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Hybrid Electric Vehicles (HEVs): Need, Recent Development and Revolution Requirement on Indian Roads

Sunil P. Sawant PG Student, AMGOI, Faculty of Engineering, Vathar ms.spsawant@gmail.com	**Maheshkumar A. Sutar** PG Coordinator, AMGOI, Faculty of Engineering, Vathar maheshkumar.sutar@gmail.com

ABSTRACT

This paper provides comprehensive study of the recent work of Hybrid Electric Two Wheeler (HEVs). The paper describes the development and the need of HEVs. From a decade we have observed various kinds of research in the area of Electric and hybrid electric vehicles but till now there is no such expected number of vehicles on Indian and abroad roads. All we know that the major issues in pollution are from the emissions from the vehicles. Through this paper we are trying to put a basic comprehensive study of, why we have to rethink the need of hybrid electric vehicles? Up to the fulfil stage of availability of the required facilities and infrastructure for the on road electric vehicles we have to use or develop reliable hybrid electric vehicles, which will be propelled by the existing I. C. engine and battery power. And simultaneously it is required to develop the revolution facilities and infrastructure for the pure battery powered or say Electric Two Wheelers (EVs).

Keywords: Hybrid Electric Vehicles (HEVs), Electric Vehicles (EVs), Internet of EVs, Revolution Requirement.

Introduction:

In today's fast moving world, having a vehicle is very common thing. But till problems related to pollution and vehicle emission is not much controllable yet. New environment friendly and affordable power systems like Electric and Hybrid Electric Two Wheelers has become very important and thus they are needed to be installed urgently. In India, continuing it, since 2010, Government of India and State Governments have announced and helping through many sources like start-up support, subsidies on the vehicles and the parts, free registration, some models were allowed to drive without Driving License, No Toll etc. The benefits are announced and given for the users and manufacturers of Electric Vehicles, Hybrid Electric Vehicles and Solar Powered vehicles.

But till now the electric vehicles are not spread or popular as expected by the manufacturers and government. We are not observing numbers of electric vehicles and models on roads. Else we have observed that numbers of dealers have closed the business.

Even the MNCs or OEMs like Hero or TVS have not got such success in this business. Obviously they are adopting the latest technology, latest research and development. But they could not get success. The end customers / end users are not reliable on the Electric Two Wheelers. The companies and we the technical people are trying to spread the technology. We might reliable on battery performance development, life,

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maintenance, new arrival of Lithium-Ion batteries. But till the end customers are not ready to use the electric two wheelers. All we know, the use should be increased. But it will be happened when we are able to develop the reliable vehicles which will be preferred by the end users. Continuing the observations, we are hereby putting, the study. To develop awareness, we are trying to develop a hybrid electric two wheeler which will be propelled by the existing I. C. engine and battery power.

Development at a Glance:

Now in India, we have switched from BS IV to BS VI by skipping BS V. On 15th November 2016, Indian government announced of the acceptance of BS VI. And the implementation on road started from 01st April 2020.

That is, for the development or for the emission standard vehicle manufacturing, the Indian as well as foreign automotive manufacturers, marketing in India took about three and half years. To develop the existing engines to BS VI norms, the automobile industries had faced many hurdles. But the automobile manufacturers are not far chasing to develop electric vehicles.

The word brand name in Two Wheeler manufacturing, TVS Suzuki had obtained patent for the Hybrid Electric Two Wheeler. The patent was filed back in 2008 in the Chennai patent office and the company earned the patent, in May 2017. In 2010, New Delhi Auto Expo, the company showcased the hybrid concept scooter through the model "TVS Qube". It was expected to roll out some models of hybrid two-wheeler in near future.

But till the TVS Suzuki or any other brand automotive companies have not started the manufacturing or not introduced commercial models of Electric or Hybrid Electric two wheelers. Might be, the companies are afraid about the mindset of customers and the existing technology?...

Or maybe the brand companies afraid about the business profit? Because there is endless business from the existing I. C. Engine two wheelers, from sales to after sales, service and maintenance. From electric vehicles, there is only profit in sales. There is less profit in after sales service. Only replacing of batteries will be the major maintenance. And if the guarantee / warranty is given for three or five years then there is no any maintenance for the three or five years. Obviously few models from companies like Hero Electric, Mahindra etc. have introduced some variants. But we are not finding the brand companies and variants on roads as per expectations.

