International Journal of Latest Engineering Research and Applications (IJLERA) ISSN: 2455-7137

Volume –04, Issue – 06, June 2019, PP –14-19

Self-Chargeable Lithium-ion Battery Powered Electric Bike

Vinod J[1], Rupesh Chalaune[2], Prashant S Ganiger[3], Arunakumara N[4], Shridhar C[5]

[1](Dept. of Mechanical Engineering, Bangalore Technological Institute, VTU, India)
[2](Dept. of Mechanical Engineering, Bangalore Technological Institute, VTU, India)
[3](Assistant Professor, Dept. of Mechanical Engineering, Bangalore Technological Institute, VTU, India)
[4](Dept. of Mechanical Engineering, Bangalore Technological Institute, VTU, India)
[5](Dept. of Mechanical Engineering, Bangalore Technological Institute, VTU, India)

Abstract: The main aim of the current work is to present the idea of harnessing some amount of energy while running the electric bike and use it in for further travelling purpose. For human being travelling has become vital. In order to sustain in this fast forward world, we must travel from place to place. It is very important that the time taken for travelling should be less, also it should be economical and easily available. With the fast depleting resources of petrol and diesel, there is need to find intermittent choice. Taking all this into account, a shift away from conventional based fuels to using a renewable source of energy is necessary. Electric bike which will be driven with the help of battery and thus provide required voltage to the motor. The focus of this project is to design and fabricate a self charging electric bike

Keywords: Battery management system, Battery pack, lithium-ion battery.

I. Introduction

The Transportation sector accounts for a large and growing share of global Green-House Gas (GHG) emissions. Worldwide, motor vehicles emit well over 900 million metric tons of carbon dioxide (CO2) each year, accounting for more than 15 percent of global fossil fuel-derived CO2 emissions. In the industrialized world alone, about 25 percent of GHG emissions come from the transportation sector. The share of transport related emissions is growing rapidly due to the continued increase in transportation activity. In 1950, there were only 70 million cars, trucks and buses on the roads. By 1994, it was about nine times that number or 630 million vehicles. Since the early 1970s, the global fleet has been growing at a rate of 16 million vehicles per year. This expansion has been accompanied by a similar growth in fuel consumption. If this kind of linear growth continues, by the year 2025 there will be well over one billion vehicles on the world's roads. In a response to the significant growth in transportation related GHG emissions, governments and policy makers worldwide are considering methods to reverse this trend. However, due to the particular make-up of the transportation sector, regulating and reducing emissions from this sector poses a significant challenge. Unlike stationary fuel combustion, transportation related emissions come from dispersed sources. Only a few point-source emitters, such as oil/natural gas wells, refineries or compressor stations, contribute to emissions from the transportation sector. The majority of transport related emissions come from the millions of vehicles traveling the world's roads. As a result, successful GHG mitigation policies must find ways to target all of these small, non-point source emitters, either through regulatory means or through various incentive programs. To increase their effectiveness, policies to control emissions from the transportation sector often utilize indirect means to reduce emissions, such as requiring specific technology improvements or an increase in fuel efficiency. Site-specific project activities can also be undertaken to help decrease GHG emissions, although the use of such measures is less common. Sample activities include switching to less GHG-intensive vehicle options, such as electric vehicles (EV's) or hybrid electric vehicles (HEV's). As emissions from transportation activities continue to rise, it will be necessary to promote both types of abatement activities in order to reverse the current emissions path. In the modern societies, the increasing needs of mobility means sometimes increasing the number of vehicles circulating. Ambient concerns, as for instance local pollutant emissions for the atmosphere, influence also, innowadays, the technical decisions related with all kind of vehicles. In this context, new alternatives to the existing internal combustion engines are mandatory. So, vehicles with electric propulsion seem to be an interesting alternative.

