

# Fabrication and Development of CVT Operated Vehicle

Tejas Gaikwad<sup>1</sup>, Pradeep Tonape<sup>2</sup>, Yogesh Desai<sup>3</sup>, Pavankumar Mahajan<sup>4</sup>, Mr. Swapnil Gaikwad<sup>5</sup>

Student, Department of Mechanical Engineering, RIT, Rajaramnagar, Maharashtra, India<sup>1-4</sup>

Lecturer, Department of Mechanical Engineering, RIT, Rajaramnagar, Maharashtra, India<sup>5</sup>

**ABSTRACT:** Nowadays, automakers have invested in new technologies in order to improve the efficiency of their products. Giant automakers have taken an important step toward Achieving this objective by designing continuously variable transmission systems (CVT) To continuously adapt the power of the engine with the external load according to the Optimum efficiency curve of engine and reducing fuel consumption; beside, making Smooth startup and removing the shock caused by changing the gear ratio and making more pleasurable driving.

**KEYWORDS:** CVT, Startup, automakers.

## I. INTRODUCTION

A continuously variable transmission (CVT), also known as a shiftless transmission, stepless transmission, pulley transmission, or, in case of motorcycles, a "twist-and-go", is an automatic transmission that can change seamlessly through a continuous range of effective gear ratios. This contrasts with other mechanical transmissions that offer a fixed number of gear ratios. The flexibility of a CVT with suitable control may allow the input shaft to maintain a constant angular velocity even as the output speed varies.

A belt-driven design offers approximately 88% efficiency,[1] which, while lower than that of a manual transmission, can be offset by lower production cost and by enabling the engine to run at its most efficient speed for a range of output speeds. When power is more important than economy, the ratio of the CVT can be changed to allow the engine to turn at the RPM at which it produces greatest power. This is typically higher than the RPM that achieves peak efficiency. In low-mass low-torque applications (such as motor scooters) a belt-driven CVT also offers ease of use and mechanical simplicity.

A CVT does not strictly require the presence of a clutch. Nevertheless, in some vehicles (e.g. motorcycles), a centrifugal clutch is added to facilitate a "neutral" stance, which is useful when idling or manually reversing into a parking space. The transmission shifts gears to provide the most appropriate ratio for a given situation: Lowest gears for starting out, middle gears for acceleration and passing, and higher gears for fuel-efficient cruising. The CVT replaces the gears with two variable-diameter pulleys, each shaped like a pair of opposing cones, with a metal belt or chain running between them. One pulley is connected to the engine (input shaft) and the other to the drive wheels (output shaft). The halves of each pulley are movable; as the pulley halves come closer together the belt is forced to ride higher on the pulley, effectively making the pulley's diameter larger. Changing the diameter of the pulleys varies the transmission's ratio (the number of times the output shaft spins for each revolution of the engine), in the same way, that a 10-speed bike routes the chain over larger or smaller gears to change the ratio. Making the input pulley smaller and the output pulley larger gives a low ratio (a large number of engine revolutions producing a small number of output revolutions) for better low-speed acceleration. As the car accelerates, the pulleys vary their diameter to lower the engine speed as car speed rises. This is the same thing a conventional transmission does, but instead of changing the ratio in stages by shifting gears, the CVT continuously varies the ratio.

## II. LITERATURE REVIEW

Colin Alexander Bell have studied and created thesis on CVT. He said, Manual transmissions, which are historically more popular in Europe, require that the correct gear ratio is manually chosen by the driver, increasing the amount of effort the driver has to exert, but also increasing perceived control. The earliest manual transmission design could be considered the "sliding mesh gearbox", in which gears are engaged by the sliding of the gears on a splined shaft using a selector fork. This has the disadvantage of causing the gears to 'grind' (gear-clash), which occurs when the associated shafts are rotating with different speeds. Modern manual transmissions overcome this through the use of "constant mesh gearboxes", in which the gear pairs are always interlocked. Each gear pair is selected though a dog-mesh (a type of clutch, Childs, 2004), whilst a synchronizer can also be employed to ensure the shafts are rotating at similar speeds

when the clutch engages. By ensuring the gears are always engaged, these types of gear boxes have the significant advantage of reducing gear-wear, which can happen when gear-clash occurs. Automatic transmissions conversely require no input from the driver to select an appropriate gear using advanced algorithms to change gear automatically based upon throttle position, engine load and vehicle speed. More complex in design, automatic transmissions typically utilize epicyclic (planetary) gear systems to provide various ratios using electro/hydraulic actuators. A torque converter is also typically employed to permit a degree of 'slip' allowing the vehicle to move away from rest and to dampen engine excitation. The torque converter itself is a large source of inefficiency within the drive train, and is one of the reasons both fuel efficiency and performance are inferior on vehicles fitted with automatic transmissions.