Development in Batteries:

As per concern to the automotive sectors, the development of batteries started from the Lead Acid batteries and now we have the Lithium Ion batteries. Through the development era the batteries introduced in progressive way are, Lead Acid, Nickel–cadmium, Nickel–metal hydride, Sodium–nickel chloride, Lithium-ion, Super capacitors, lithium–sulphur.

In all types of automobiles, the Lead Acid batteries are used widely till now. Because of its lower cost and obviously the performance is improved well. Now the battery manufacturers are assuring the performance of the Lead Acid batteries up to five years. For the EVs and HEVs also the Lead Acid batteries are used.

But now to reduce weight and for better performance, the Lithium Ion batteries are adopted. The Lithium Ion batteries are proving better efficient in EVs and HEVs. But it is costlier. Though it is costlier, comparing to performance, Lithium Ion batteries use is essential now.

Facilities required for the improvement in revolution or inter netting of EVs:

01) Standardization of Spares and Accessories – As we are practicing the tyre specification

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standards, in such way we have to standardize the spares like controllers, inverters, chargers etc.

02) Standardization of Power Rating - As we are practicing the ccs of I.C. engines like 100cc, 125cc etc., likewise we have to standardize the Hub Motor wattage like 250 watts, 350 watts, 1000 watt, 1200 watt etc.

03) Standardization of Batteries – In automobile sector we are practicing 12 Volt batteries (capacities may vary in terms of Ah), likewise we have to standardize the batteries like 36 V, 48 V, 60 V etc.

04) Charging Stations - Charging stations network should have to be developed. We can utilize the existing fuel outlets. But have to develop planned power grid distribution.

05) Battery Replacement Stations or Standby Battery Availability - At the charging stations or existing fuel outlet, easy battery replacement or standby battery network facilities are required.

06) Repairing Shops and Technicians - For the new technology adoption, training to the existing technicians and new technicians are required. The repairing or service stations road side network should have to be developed.

Existing Two Wheeler propelling system:

We can generally classify the two wheelers by the propelling method as following.

a) I. C. Engine Powered
b) Electric Powered
c) Hybrid Electric Powered

a) I. C. Engine Powered – We may say it, the conventional I. C. Engine Powered two wheelers. The vehicles are continuously developing their performance in fuel economy, vibrations, comfort and concern with our view, i.e. emission standards also. The automotive industry is changing, developing and performing very well to reduce pollutants, noise and vibrations. But due to wide use of vehicles, we are facing for the clean environment solutions.

The next two types of the two wheelers are much struggling to spread on Indian and abroad roads. And I think this is the wide area for the researchers.

b) Electric Powered – The two wheelers are propelled by battery power. The travel is limited as per the battery charging status, as at now we are not reliable on battery performance. We mean, we technical people and the end customers also... And now a day or till today, we have no such charging stations revolution or electric vehicle service network. So some brands and variants of e-bikes are observed on roads but not widely used. Why? …will be our study…

c) Hybrid Electric Powered – The two wheeler are (I. C. Engine + Electric) powered or (Electric + Solar) powered. Both the types are propelled by the combined sources or individual source. But till today, these types of two wheelers are not commercially manufactured by any of the brand automobile manufacturers.

Rather, it is essential to use or spread the hybrid electric two wheelers, earlier for the clean environment solutions. Because the existing I. C. Engine vehicles are increasing pollution and the electric bike are not spreading.

We know that the major issues in pollution are from the emissions from the vehicles. Hence for the awareness of use of e-bike and awareness of performance of new technology in batteries, the Government and the brand automobile manufacturers are required to rethink to develop reliable hybrid electric vehicles. i. e. Existing I. C. Engine + Electric powered.

Need of HEVs:

Competition with Internal Combustion Engine Vehicles (ICEVs) should not be the target at the current stage. At the current stage

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we have to improve use of electric vehicles with reliability and technology.

Today there are numbers of reputed Electric Two Wheelers manufacturers like Hero Electric, TVS Suzuki, Okinawa Autotech, Lohia, Ather Energy etc. But the customers are not increased as planned by the manufacturers. No doubt it is happening, but at very slow rate. The automobile manufacturers are going ahead through various researches and technologies. But it is not satisfying the customers.