During the revolution for the eco-friendly technologies bicycles were the most depended modes of transportation, along with this the consideration of the increase in fuel price and the environmental factors we must admit that it is far more better to use a bicycle over a motor vehicle for short distance travelling. Imagine how useful would the bicycle be if even the small effort applied by man for climbing slopes and riding on rough terrain is reduced in it. We thought the same way to develop the basics of our project "The e-Bike". Sustainable and personal mobility solutions for our world environment have traditionally revolved around the utilization of bicycles or provision of pedestrian facilities. An electric bicycles offers a cleaner various travel short –to-moderate distance instead of fossil fueled automotive. From conventional automobile for transport we experience problems like traffic congestion, parking difficulties and pollution from fossil fueled vehicles. It appears that only pedal power has not been sufficient to supplant the usage of petrol and diesel automotive to date, and therefore it is necessary to investigate both the reason behind continuous use of environment unfriendly transport and consider potential solutions An e-bike combines the advantages of a normal bicycle with that of a motorbike. It is an ecological means of transport, with low maintenance costs, allowing you to travel freely and easily without sweating. It is almost as ecological as a bicycle, because electric motors need very small power to propel you effectively batteries however need to be disposed-off correctly. An e-bike can make you regain your optimal shape, due to the fact that you can combine the electric assistance with your own pedaling effort, allowing you to make some beneficial exercise, increasing the assistance of the electric motor when you are tired or when the road goes uphill. Therefore the concept of Battery operated electric Bike came to play as the conventional petrol powered bikes are not meeting the expectations and also the fuel prices are hiking day by day drastically, as the consumption of petroleum products increased so is the Environmental pollution thus to overcome this problem we can make use of Battery powered vehicles. Energy crisis is one of the major concerns in today's world due to fast depleting resources of petrol, diesel and natural gas. In combination with this, environmental decay is an additional factor which is contributing to the depletion of resources which is an alarming notification. An electric bike is first and foremost, a bike. It uses the same designs, geometries, and components as any other bike, but it includes an added electric wheel motor. This is powered by a rechargeable battery, which gives riders an extra boost of power and ultimately provides a smoother, more convenient and less strenuous cycling experience. Electric bicycles are becoming increasingly popular throughout the world, as more and more people look for efficient, affordable and eco-friendly modes of transportation. In recent years, electric bike use has skyrocketed in Asia, most notably in China, which has established itself as the world leader in electric bike use. There are now an estimated 200 million electric bikes in China, with millions more added every year.

The main aim of the current work is to present the idea of harnessing some amount of energy while running the electric bike and use it for further travelling purpose. The Ebike are being modified day by day but this is also having some limitations like it cannot be charged externally, if the battery discharge while travelling it creates problem that means it is used for small distance travel only. So some modification is required in the design of E-bike. This modified design is economical compared to conventional petrol powered bike for the common people in our country so they can afford to buy it. Most of the Automobile manufacturers nowadays are adapting the battery technology to produce completely battery operated vehicle, but whereas in the two wheeler segment only a few manufacturers are providing battery powered bikes that are not so efficient as they use lead acid batteries and are not reliable for longer period. So one has to make use of lithium ion batteries in order to sustain battery life for longer periods of use, which in turn gives idea on charging an battery while the bike is running, Thus emerged the concept of self-charging electric bike using the Super capacitors for charging up the secondary battery via dynamo setup and utilize it when the primary battery run out of charge, thus for doing so we make use of the two dynamo's connected to the front wheel of the bike in order to generate the electric power to charge the secondary battery via super capacitors. The super capacitors are used because, the dynamo will exhibit varying outputs of voltage depending on the speed at which the vehicle is running, thus the super capacitors will collect the charge coming out of the dynamo regardless the varying voltages and gives out constant output to the secondary batteries to charge them conveniently without causing any damage to the battery pack. Thus this implementation helps in preserving secondary battery pack for longer periods and also

charging up the batteries in required voltage rates. Therefore the proposed concept is applied into work in the e-bike and similar results can be expected from the completed model.

II. Literature Survey

Ankit et al. [1], E-Vehicles are poised to cause a major disruption in the automobile as well as the energy industry across the globe. This disruption is propelled by powerful purpose of creating a greener, safer and sustainable planet. Over 194 participating countries in the historical Paris climate agreement enforced in 2016 pledged to limit the average increase in global temperature to less than 2 degree celsius in this century. The USA, China and India combined together account for a staggering 50% of the world's Green House Gases (GHGs) emissions. The transport sector of these major economies form the bulk of the emission of GHGs. The USA and China have already promoted the replacement of fossil fuel powered vehicles by e-vehicles and as of 2016 have the highest stock of evehicles in the world; however, India is lagging behind its counter-parts. Out of the 20 most polluted cities in the world, 15 cities are in India. India has pledged to cut down its share of GHGs emissions significantly in order limit the average increase in global temperature. As a result of this, the Indian government has set a target of 100% e-mobility by 2030.

