DESIGN FABRICATION OF E-BICYCLE AND COMPARATIVE ANALYSIS OF LEAD ACID BATTERY AND LITHIUM ION BATTERY

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Abstract- As the worldwide population is growing day by day and there is increasing demand for the product from the manufacturing industry a simple, reliable, eco-friendly, safety, and less costly product. One of them is electric vehicles. One type of such an electric vehicle is the electric e-Bicycle (e-cycle). E-cycle typically incorporates a battery, which can be charged at an ordinary domestic power socket, linked to an electric motor in the bicycle transmission system. Increase in fuel price of Petrol bike along with the consideration of the environmental factors uses a bicycle over a motor vehicle for short distance traveling. The rider has the power to controls the output power from motor i.e. speed using a handlebar mounted throttle and controller. . The main aim of this paper is to present the idea of harnessing the various energy and use it in today's existence of human life .Now-a-days there are so many vehicles on road, which consumes more fuel and also hazards our environment. It is our responsibility to reduce the consumption of fuel and its hazardous emission products. Taking this into consideration it is our small step towards reducing the use of more fuel consuming vehicles and attract the eye of people towards its alternatives i.e. Electric bicycle. So we intend to design a cycle which would run on an alternative source and also reducing human efforts called as Battery Operated Cycle. In this paper we design an alternative mode of transport for betterment of social and environment.

Keywords: Cycle, Electric cycle, Battery, Eco-friendly, transportation, Pollution, etc.

1. INTRODUCTION

As worldwide population is growing day by day and there is increase in manufacturing and using of fuel powered. This vehicle require fossil fuel to run and it a limited source of energy which will be over after some period and to cop up with this need, the revolution for the eco-friendly cycles 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 cycle over a motor vehicle for short distance travelling. Imagine how useful would the cycle be if even the small effort applied by man for riding on rough terrain. This project is based on combination of the standard geared cycle with an electric power motor. The system is modified in such a way that the rider can make choice of which mode he prefers i.e. he can either choose the cycle to be driven completely with the electric motor or he can choose it to be driven manually by himself. The idea of mounting the motor and its support assembly onto a geared cycle was to reduce the effort to-be applied for extra little weight that the rider will have to take along with the cycle. The unit has been designed in such a way that people of any age group can depend on it. Our idea of Implementation of the project was mainly biased towards providing inter college transportation. E-Bicycle Typically incorporates a battery, which can be charged at an ordinary domestic power socket, linked to an electric motor in the Bicycle transmission system. The rider have the power to controls the output power from motor i.e. speed using a handlebar mounted throttle and controller. The term 'e-bike' is generic and includes a combination of different electrically powered two-wheelers some of which function by simply turning a throttle. This Bicycle is designed and made in very less cost as compared to original cost, so any

one can afford this Bicycle. As we know that due fuel powered vehicles, the emission of toxic gases is increasing day by day, due to this 4.3 million people

1.1 Background

Global warming and depletion of nonrenewable resources are becoming major problems in the current scenario. People try to move towards "clean" energies. In fact, the most important invention of the last century was the invention of the petrol and diesel engine. The transportation sector has been revolutionized every bit. Speed has converted days into hours, hours into minutes and seconds. Passenger comfort and "less strain on human muscles" are guiding forces behind it. But this rapid modernization in the transportation sector guzzles a lot of fuel. Increased level of pollution and global warming are demerits of excessive usage of petrol and diesel vehicles. To overcome these problems scientists have come up with a concept of e-vehicles (i.e.) electric vehicles. The greatest advantage of e-vehicles is that they do not use fuels such as diesel and petrol and hence do not emit fuming exhausts (these exhausts are very detrimental to health). Electric Bicycles (also known as e-bikes) are the most important vehicles under the category of electric vehicles. These are very much user-friendly for commuting within city limits. These e-bikes are basically simple bicycles fitted with an electric motor which augments its speed. Worldwide there are many types of electric bicycles ranging from the ones which have a small motor which assists in easy pedaling (less exertion) to the ones having more powerful motors which resemble very closely to mopeds. However, all-electric bicycles have the ability to be pedaled by the rider in case of battery discharge or any other fault in the motor. The electric bicycle is an electrical-assisted device that is designed to deliver the electromagnetic momentums to a present bicycle therefore relieving the user of producing the energy essential to run the bicycle. It is provided with the dynamo to generate electric power from rotating wheels.

