Feasibility Analysis of Converting Maruti Omni Van in to Electric Van

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Abstract: The main purpose of this research is to conserve the fossil fuels, reduce air pollution, preventing the current 15 year old conventional vehicles from being discarded if a law curbing the use of these old vehicles is passed, with the help of the introduction of an economical electric conversion kit in the current vehicles. The result is that, the converted electric vehicle is now more economical to run than its previous conventional engine, more practical as a low cost electric vehicles in a nation like India where people couldn't afford costlier environment friendly vehicles, as there would be challenges for ensuring to keep the technology under purchasing power of the people to actually see such vehicles running on road. Also this new EV would produce least amount of emissions, use significantly lesser amount of fuel as this vehicle would be using a 100 cc motorcycle engine. If introduced in the market, the kit could save the 40 Lakh LMVs that are currently in danger of being scrapped if any strict emission law is passed.

Index Terms - Electric Vehicle, Light Motor Vehicles, Miniature Circuit Breaker, Brush Less Direct Current.

I. INTRODUCTION

While electric autos are as of now a cutting-edge slant in the car business, they have really been around for a significant long time. This report intends to feature the past victories and disappointments of the electric vehicle, and offer expectations for the eventual fate of the electric vehicle. Truth be told, the main effective electric auto was presented in 1890 by William Morrison.

Electric vehicles offer potential to broadly diminished fuel usage and spreads all through common undertaking in light of the degree for in action the prime mover at its optimal and besides the ability to satisfy sudden power demands from a mix of the prime mover and keep essentialness. Electric vehicles can in like manner work with zero releases in fragile urban circumstances. Therefore, disregarding the additional regard related to electric vehicle structures, there will be conditions inside which the extended capital cost is even. Appeared differently in relation to vitality parts, these vehicles use existing development and might be made a lot of monetarily. They additionally give the most bewildering "incredible well to wheel" profitability.

The fundamental style comprises of a dc control supply battery. The battery is associated with inverter that is bolstered to a BLDC engine that chips away at AC. The engine is associated with the front wheel of the 2 wheeler vehicle. Since the engine turns the associated wheel pivots as well, in this way, bringing about vehicle movement. At low speeds this method of impetus is utilized. The following part comprises of an IC motor that moves the cylinder consistently. This can be associated with the transmission thus the vehicle moves.

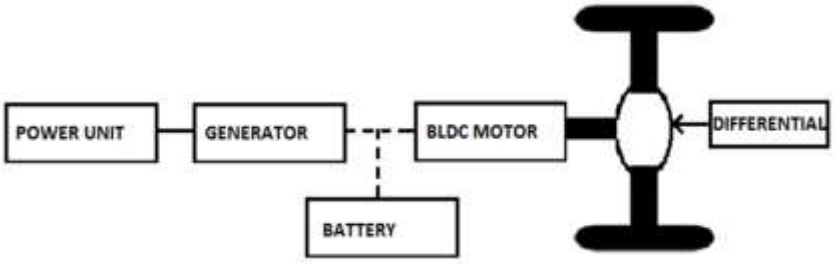


Fig.1 Schematics of Series Electric Vehicle Type

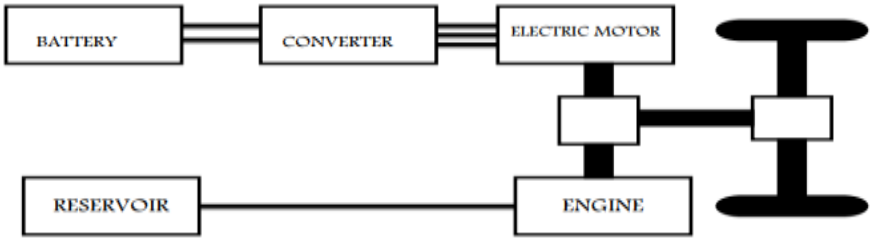


Fig.2 Parallel Electric Vehicle Type

II. PROPOSED METHOD

We began by searching for suitable vehicles that were produced before 2000. This is done because there are many ongoing proposals that may in future ban 15 to 20 year old vehicles, because they emit high amount of pollutants or have very low fuel efficiency as compared to modern fuel efficient vehicles. One such example of a proposal is that of SIAM (Society of Indian Automobile Manufacturers) which has asked the government of India, for a ban on all 15 year old vehicles across the country in a bid to reduce pollution. If this is accepted by the government of India then all these 15 year old vehicles, which are numbering over 40 lakh, LMVs (Light Motor Vehicles) would in one shot, be rendered useless and would result in a large amount of waste generation in the form of unused metallic body frame, seats, electrical and electronic components, toxic batteries, tyres and various other automobile components, that will be lying around junkyards.