LanguangLua et al. [2], discussed on the key issues for lithium-ion battery management in electric vehicles. Compared with other commonly used batteries, lithiumion batteries are featured by high energy density, high power density, long service life and environmental friendliness and thus have found wide application in the area of consumer electronics. However, lithium-ion batteries for vehicles have high capacity and large serialparallel numbers, which, coupled with such problems as safety, durability, uniformity and cost, imposes limitations on the wide application of lithium-ion batteries in the vehicle.

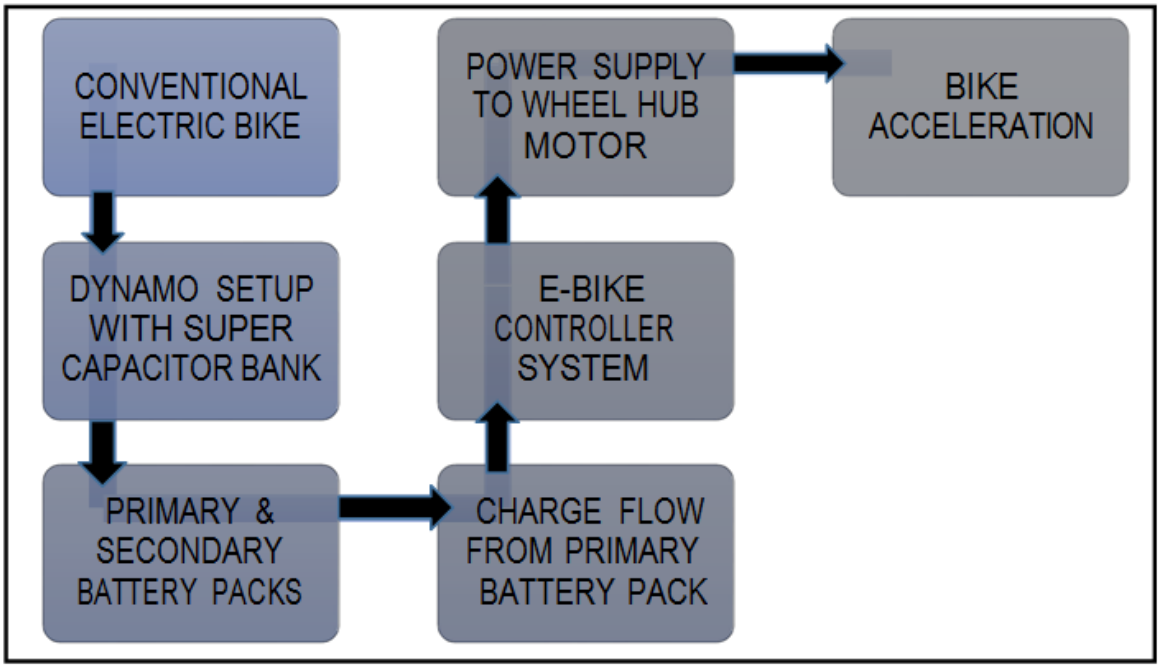
Paul Wolfram et al. [3], this paper aims to inform the debate over how electric vehicle technology could fit into a lower-carbon 2020–2030 new vehicle fleet in Europe by collecting, analyzing, and aggregating the available research literature on the underlying technology costs and carbon emissions. About a 50% cost reduction, compared with approximate cost reductions of 60% for battery electric vehicles and 70% for fuel cell vehicles. The authors further find that carbon emissions of battery electric vehicles using European grid-mix electricity are about half of average vehicle emissions, with fuel cell vehicles and plug-in hybrids having a lower emissions reduction potential. A lower-carbon grid and higher power train efficiency by 2020 could cut average electric vehicle emissions by another third.

III. Objective

Electric vehicle are the one approach to achieve better fuel economy in automobiles. Electric vehicle (EV) technology has the potential to reduce urban emissions and overall petroleum consumption, if it uses grid electricity. A plug-in hybrid electric vehicle (PHEV) has the facility to plug-in to a domestic/industrial electric outlet, thereby reducing a significant portion of transportation petroleum consumption. A key benefit of plug-in hybrid technology is that the vehicle no longer depends on a single fuel source. The main objective of this study is to implement the plug-in technology concept for two-wheeler by proposing a control strategy and to demonstrate the benefits of all-electric range and fuel economy improvements. The work also focuses on the investigation to evaluate the energy requirements, its mass and initial cost of the battery pack for daily average travel needs of plug-in electric two-wheelers in India. This study also investigated the influence of driving cycle and all-electric range on battery parameters for three different battery types and driving cycles.