1.2 Motivations

The motivating factor is to identify the need of finding and modifying E-Bike is to overcome the issue of the pollution because of vehicles in metro towns & urban zones is swelling uninterruptedly. Considering the all class of society it is not reasonable for all to purchase (scooters, mopeds or motorcycles). There is also provision of solar panels to generate more electric power. The single biggest advantage of electric bicycle is that it is cost operative as it mainly only entails building cost as running cost would only require the charging of the battery. The currently existing electric scooters are far more costly and due to budgetary constraints a middle class person cannot afford such a locomotive at his place. Along with the development of technologies the theory must be also implemented to design and manufacture a product that can be sold off at a greater frequency, which has a very low production cost and one that is of good quality. In order to implement all the above ideas, we planned to make the design and product in such a manner that it can be competed with the existing "e-Bikes" in the market. The basic idea is to attach a motor to the cycle for its motion. A motor that is powered by a battery and that can be switched on during difficult terrains and switch off and pedal to get the battery re-charged during motion in a flat terrain. The fig no 1.shows the electric bicycle available in the market

1.3 Problem statement of this paper

The world is facing with big challenges including depletion of fossil fuels and global warming caused by exhaust emissions from conventional vehicles fuelled with gasoline or diesel. So, to overcome these challenges we are going to manufacture electric bicycle.

1.3 Objective of this paper

1 To reduce the human effort.
2 To increase the human comfort and Easy maintenance
3 To overcome the fossil fuel challenges.
4 To reduce the pollution.
5 To provide better health benefits as the bicycle can be operated manually.
6 To provide easy charging of the battery.

2. LITERATURE REVIEW

2.1 Research Gap

The Bicycle, in its present upright form, called a "Safety Bicycle" and introduced by the Rover model in 1885, is a relatively cheap method of extending the range, increasing the speed, and improving the energy efficiency of human powered transport. It can coast down hills, roll easily along the flat, and make use of gearing to tackle steep hills. Many Bicycle alternatives exist, ranging from recumbent models to chunky off-road machines; however the "safety Bicycle" shape remains most common. Electric Bicycles, with more than a century of commercial history (the first patents for electric Bicycles were granted in the 1890s), have long been available, and found adopted in small numbers in many countries. Their relative lack of popularity until recently may be attributed to technological or economic factors, however the fact of their existence means that they are already covered by legislation in most countries. In terms of personal electro-mobility alternatives, there are a plethora of amazing inventions ranging from the Segway, the Yike Bike, Ryno, various electric scooters, skateboards, power skates, and electric quad bikes and so on. Ignoring the fossil-fuelled variants, recent alternatives have been released which are powered by compressed air, flywheel, fuel cell and probably other unusual power sources. However the vast majority of experimental machines use a combination of electrical motor and battery. Battery solutions tend to be limited to the robust but weighty lead-acid cells in cheaper or older systems, through surprisingly few NiMH variants, to Lithium Ion (predominantly LiFePO4 or LiMn2O4 based cells) in more modern and expensive variants .The Segway is one of the most imaginative and innovative personal mobility solutions to have been developed in recent years, with a loyal following of users, and several niche application areas. However the Segway has not attracted widespread adoption on campus to date. General Motors have used the Segway as the foundation for their P.U.M.A. (Personal Urban Mobility & Accessibility) project which effectively adds car-like features to the Segway; a seat, roof and steering wheel. Whilst this is exciting and extremely attractive from a technological point of view, it leads to a very expensive transport solution, requires significant thoroughfare space, and may require licensing for use in certain locations (for example, even the basic Segway is not currently legal for use in public areas within Singapore). Electric quad bikes are likewise expensive, bulky to park and have few advantages over an electric Bicycle. In fact, all of the devices mentioned are expensive, certainly significantly more so than a standard Bicycle, and most work on the premise of simply adding a motive power source to a Bicycle- type system (or scooter/skateboard/skates). However it is by no means certain that lack of such power assistance is the main reason why Bicycles may not have been more widely adopted in many campus environments. Thus, adding motive power alone may not lead to the more widespread adoption of electric Bicycle-type transport.

