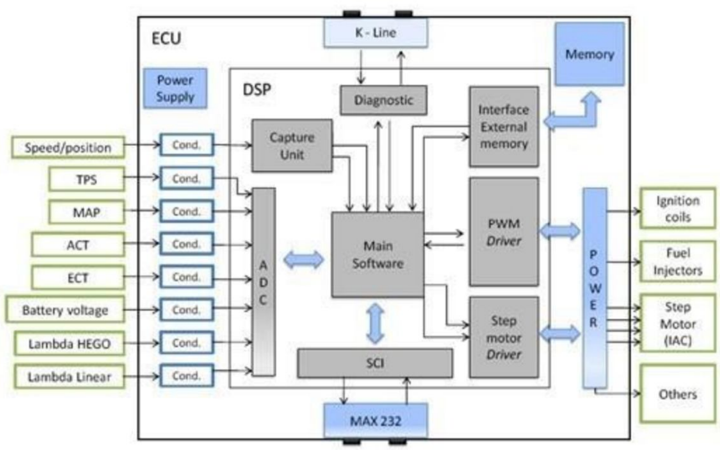

Figure 4 : Diagnostic ECU

III. WORKING

A. Steering

The steering system chosen is Ackermann steering, designed to align the vehicle's trajectory to driver requirements or race track conditions. The challenge of ensuring the wheels track circles with different radii inside and outside corners prompted Ackermann's development of steering geometry. This geometry contains the interconnected components of the steering system of a car or other vehicle. Ackermann steering geometry, a common configuration for all cars, solves the problem of achieving the correct steering angle when cornering or turning corners.

B. Suspension

All suspension components in a road car are present in a Formula 1 car. These parts include control arms, anti-roll bars, shock absorbers, springs, and shock absorbers. The suspension must support high loads. The suspension of a Formula 1 car must be strong and rigid to withstand the stresses of cornering at high speeds without damage. The main function of suspension is to attach the vehicle to its wheels. It doesn't have to be, because moving heavy loads requires a complex system made up of many parts.

C. Braking System

Disc Brakes: One of the biggest advantages of a Formula 1 car is its braking system. Formula 1 cars use carbon fiber reinforced composite brake discs. When the disc heats up due to the friction between the disc and the brake pad, the coefficient of friction between the pad and the disc can reach 0.6. These higher temperatures result in higher wear rates on steel brake rotors.

IV. CONCLUSION

As a result of this study's powertrain simulation, vehicle reliability was improved. Most engineering students dream of developing powertrains with lower power-to-weight ratios. Engine selection plays an important role in the powertrain. A square motor was selected as it produces more power compared to torque. In a racing car, power is more important than torque. Once you know the requirements of your drivetrain system, look at the pros and cons of the various components. Thanks to the careful selection of the engine platform, the KTM 390 is recognized as the best engine in its segment. This is because the power required exceeds the torque. In a racing car, power is more important than torque. Fuel efficiency is important along with power, and the power delivery environment is also important. Choosing chain drive reduces power losses. It seems reasonable to continue research into ways to improve the reliability of cars and minimize their weight. We achieved our goal of designing a powertrain without compromising driver safety measures, and the drivetrain was designed for Student Formula racing cars in accordance with SAE international regulations.

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