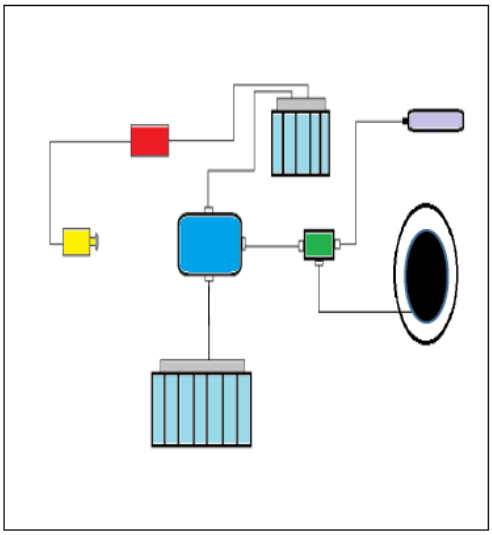
IV. Working Methodology

The proposed project mainly needs a currently available battery powered bike, specially designed swappable battery modules, secondary battery pack, super capacitor bank, dynamo setup, battery management system, interconnecting circuit etc.



V. Circuit Connection

The working principle of the proposed electric bike model is similar to that of the ordinary electric powered bike but with minor upgrades to the battery technology, charging methods & utilizing the power available from external dynamo setup.



Symbols	Name of Parts Used
	Dynamos
	Interconnector
	BMS
	Capacitor Bank
	Battery Packs
	Throttle
	Wheel Motor

In Figure shows the illustrative circuit connection of the entire bike setup. In figure the yellow color symbolize dynamo set-up, dynamo is an electro-mechanical device that converts the rotational motion to the electrical energy using the electromagnetic behavior. This is based on the faraday law of electromagnetic induction. Here red color indicates the capacitor banks which work as the major component of the secondary battery charging system, because of its property to balance the charge flow to the secondary battery pack. During the high speed, high current flows from dynamo to battery packs similarly during low speed low current will flow to the battery due to which there is voltage fluctuation in the system, which may damage the battery packs. Therefore, it takes the high as well as low current but delivers the uniform current to the battery pack.

VI. Result & Calculations

For the battery packs, we have connected 26 lithium ion battery in parallel connection. Each battery have nominal voltage of 3.6 voltage to 3.7 voltage and it can be maximum charged up to 4.20 voltage therefore we can say maximum charging voltage capacity of each battery is 4.20 voltage. For the battery pack, we are using lithium ion 18650-model battery. To specify the battery 18 and 65.0 stand for the 18mm diameter and 65.0 long variant cell. When we connect them in the parallel its total voltage ranges from 39 voltage to 54.6 voltage and its actual capacity ranges from 2200mAh to 3300mAh. Whereas battery has a capacity of 1000 watt. To charge it charger of 73.5-voltage of output that is similar to the 2.7A ± 0.1A is taken which take 70V‑300V AC~47 ‑ 63 Hz, 2.2 Ampere max., as a input with float voltage of 68.5V, ± 0.5V and boost voltage of 73.5V, ±0.5V.

VII. Dynamo Calculation

Dynamo is the electro mechanical device, which converts mechanical rotation to electrical energy, which is based in the Faraday law of electromagnetic induction. Presently we are using dynamo with specification of 6 volt and 3 watt as for economic purpose and simplicity. While testing with the various condition-using ammeter with varying load and speed condition we get the different readings while running with speed around 5 km/h we are getting 1.3-voltage output as speed goes on increasing output voltage increases too. We get around 4.7 volt of maximum output with speed around 15km/h of average. Due to various loss, condition like friction between wheel and dynamo expected output can be achieved.

VIII. Capacitor Calculation

A capacitor is a passive two-terminal electronic component that stores electrical energy in an electric field. The effect of a capacitor is known as capacitance. While some capacitance exists between any two electrical conductors in proximity in a circuit, a capacitor is a component designed to add capacitance to a circuit. As for the battery requirement and dynamo set up we are using 3 capacitor of 2.7V 500f.