2.2 Review of Literature

1. **The German Naturalistic Cycling Study – Comparing cycling speed of riders of different e-bikes and conventional bicycles [1]**

Objective of this paper to was to explore the acceleration and speed of orthodox and electrically powered bicycles under truthful statuses. Authors distinguished between electric bicycles which deliver provision up to 45 km/h (as known as S-pedelecs) and 25 km/h (speed of pedelecs). Additionally, as speed limits of 30 km/h might influence especially on theexecution of speedier cyclists (e.g. Spedelec rider), the potential mean speed might be even advanced under various situations. Authors also found noteworthy variances in numerous measures between pedelecs and orthodox bicycles, although less noticeable. This might interpreted as a symptom that, when accelerating from standstill, the assistance provided from motor used by the pedelec riders to reach their preferred speed easier, not earlier. Authors also given the variance in the user population, it is not irrational to admit that at present, e-bikes do not cause any revolution in cycling mean speed at all. The growth of e-bikes in younger cyclists is still there. It has even been embraced that the e-bicycle is going from being a "recovery vehicle" to a stylish frill. By this authors gave the vision that this will change two wheeled activity and street security in the center and long stretch.

2. **Urban Electric Bike [2]**

In this paper, authors considered importance of easy vehicle mobility and compactness. In which they revealed that folding is the strategic feature of the e-bike which would not have been probable devoid of the folding arms. For the ease of sliding of the arms a bolt is provided. In order to provide rigidity to the bike a guide has been provided on the main frame

About other components, both the plates are welded on front arm of the bike and a constraint is established on the back arm to confine the angle between the two arms to 50°. Furthermore, in paper the specifications and functionalities regarding components of e-bike were discussed. At initially, fundamental driving component about Hub Motor that Regular electric motors utilize a mechanical gadget called a commutator and two contacts named carbon brushes to switch the electric current periodically and affirm the pivot continues handing over the comparative bearing. Hub motors are characteristically brushless motors (See fig. 4) which replaces the commutator and brushes with planetary gears and an electronic circuit. The Hall Effect Sensors help to locate the position of the permanent magnets and which coils to activate to keep the motor spinning. Then about the accelerator or say throttle, author discussed below working. Working of a Twist throttle is based on the principle of potentiometer which is also called variable resistor. It is used to fluctuate the voltage passing through the throttle. In order to pass more through the throttle, the more twist should be provided as a result less is the resistance. Therefore twist throttle offers the signal to the BLDC hub motor controller to increase or decrease the current passed to the motor.

3. Campus Mobility For The Future: The Electric Bicycle [3]

This paper presents the various outcomes and results of the study containing visions into the scheme. Electric bikes, of much sort have been surveyed by and by in a semi-open contract conspire on the Nanyang Technological University campus in Singapore. According to this campus, it is a famous and helpful administration, with a few models of electric bike being exceptionally very much utilized. Riders contemplate the premier of the electric bikes to be both agreeable and engaging while at the same time utilizing it, and extremely suitable for campus travel. Understudies and general society alike view the plan unhesitatingly, and creators have seen a lessening in the quantity of miles driven via auto inside the grounds for the dominant part of clients who are additionally drivers. In this paper, authors have sensibly inspected the utilization of bikes on campus, displaying and investigating review results that endeavor to clarify blocks to bigger acknowledgment of the bike. Authors likewise bolster the general public by giving arrangement that if this information is coordinates with a portion of the qualities of the campus encompassing, it is conceivable to suggest specialized, arranging and reasonable arrangements that together should help the more prominent acknowledgment of bike transport. This is the concentration of the rest of the paper.

4. Design And Fabrication Of Dual Chargeable Bicycle[4]

In this paper, authors discussed about the crucial components and its experiments of e- bike, alternator and batteries. First, alternator which is an electromechanical device that transforms mechanical energy to electrical energy in the form of alternating current. The brushes of a DC generator carries a small fraction of the current, which carry the generator's whole output. A set of rectifiers (Diode Bridge) is essential to alter AC to DC. To provide direct current with low ripple, authors used a three-phase winding and the pole pieces of the rotor are shaped (claw-pole) to produce a waveform similar to a square wave as an alternative of a sinusoid. Author used alternator of Yamaha bike which workings are done at high RPM since authors' electric bicycle is restricted to low RPM so they changed the windings of alternator and upsurge e the drive ratio. Hence, it can function at low RPM.

5. An Improved & Efficient Electric Bicycle System With The Power Of Real-time Information Sharing[5]

Firstly they are using the sun based board as a hotspot for E-bicycle. In that they utilized the 20 KW sunlight based board and it is associated with the 12 v battery. So the sun powered board is utilized to charge the battery. Here basic concept they applied that the solar energy is converted into electric energy by using photovoltaic effect. The second source of energy is that they are convert the mechanical energy into electrical energy by using dynamo. Dynamo is a electric device which generate the power with the help of commulator. In this paper they mentioned the procedure of how mechanical energy is converted into electrical energy and it will utilized for run the electrical bike. They connect the dynamo in the front wheel of E-bike. As the wheel of bike is run along the wheel commulator also rotate and it will generate the power. So the mechanical energy gets converted into electrical energy and it will store in dynamo whenever it will be required, it will supply the energy to E-bike.