Thus we have selected such a vehicle that is a pre-2000 year production model of Maruti Omni that will be converted into an electric vehicle.

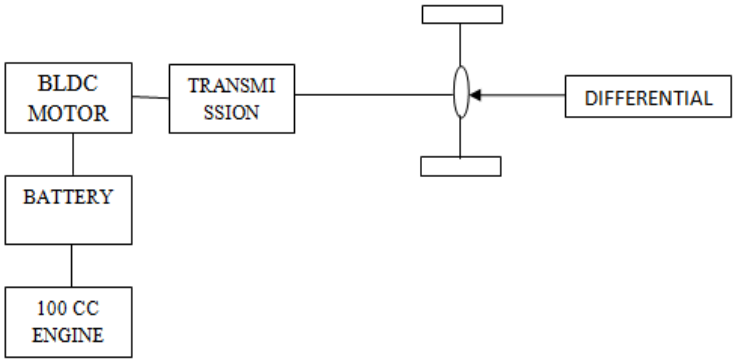


Fig.3 Block Diagram of HEV Kit

2.1 Initial Phase

The accelerator pedal wiring was connected to the controller through the MCB port, while the braking system remained untouched. Another switch was put in place that would reverse the rotation of the motor, so that reverse motion of the vehicle can be attained. Four 12 volt batteries were connected in series and placed at the rear side of the vehicle that would act as the prime power house of the vehicle.

2.2 Intermediatory Phase

Thus, again the BLDC motor was disconnected from the propeller shaft, the gearbox was brought out and all the gears were removed except the first gear and the reverse gear, although all the levers were removed. No clutch would be used, as a single gear would be selected at all times.

The gearbox was connected to the propeller shaft and the BLDC motor was then coupled to the gearbox and put back together in the vehicle.

2.3 Final Phase

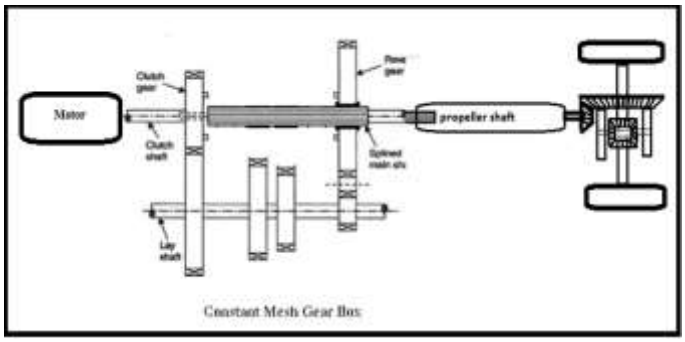
The gearbox is again stripped out and the electric motor is again decoupled. The first gear and the second gear are introduced into its place.

The gearbox is again connected back to the propeller shaft and the BLDC motor was then coupled to the gearbox and put back together in the vehicle.

III. IMPLEMENTATION

With the ever growing demand for cleaner vehicles and diminishing fossil fuel reserves, there is wide area of implementation of the cost effective conversion of conventional old vehicles into new electric vehicles. But the change towards greener vehicles comes with a hefty price tag that de-motivates the consumer. To give an example, following are the cost comparisons of the available electric vehicles in India that prove to be a financial hindrance for the average buyer in switching towards greener energy.

*To calculate the change in rpm after inducing gear.



As we know

Gear ratio = $\frac{T4}{T3} \times \frac{T2}{T1}$

= $\frac{33}{21} \times \frac{27}{12}$

= 3.53

Rpm of propeller shaft = $\frac{3000}{3.53} = \frac{speedofsource}{gear\ ratio}$ = 849 r.p.m

Torque at propeller shaft = P x 60 = 3 x 1000 x 60= **33.74 Nm**

2πN 2π x 849

Rpm of rear axle = $\frac{3000}{3.53 \times 4.33}$

= $\frac{3000}{15.30}$

Final rpm N = **195.95 rpm**

Speed of Car = $\frac{3000 \times \pi \times 0.3048 \times 60}{4.33 \times 3.5 \times 1000}$

= $\frac{172272.96}{15309.643}$

= 11.252579 km/hr

Final Torque = $\frac{Power \times 60}{2\pi N}$

= $\frac{3 \times 1000 \times 60}{1230.597}$

= **146.27047 Nm**

Torque is 146 Nm at 195 rpm but previously torque is 59 Nm at 2500 rpm, 24.5 kw at 5000rpm.