Despite the extra effort required, nearly 80% of vehicles sold in Europe come equipped with a manual transmission (Bharat Book Bureau, 2006). It is thought that the reason for this is that motorists with an interest in performance prefer to select the correct gear themselves (control), whilst those who are more concerned with fuel economy believe that automatic transmissions deliver inferior economy (Bharat Book Bureau, 2006). The latter reason is generally true, with properly operated manual transmission vehicles offering an improvement of about 5% to 15% over automatic transmissions depending on driving conditions and style of driving (Kluger and Long, 1999). Outside of Europe this trend is not repeated, especially in Northern America, where drivers almost universally prefer automatic transmissions. Because of this, it can be reasonably expected that CVT technology is more likely to be adopted in North America before Europe.

S. Golabi et al - automakers have invested in new technologies in order to improve the efficiency of their products. Giant automakers have taken an important step toward achieving this objective by designing continuously variable transmission systems (CVT).

Gigih Priyandokoc et al - The simulation results have significantly improved the performance of the conventional PD controller to complete 75.08% rotation of the CAM from lower gear ratio to top gear ratio is less than 6.79 sec (CVT ratio from 0.9 up to 2.8).

M. Pasquier - In this study, presented different control approaches for the CVT from conventional 5-speed manual mode to hybrid trade-off strategy.

Vishnu Seelan - A Continuously Variable Transmission or CVT blends the ease of an automatic transmission with the efficiency of a manual transmission.

Liu et al said that electric motorcycles can help to reduce carbon emissions for the sustainable development of the environment. Basing on the perceptions of environmental policy, pollution reduction, etc. the motorcyclists can accept electric motorbikes as an alternative.

Jeyapandiarajan et al showed a simulation of a chassis analysis for an electric motorcycle to find the most suitable material basing on strength, cost and weight of the chassis.

In aspect of traffic noise and emissions, Hernandez et al showed the environmental benefits when using electric motorcycles in comparison with gasoline-powered motorcycles.

Marinov et al. proposed a methodology to develop electric motorcycles with different capacities and for different driving conditions. The authors confirmed in a study on the electrical sizing of the electric motorcycle drive that when driving on a flat surface in urban conditions at a constant speed, a rated motor power about 35% is used. When converting an internal combustion engine motorcycle into a battery-powered electric one, the life cycle energy consumed and emissions reduced 72% and 45%, respectively. This is significant considerations for the current global issue of transportation.

In 2012, David G. Dorrell from Sydney University of Technology and Mircea Popescu from Motor Design Ltd, Elsmere, UK presented the study of electric motor for electric motor. The authors presented a design solution for electric motorcycles based on the use of brushless permanent magnet electric motors (DC or AC) with a wide range of speed and power. The motor can operate at high current density and accelerate in a short time.

In 2016, Ruensumruay et al. presented a study of the influence of electric motorcycles on energy consumption in Thailand. The authors proposed an electric motorcycle model using the Artificial Neuro-Fuzzy Inference Systems (ANFIS). The physical and technical information of motorcycles was collected from survey questionnaires in Bangkok and urban areas. The authors proposed that the important factors that affect the energy consumption of a motorbike are motor size (cc.), longevity (years), distance (km/day), average speed (km/h). Energy consumption in the transport sector is modeled on several scenarios for the number of electric motorcycles in the future. The authors suggested that this development model can forecast energy consumption in preparation for future transport energy planning.

In 2012, Tokunaga and Kesamaru presented a development of a new PM motor for sport electric motorcycles. The authors proposed that the requirement for electric motorbikes is high-performance motors operating at variable speeds. A permanent magnet motor can be operated at rated power with high efficiency but low efficiency at high speeds. Therefore, the authors presented new techniques to improve the efficiency and proposed motor specification for electric motorcycles. An analysis and comparison of control techniques in electric motor drive systems were given by Fernandez and Coello proposed.

### III. PROBLEM DEFINATION

The CVT technology is more costier and hence it is used rarely. This leads to see the actual working of CVT in actual in colleges. We are making the model to Keep in college so that to increase the practical knowledge of Pupils in low cost.

#### OBJECTIVE

- To design gearless bike by mean of CVT transmission.
- CVT varies the transmission ratio continuously.
- Shifts automatically with an infinite number of ratio.
- Seamless power delivery.
- Constantly changes its gear ratio to optimize engine efficiency.
- Allows the engine to revolve almost immediately to deliver maximum torque.