6. Design Of Electric Bike With Higher Efficiency[6]

From this paper it can be found that they are focused on the improvement of efficiency of E-bike. Generally the speed of E-bike is in the range of 40-45 km/hr at maximum. So there they increase the speed of E-bike and design the aerodynamic shape in such a way that the efficiency of E-bike is improved. For the increasing the speed they are done the comparison of power transmission system. In that they found four power transmission system. Based on Application the out of four any one of them power transmission system is used in E-bike. Generally the chain drive is used for transmitting the power. Along with that there are three different types of motor is also used like Gear hub motors, Crank drive motors and direct drive motors. So after completing experimental study it can be found that due to the specifications like light weight, inexpensive, compact, offering non-slip the chain drive is more efficient as compared to belts or gears.

7. Design And Development Of Solar Assisted Bicycle[7]

In this paper, study on alteration of present bicycle in form of solar assisted which is energized by solar energy is carried out. For both city and nation streets that are made of bond, black-top, or mud, this bike is fitting, It is reasonable, unobtrusive in development and can be widely utilized for short separation voyaging especially by school youngsters, understudies, office goers, villagers, postmen and so forth. It is especially reasonable for youthful, matured, disable individuals and provides food the need of financially poor class of society. The best critical component of this bike is that it doesn't expend important petroleum products along these lines sparing crore of outside trades.

8. Design, Fabrication And Performance Analysis Of Solar Power Bicycle[8]

In this paper, authors carried the selections of different components of E-bike.
Determination of Battery: Two Li-ion Battery storing with 12 V and 12 amp-hour rating are kept in use. The variety of battery relies upon its voltage, ampere and wattage rating and so forth. The whole energy of totally charged battery in two hours is 288 Watt-hours. Choice of Motor: A Brushless D C Motor (BLDC) for 300 Watts control with electronic compensation framework is painstakingly picked. Brushless DC Motors (BLDC) have many favored contrasted with mechanically moved DC motors in light of the fact that BLDC engines have permanent(long enduring) magnet , electronically drove, No twisting on rotors, frictionless operation, not so much commotion but rather more undeviating(uniform) torque..

9. Design, Development And Performance Evaluation Of Solar Power Assisted Tricycle[9]

In this paper, the solar powered tricycle as an auxiliary for auto rickshaw is carried out by authors. Authors mentioned key relevant features of the solar power assisted tricycle in this paper.

a. For higher power, motor of higher capacity can be used.
b. It works with a reasonable speed with less fatigue to the rider.
c. Source of power and shade utility by mounting solar panel..
d. The tricycle is steadier contrasted with a two wheel bike.
e. The parking place for solar powered vehicle does not involve a shed.
f. The battery can be charged even while riding the tricycle. This guarantees unremitting vitality contribution to the tricycle with no extra cost.

10. A Dynamic Model For The Performance And Environmental Analysis Of An Innovative E-Bike[10]

The authors have directed an ecological investigation of the considered vehicle, especially contrasting the e-bicycle and a thermal moped, as far as ecological effect. This paper spoke to the natural examination of an electrically supported bike under genuine driving circumstances of mimicked speed-time profiles.
In think about, trial results of roller test seat estimations completed on a warm moped utilized so as to assemble the apropos emissive information amid genuine driving circumstances. The ecological appraisal was performed considering an examination with the emissive execution of this moped by utilizing kinematic parameters that assign the reenacted driving elements; an unmistakable advantage of e-bicycle likened to thermal mopeds was appeared and figured as far as emanations spared of CO, HC and NOX, which was a general report finding of this paper.

11. The Copenhagen Wheel: An Innovative Electric Bicycle System That Harnesses The Power Of Real-Time Information And Crowd Sourcing[11]

In this paper authors deliberate innovative bicycle wheel concept which is used for comfortable ride of e-bike. The name of that wheel is known as Copenhagen wheel. The Copenhagen wheel is a bike wheel that can be effortlessly retrofitted into any normal bicycle. It look for red center point not just contains engine , batteries and inward apparatus framework yet in addition incorporates ecological and area sensors which are controlled by the batteries in the haggle information for cycling related versatile application.