There are the following reasons reviewed through our observations, various surveys and study of the reference papers.

a) The travelling range is low.
   Now with the new technology, the range is extended in 3 digits. i.e. 100 Km and more but the feedback is, if the vehicle stopped or needs charging in between the way, what will be the alternatives or supporting systems like fast charging (booster charging) stations.
   The required facilities for the development of revolution and internet of EVs and HEVs are widely discussed in the bellow Referenced Paper No. 08
b) Not believes on battery life.
c) Till now the technology is not well developed.
d) Not satisfying the users.

Reviewed through the referenced papers and as we have stated in this report's introductory section, new environment friendly and affordable power systems like Electric and Hybrid Electric Two Wheelers has become very important and thus they are needed to be installed urgently. Because the Electric and Hybrid Electric Two Wheelers will

a) Reduce environment pollution.
b) Reduce global heat.
c) Reduce Nation's huge importing and processing expenditure on good fuel availability.
d) Reduce individual expenditure on fuel and maintenance.
e) Reduce noise and vibrations.
f) Obviously cumulatively improve community health.

Surveys Reviewed –

We reviewed various surveys observations which were performed in India and abroad. The surveys were performed by various agencies, researchers and academics under graduate and post graduate projects. We are putting some parts of the surveys by acknowledging it in the references. We are putting it to support our conclusions.

Survey One

A survey [Reference No. 15] for e-bicycle was taken from the participants of various regions from Maharashtra State (India) in 2020. From the survey following observations were devised.

1) 75% people are interested to use e-bicycle over a conventional bicycle.
2) 80% people require extra features in an e-bicycle.
3) Student and employee found most interested for e-bicycle.

The survey shows that the customers are aware of the electric vehicles. They are thinking to purchase and use it. But at the stage of actual purchase, the customers prefer conventional I. C. Engine bikes.

Another survey, (reference no. 02), as follows, states the servicing and maintenance feedback. (Table of Survey Two and Survey Three)

Survey Two

Number of times e-bike has been serviced (%)	
1	14..60
2	07.30
3	03.30
4	01.30

5 or more times	03.30
No service needed to date	70.00

Survey Three

Part of the e-bike that was serviced (%)	
Repairs to the electronics/display	37.50
Repairs to motor	20.90
Replace battery or battery issues	27.90
Bike-related issues	07.50
Other	06.20

The **Survey Two** states that there were very few visits for the servicing and maintenance of e-bikes.

The **Survey Three** states that the maximum issues were for the servicing of batteries. Obviously there is remarkable development in batteries. But till date it is not proven success on roads.

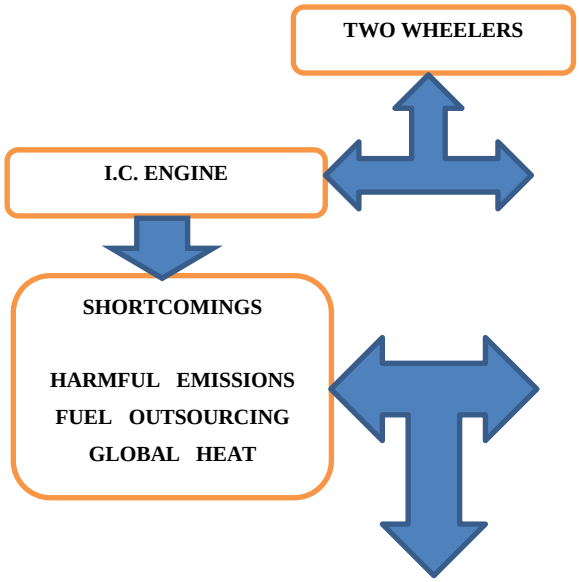
Conclusions:

Hence for the above cited issues, it is required to develop the reliable Electric Two Wheelers. But till for awareness and popularity we have to develop reliable Hybrid Electric Two Wheelers. We have to create reliability of the electric system for the electric vehicles amongst the communities. Hence we have to restart to think about the Electric Hybrid Two Wheelers, which will work on both, existing I. C. Engine and Electric Powered System. So that reliability on electric system will be increased and the community will think to use the Electric Two Wheelers.

The Hybrid Electric Two Wheelers (I. C. Engine + Electric) can be developed through following practices.

01) Individual and Separate propelling by existing I. C. Engine to the rear wheel and Electric powered to the front wheel.
02) Starting torque from I. C. Engine and switch over running torque by Electric power system.
03) Solar system can be developed to support the electrical power system. The solar system may be used to charge the battery up to 50% during running and parking. The solar panel can be auto adjusted for the maximum intensity.
04) The regenerative systems by utilizing suspension movement, brakes and hub motor wheel itself can be developed.