IX. PROBLEM FORMULATION

From the previous literature studies, it can be observed that, none of the bikes or vehicles is made fully electric and regenerating. While coming across the development of electric vehicles hybrid vehicles were the greatest innovation in the field of the automobiles. Hybrid vehicles are those vehicles which utilize any two source of energy (one conventional and another non-conventional). This generally utilizes fossil fuel and electricity. To overcome the defect of pollution caused by IC engines hybrid vehicles were design. This could not completely control the pollution but can reduce up to certain extent. More over about pollution IC engine vehicles or bike make use of fuel during ideal condition. Due to which energy is being wasted. Due to which people started to think about fully electric vehicles which can reduce the fuel consumption during ideal condition and we could think for the pollution free society.

Work done on this type of model is in different proportions as one individual has proposed their work on lithium ion battery technology and its advancements, other has worked on super capacitor charging methods, and so on. Here in this project it is combination of all the above mentioned works i.e. utilization of electric bike and implementing dynamo setup for front wheel to charge the secondary battery via super capacitors and the primary batteries made up of lithium ion, and many other technologies regarding the above mentioned works In the development of electric vehicles none of the vehicle is fully electric and regenerative, to overcome this, our project focus on the self-charging system. Energy which is being loss due to friction and kinetic energy produce due to rotation of the wheel is utilized for re-charging of the battery packs which helps in the further running of the bike. Thus, it will be easy in operation and gives greater efficiency than conventional vehicles. During the working phase in project lots of difficulty were formed. Since, it is the new technology emerging in the field of automobile. As a mechanical engineer doing electrical set up was really tough for us. As required parts like lithium-ion battery, nickel strip were not easily available for us. Due to that concerned collecting those parts were problematic and we had to order from different city. Specially nickel strip was hard to find in market. Similarly many other parts were hard to get, if we get also due to economical aspect things were not into our comfort zone. As soon the completion of the project we need some charging station that are freely and easily available for the customer need. Since its new technology evolving its difficult to find charging station. Like petrol pumps, electrical station should be easily available. As per the Indian government new policy for electric vehicle is been implementing. They have strategy that in the major cities like Mumbai, Delhi, Bangalore etc. such charging station and necessary thing for electric bike will be implemented and with the motto to control pollution, government is taking this steps.

X. Finished Model

XI. CONCLUSIONS

- Behind the concept of e-bike, decreasing of environmental pollution and saving the fossil fuel for future.
- Making use of the swappable type battery packs reduces charging time and its convenient to travel longer distances with ease.
- Since the Dynamo setup will charge the secondary battery on the go we need not charge it individually like Primary battery.
- This will significantly bring down the charging cost and also increase the range of the travelling.
- Thus by utilizing the efficient battery technology and charging method we can reduce the overall cost and pollution caused due to the transportation.

XII. Scope for Future Work

Looking toward future, electric vehicles are going to overcome over the IC engine vehicles in few years of time. Due to continue use of fossil fuel there sources are getting empty and price are hiking day to day. People are suffering different kind of horror able dieses. New dieses are evolving due to carbon pollution. Pollution causing from the automobile can be overcome if we adopt some renewable sources of energy. So electric bikes are the one step forward to save the word. Technology, which we are using, is not just sufficient to rule the road and to overcome the IC engine vehicle.

If we look after some different battery technology, which could give more output in less charging condition (less charging time) we can achieve high efficiency and better torque. Improvement in wheel motor we can increase the speed of a bike. Different technology like dynamo set up and capacitor connection can help to improve the recharging time and condition of secondary battery pack. Better dynamos can optimize the voltage output. Use of more number of battery cells in battery packs could give the better millage and can increase the range of travelling.

References

[1]. Ankit Kumar, S K Choudhary, Chethan K N, Commercial Viability of Electric Vehicles In India, International Journal of Mechanical Engineering and Technology, Vol. 9(6), 2018, Pp.730-745.

[2]. LanguangLua, XuebingHana, JianqiuLia, JianfengHuab, MinggaoOuyang, A Review on The Key Issues For Lithium-Ion Battery Management In Electric Vehicles, Journal of Power Sources, Vol. 226, 2013, Pp. 272-288.

[3]. Paul wolfram, Nicholas P. Lutsey, Electric vehicles: Literature Review of Technology Costs and Carbon Emissions, The International Council On Clean Transportation, 15 July 2016, New Haven, United States.