12. Parametric Finite Element Analysis Of Steel Bicycle Frames: The Influence Of Tube Selection On Frame Stiffness[12]

Authors presented a parametric Finite Element model of road bicycle frames using beam elements with wavering tube profiles in this paper. In order to observe the impact of tube profiles on lateral stiffness and vertical compliance of the frames, wide range of current frame geometries had been subjected to several in plane and out of plane loading situations. This was postponement of preceding effort which considered the influence of overall frame geometries (tube lengths and angles) on the stiffness characteristics of frames. For a subset range of frame sizes (with seat tube lengths varying from 490-630mm), parameters were utilized to characterize measurements for roundabout tube profile shapes, shifting divider thicknesses related with butted tubes.

13. Parametric Finite Element Analysis Of Bicycle Frame Geometries[13]

This paper has outlined by respective authors which includes a Finite Element model by means of beam elements to signify a customary road bicycle frame. The model simulation carries two standard loading constraints to undergo the vertical compliance and a lateral stiffness characteristic of 82 existing bicycle frames from the bicycle geometry project and compares these characteristics to an improved solution in these circumstances. Maybe obviously littler edges (490mm seat tube) act the most thoughtfully as far as both vertical consistence and horizontal solidness, while the shorter best tube length (525mm) and bigger head tube edge (74.5°) brings about an along the side stiffer edge which relates with discoveries from literature outcomes. The upgraded esteems demonstrate an extensive improvement over the best of the current casings, with a 13% expansion in vertical dislodging and 15% decline in horizontal relocation when identified with the best of the dissected edges. Here general stacking conditions for frame structure and other auxiliary parts (rear dropouts, sections, handlebar, situate tube) are appeared in Figure-9 and 10.

14. Numerical Study On Materials And Design Optimization Of A Bicycle Frame[14]

In this paper the procedure of selecting a material for robust frame structure is approached by authors Author has taken- materials like composites (HT Graphite epoxy and S-Glass Epoxy) and Aluminium Alloy 6061-T6 for Circular and Elliptical cross section. From ANSYS 14.5 simulation results it is determined that composites (HT Graphite epoxy and S-Glass Epoxy) can be used as bicycle frame material due to its better results (stress, strain & displacement) when compared with Aluminium Alloy 6061-T6. Also, for the bicycle frame the Circular cross section is more preferable than Elliptical cross-section because of high strength withstanding ability. Then in the two composite materials (HT Graphite epoxy and S Glass Epoxy) Due to less cost and reasonably high strength S-Glass Epoxy can be preferred when compared to HT Graphite Epoxy Figure-11 and Figure-12 shows the stress, strain values and deformation values for circular cross section frames and elliptical cross section frames respectively.

15. Performance Evaluation Of Electric Bicycles[15]

In this paper authors discuss the configuration and overview of E-bike. In this they have classified the various possible components used to build an e-bike. As per shown In the figure 13, the fundamental design of an electric bicycle drive comprise of a controller that controls control stream the battery to the electric engine. It implies the power provided from electric engine is utilized to run e-bicycle. The power act parallel along the power delivered by rider via pedal on the bike. The specifications regarding E-bike

3. DESIGN CALCULATIONS

3.1 Transmission -

The Motor used in the electric bicycle is self-generating motor with power and speed of 350 watt and 2750 rpm respectively. The motor runs on 24 volts and full load current of ≤ 19.20A.

P = 2 * 3.14 * 2750 * T/60
T = 1215 N.mm
Reduction in chain drive
R chain = 66/11 = 6:1
Torque at wheel shaft = T * R chain = 1215 * 6 = 7291.8 N.mm
Speed at wheel shaft = 2750/6 = 458.33 rpm = 57.0554 km/hr.

3.2 Shaft design:

$\sigma_s = 16T_W/(3.14*D^3)$
Assuming, diameter of shaft = 10 mm
$\sigma_s = 37.155$ N/mm^2
Where, T_W = Torque at wheel shaft
D = Diameter of shaft
σ_s= working stress.

Material to be used = 30C8 Plain carbon steel
Material σ_s = 66.67 N/mm^2 (F.O.S = 3 and σ_{UT}= 400 N/mm^2)

Therefore, design of shaft is safe.

Design of Sprocket and Chain for Electric Bike
We know,
TRANSMISSION RATIO = Z2 / Z1 = 66/11 = 6
For the above transmission ratio number of teeth on pinion and the number of teeth sprocket is in the range of 21 to 10, so we have to select number of teeth on pinion sprocket as 11 teeth.
So, Z1 = 11 teeth
The outer diameter is decided on the basis of driving chain sprocket number i.e #25 and driven chain sprocket i.e #40.
CALCULATION OF MINIMUM CENTER DISTANCE BETWEEN SPROCKETS
Dc1=25.45
Dc2=274.21mm
The minimum centre distance between the two sprocket = C' + (80 to 150 mm)
Where C' = Dc1 + Dc2

C'= 25.45+274.21

C' = 299.66 mm
MINIMUM CENTER DISTANCE = 299.66 + (80 to 150 mm) MINIMUM CENTER DISTANCE = 380mm to 450mm.