Following figure shows the review of the performances, of the types of the vehicles and our suggestion of better solution.



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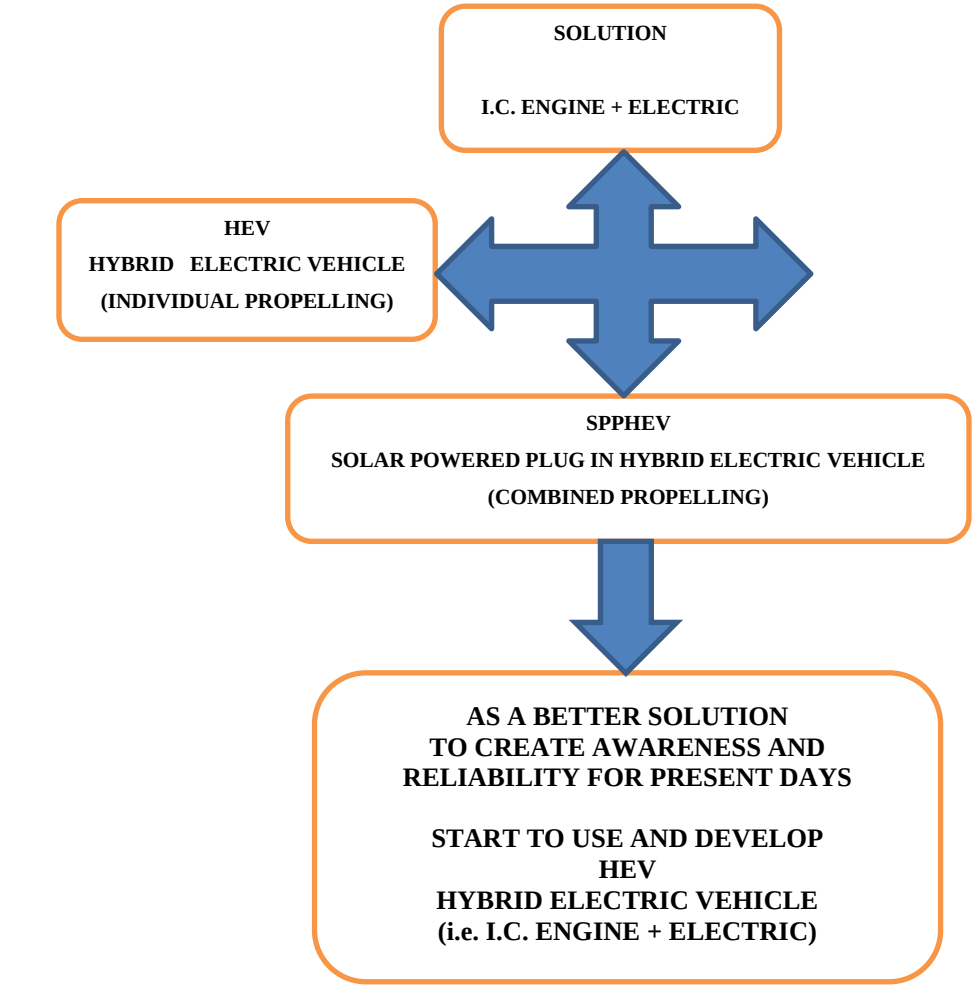

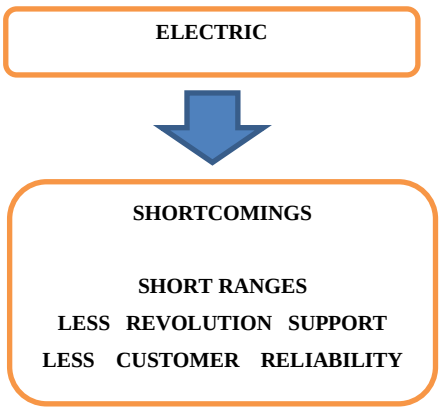

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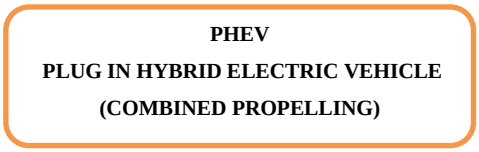

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