For this we need rear axle ratio details of **MARUTI OMNI**

So, we will refer to the informative chart of marutiomni for its different varients this chart gives us many important technical information about our variant or model of that particular vehicle. Like our vehicle comes in three variants. The three variants of marutiomni van are as follows:

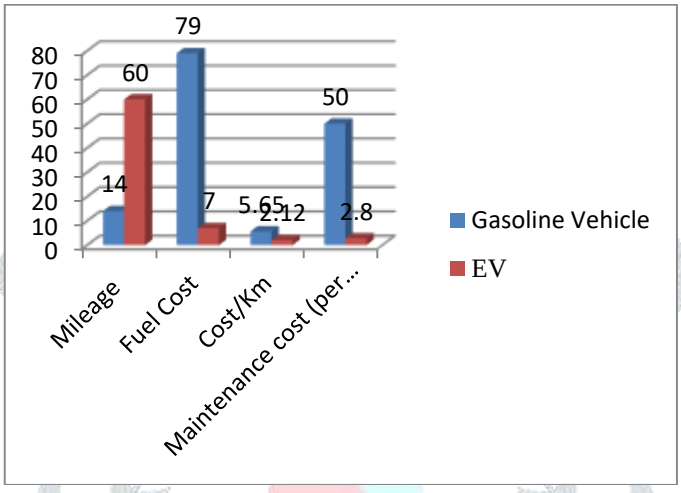
1. Omni 5STR, BS-IV (Petrol)
2. Omni 8STR, BS-IV (Petrol)
3. Omni Cargo, BS-IV (Petrol)

IV. RESULT ANALYSIS

After the van is converted into an EV, there is a significant difference in the operational cost of the new vehicle as compared to its conventional running cost when it was running on a gasoline engine a comparison between the operating costs of the vehicle before and after the vehicle was converted into an electric vehicle is given below in table 1.

Table 1 Comparison between Gasoline Vehicle & Electric Vehicle

	Gasoline Vehicle	EV
Mileage	14	60
Fuel Cost	79	7
Cost/Km	5.65	2.12
Maintenance Cost(Per 100km)	50	8

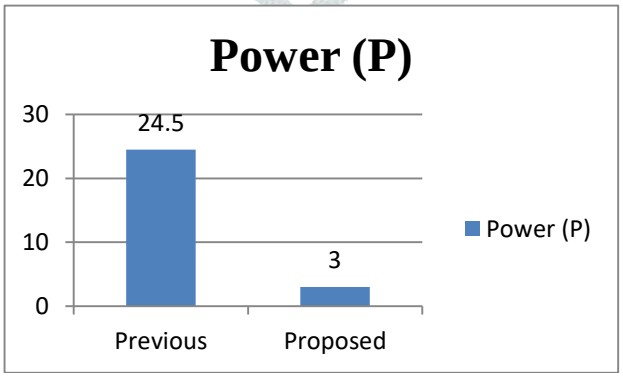


Graph 1: Economy of Maruti Omni Gasoline vs Maruti Omni EV

The graph shows the comparison between the economy of the Maruti omni van gasoline / petrol engine and the Maruti omni electric vehicle.

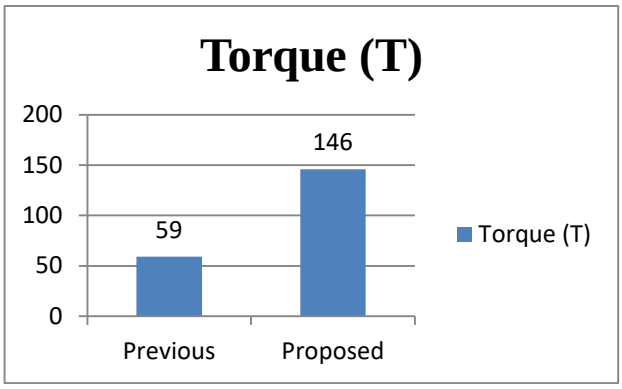
Table 5.2: Comparison of previous and proposed parameter

Work	Torque (T)	Speed (N)	Power (P)
Previous	59 Nm	2500 rpm	24.5 kw
Proposed	146 Nm	197 rpm	3 kw



Graph 2: Comparison of previous and proposed used power

Graph 2 shows comparison of used power in previous and proposed research work. In the previous work high power used and proposed work used low power. The power unit used is kilowatt.