### IV. DEVELOPMENT OF AN ELECTRIC MOTORBIKE WITH A CVT TRANSMISSION

The drive system integrates a CVT transmission system which has been designed, manufactured and installed in the body frame of the motorcycle, replacing the drive system using the petrol engine of the vehicle. A 230V AC motor is installed with a few parts that have been designed and fabricated to fit the Cygnus body frame as shown in Fig.



The main components of the motorcycles drive system, including a belt-pulley transmission, a CVT transmission, etc., have been designed, fabricated, and assembled into the body frame as described in Fig. the electric system was installed with fire safety requirements. The control system was installed and connected with carefully controlled parts of the motorcycle. After installing the new driving, electrical and control systems, the electric motorbike was formed and it was necessary to test its performance. After installation, the tests were conducted to find out the most appropriate set of control parameters for electric motorbikes.

#### Advantages of CVT

- CVTs provide unlimited gear ratios and improved performance.
- Pulleys and a belt inside the CVT seamlessly change the gear ratios without any “shift shock” or delay.
- The infinite ratios help in maintaining a steady cruising speed, reducing the fuel emissions and thus improve fuel economy.
- Due to its ability to change the ratios continuously, a CVT helps to keep the engine in its optimum rpm range, thereby increasing the fuel efficiency.
- The 2012 model of the Honda Jazz sold in the UK actually claims marginally better fuel consumption for the CVT version than the manual version.
- CVTs provide quicker acceleration than a conventional automatic.
- A key advantage of a CVT for a manufacturer is that its production costs lesser than a conventional multispeed automatic because it uses fewer parts.
- CVT eliminates the gear shifts of a manual transmission and the accompanying rise and fall of engine speed.

#### Limitations of CVT

- CVTs use steel metal belts, which have less torque transmitting capacity and thus a CVT cannot be used in heavy vehicles. Its application is limited to small vehicles.

- Friction between the belt and the pulley causes greater wear.
- The transmission fluid is a little expensive.

## V. RESULTS AND DISCUSSION

The results show that electric motorbikes operate stably with the speeds changing from 0 to approximately 30 km/h. This achievement may be due the speed of electric motorcycle is kept stable, reducing losses due to uphill or frequently turning on/off the motor of motorcycle at intersections where motorbikes must stop. These moving conditions are suitable for electric motorcycles to achieve the highest performance, longer driving time, longer travel distances. These parameters are relatively in accordance with the design requirements. These parameters are like those of electric motorcycles on the commercial market. As such, it has satisfied the purpose of integrating a CVT transmission to the drive system to improve the safety of using electric motorcycles. In addition, one of the most important mechanical properties of a vehicle is its wheel torque. The relationship between the torque and speed of the motorcycle will be used to evaluate a design criterion for the ability to operate in urban traffic conditions when the speed needs to be regularly changed. In this study, this relationship will be analyzed to assess the appropriateness of the design and integration of a drive system containing a CVT transmission into the Cygnus body frame. Basing on the dynamic diagram of the electric motor drive system shown in Fig. 1, the torque of the motor output shaft can be described as follows [21]:

$$T_m = -\frac{K_b \cdot K_t}{R_a} \omega_m + \frac{K_t}{R_a} e_a$$

Where,  $e_a$  - armature voltage of the motor;  $K_b$ ,  $K_t$ , and  $R_a$  are the electric motor constants. Assuming ignoring losses between the transmissions, an expression can determine the wheel shaft torque as follows:

$$T_4 = \frac{N_2}{N_1} \cdot \frac{N_4}{N_3} \cdot \frac{N_6}{N_5} \cdot \frac{1}{i_{CVT}} \cdot T_m$$

Where,  $i_{CVT}$  - CVT transmission ratio. With motor parameters and transmissions designed, Eq. (5) can be rewritten as follows:

$$T_4 = -\frac{7.8}{i_{CVT}} \left( \frac{1}{10\pi^2} \omega_m - \frac{10}{\pi} \right)$$

## VI. CONCLUSION

We have studied previous literature on CVT transmission. We use CVT transmission in bike by certain changing in transmission system. The idea of conversion of a gearless scooter with CVT into an electric vehicle is first of its kind. The CVT provides a much more load bearing capacity to the vehicle. The testing of the vehicle was a success. The required output was obtained from the project. The advantages of the vehicle were noted. This project is best suited for converting old scooters in your household into an electric vehicle at minimum cost and maximum efficiency. There is no one best motor type, rather there are different types of motors to suit personal requirements, such as price and performance.

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