3.3 Brakes:

Basic input values
Max. Weight of bicycle= 100kg
1. Brake Pedal
F_{bp} = Force output of brake assembly
F_b = Force applied by driver=3kg
Pr= Pedal ratio.
Fbp=Fb ×Pr
30×5 = 150 N

2. Brake pads
By assumption

$F_{bp}=F_{clamp}$
F_{clamp}=clamping force by brake pads to rim
F_{clamp}= 150 N
$F_{friction}$ = frictional force generated by brake pads
F_{bp} = coefficient of friction between brake pad & rotor
$F_{friction}= F_{clamp}$ x. F_{bp}
= 150x 04 (dry condition)
= 60 N
Friction = 150×0.1 (wet condition)
=15N
Torque generated by the
The brake pads at the rim.
$T_r = F_{friction}$ x Radius of rim
$=F_{friction} \times 0.645$
Tr=9.675 Nm
Torque of wheel generated by motor
T_w=0.72918 Nm
Since, $T_r > T_w$
The force generated by the rim is more than torque at wheelvehicle decelerate and wheel will lock.

3.4 Frame:
According to the ergonomics and the market survey the frame geometry of the bicycle is designed by considering the parameters like riders' height, wheel diameter etc. The frame geometry is as follows:

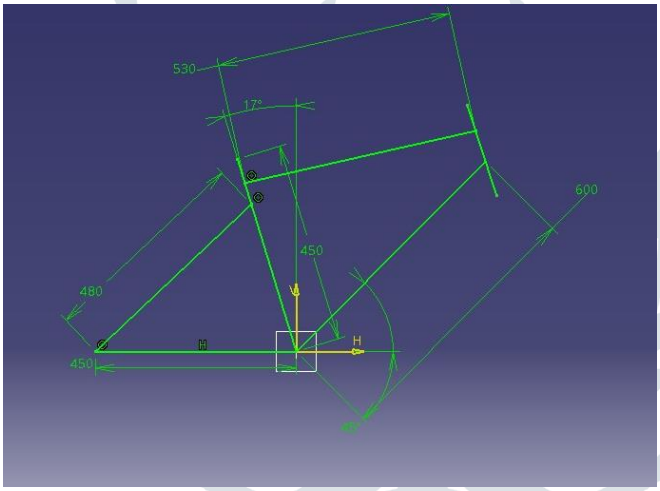

Figure No. 01. Frame Geometry of E- Bicycle-1

The Material for the frame is selected according to the parameters like tensile strength, Elongation, density, hardness, etc.

Table No 1. Properties of material

Material	Yield strength (MPa)	Tensile strength (MPa)	Density (kg/cm^3)	Hardness (BHN)
Aluminium	240	290	2.7	95
Mild steel	250	345-525	7.85	130

According to the table mentioned above we can conclude that mild steel can be used for manufacturing of

frame. Mild steel has been used from past years because of its properties.
Aluminum can also be used for frame in the form of alloy by changing its properties.