Graph 3: Comparison of previous and proposed Torque

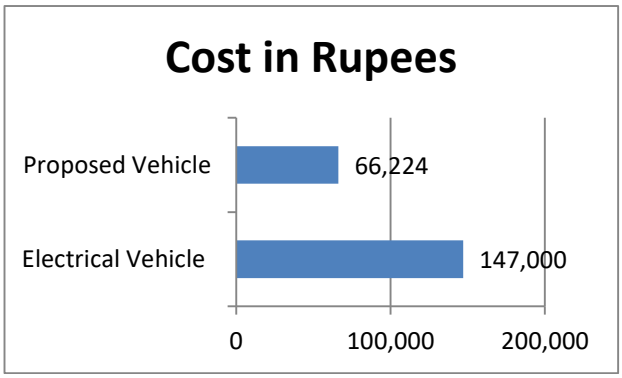
Graph 3 shows comparison of torque in previous and proposed research work. In the previous work get the low torque and proposed work get the high torque. The torque unit used is Nm (newton meter).

Table 5.3 Specifications of the new EV

S No.	Specifications	Results
1	Maximum weight the EV can carry	Upto 8 people or 650 kg
2	Range of Van when solely running on battery	60 km when 32 amp 150 km when 100 amp
3	Total cost of the conversion into EV	66000-67000 rupees
4	Maximum speed	30 km/h
5	Total charging time of the vehicle	4 hours
6	Capacity of the engine	100 cc
7	Maximum speed of electric motor	3000 rpm
8	Power of the BLDC motor	3 KW or 4.02 HP
9	Voltage generated by battery powerhouse	48 volt
10	Cost per km	Rs 2.12/km

Table 5.4 Cost Comparison

Parameter	Electrical Vehicle	Proposed Vehicle (Cost of conversion)
Cost	1.47 Lac	66,224



Graph 4 Cost comparison graph

V. CONCLUSION

The vehicle achieved a speed of 30 km/hr as its top speed and a distance of 60 km is covered by the vehicle. The main reason for the lower top speed of the vehicle is that the vehicle has been given 2 gears but their number cannot be increased. And also the power of the motor is only 3 KW which is about 4.02 BHP. The vehicle we have converted was having a 45 BHP engine. As we have not used any of the turbo charger to charge our battery, it took 3 hours to get to the 80% charge, while it took 4 hours to completely charge the battery, and to charge this much of the battery pack the unit charged is 1 unit that is approximately equal to 7 rupees..

REFERENCES

[1.] Hassan Fathabadi. Novel battery/photovoltaic hybrid power source for plug-in hybrid electric vehicles https://doi.org/10.1016/j.solener.2017.10.071.

[2.] Sudhir Gupte. Faculty of Automobile engineering at A. D. Patel institute of Technology, Vidyanagar, Gujarat,India. Experimental Analysis and feasibility study of 1400 cc Diesel engine car converted into hybrid electric vehicle by using BLDC hub motors.

[3.] Vehicle Engineering. Published by: AcademyPublish.org (Publishing Services LLC), 2120 CareyAvenue, Cheyenne, WY 82001, USA

[4.] Richaed Stone & Jeffrey K. Ball, Automotive Engineering Fundamentals, SAE International, 2004.

[5.] O'Keefe and Markel (2007) have presented a comparison of the costs (vehicle purchase costs and energy costs) and benefits (reduced petroleum consumption) of PHEVs relative to hybrid electric and conventional vehicles.

[6.] (Su-Hau et al. 2004) focused on the highly efficient energy usage of the battery energy and proposed an integrated management system for electric motor.

[7.] (David and Sheng-Chung 2004) proposed new parallel-type hybrid-electric-power system comprises an engine's energy distribution and a torque-integrated mechanism to let the engine achieve maximum thermo-efficiency with minimum emissions

[8.] Shikha Rokadiya, Anup Bandivadekar, Hybrid and Electric Vehicles in India Current Scenario and Market Incentives, December 2016, in International council of clean transportation.

[9.] Ashton, R. (1998), "Energy Storage," in Design of a Hybrid Electric Vehicle, Project Report, University of Oxford, Department of Engineering Science, UK, 1998.

[10.] Armstrong, A. (2000), "ICE Hybrids-Good Enough?" in Fuel Cells 2000, USA.

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