4. CONCEPTUAL CAD MODELS

4.1 Cad model of bicycle frame

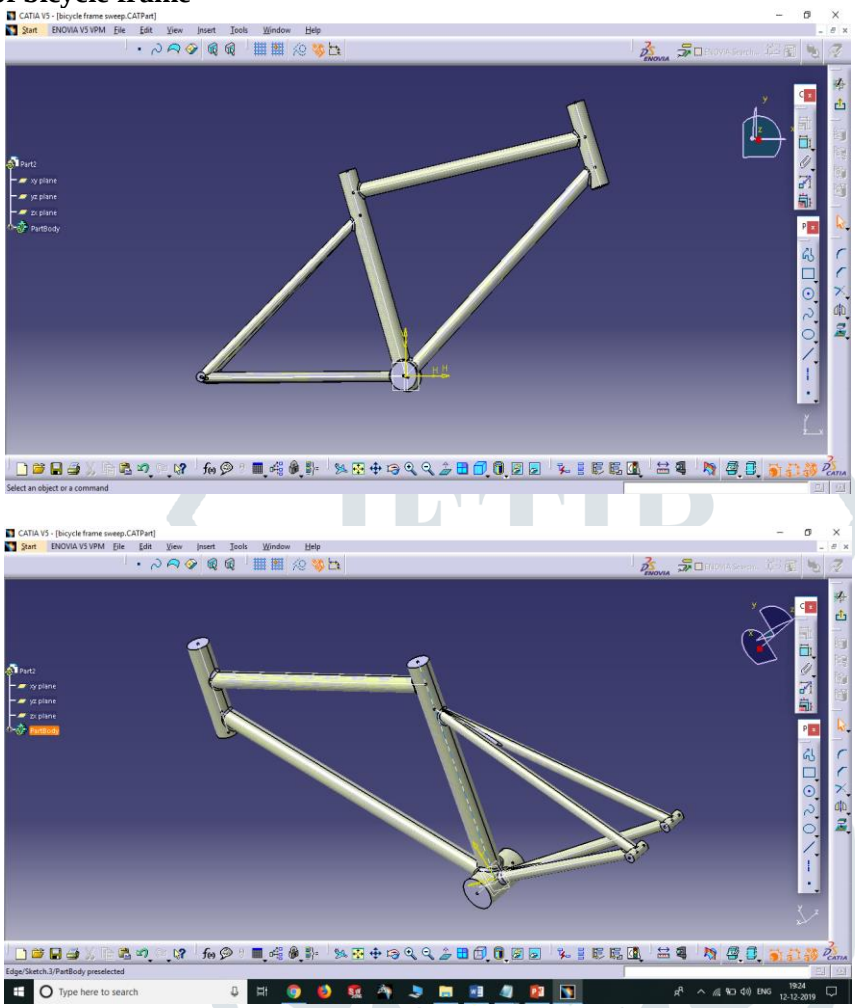

Figure No. 02. Frame Geometry of E- Bicycle-2

All the components of the Bicycle are assembled in such a way that, the Bicycle will not look messy and the weight of components does not affect to the Design of Bicycle. Key port is given in middle of handle bar which controls all the electrical circuits as shown in shows the fully assembled Bicycle which is actually an Electric Bicycle.

4.2 Complete Fabricated Electric Cycle

Figure No. 03 Complete Fabricated Electric Cycle

5. COMPARATIVE ANALYSIS OF LITHIUM ION BATTERY AND LEAD ACID BATTERY

5.1 INTRODUCTION

5.1.1 LEAD ACID BASICS

Lead acid has been around for over 100 years and will be a market force for the foreseeable future due to its low cost and established manufacturing base. The two types are identical in their internal chemistry. The most significant differences between the two types are the system level design considerations. Flooded lead acid batteries require three things that VRLA don't: upright orientation to prevent electrolyte leakage, ventilated environment to diffuse gases created during cycling, routine maintenance of electrolyte. Due to these differences, the lower cost of flooded lead acid must be balanced against the added complexity and secondary costs.

"Deep cycle" and "shallow cycle" lead acid batteries can be found in both the VRLA and flooded classes. Shallow cycle VRLA batteries are commonly used for automotive start, light, ignition ("SLI") batteries that must deliver high power pulses for short durations. The stationary power market uses deep cycle since the batteries will often discharge at a low rate over the course of multiple hours.

5.1.2 LITHIUM ION BASICS

The concept of a lithium-ion battery was initially conceived in the 1970's and began to see widespread adoption by the 1990's. All lithium-ion cells are "deep cycle" meaning that they have the ability to be fully charged and discharged. The life of the battery will significantly increase if the depth of each discharge is limited to 80% of the rated capacity.

5.2 LIFE CYCLE AND PERFORMANCE

Lithium-ion has significantly higher cycle life than lead acid in deep discharge applications. The disparity is further increased as ambient temperatures increase. The cycle life of each chemistry can be increased by limiting the depth of discharge (DoD), discharge rate, and temperature, but lead acid is generally much more sensitive to each of these factors.

In the figures below, AGM refers to a lead acid battery.

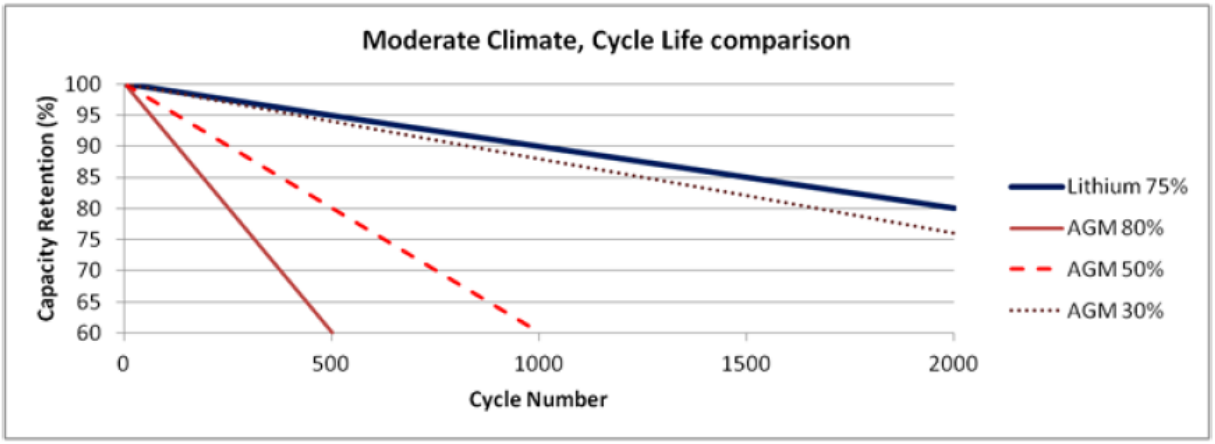

Figure No. 04 Moderate Climate Cycle Life Comparison

In hot climates where the average temperature is 33°C, the disparity between lithium-ion and lead acid is further exacerbated. The cycle life for lead acid (flooded and VRLA) drops to 50% of its moderate climate rating while lithium-ion will remain stable until temperatures routinely exceed 49°C.

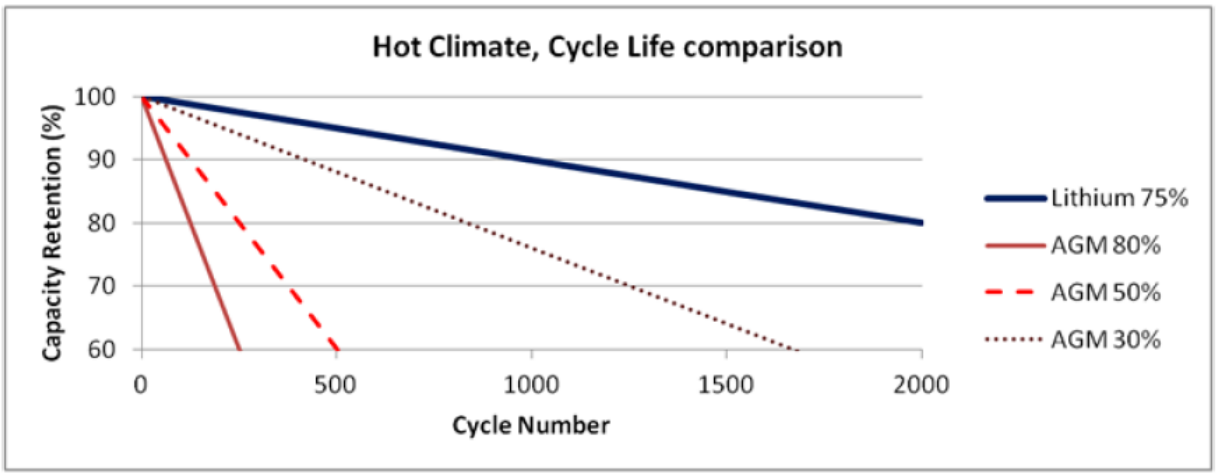

Figure No. 05 Hot Climate Cycle Life Comparison

Analyses indicate that lithium-ion has an 18% higher lifetime cost when compared to lead acid in moderate climates, but is much more cost effective in hot climates. There is a significant area of the world that sees average temperatures high enough to decrease the life of lead acid batteries. A factor not represented in the figure is that the battery systems are often housed in enclosures that see internal temperatures 10°C higher than the air temperature due to solar insolation, which would further decrease the performance of lead acid. The average temperature is also not completely representative of how much time is spent at extreme temperatures where the degradation accelerates in lead acid systems (e.g. one hour spent at 40°C and one hour spent at 20°C has a worse impact on the battery compared to two hours spend at 30°C). Another critical consideration for lead acid is how long the system will take to discharge. The shorter the discharge period, the less capacity is available from the lead acid battery. A 100Ah VRLA battery will only deliver 80Ah if discharged over a four hour period. In contrast, a 100Ah lithium-ion system will achieve over 92Ah even during a 30 minute discharge. As shown in the figure below, this condition makes lithium-ion very well suited for applications where full discharge occurs in less than eight hours.

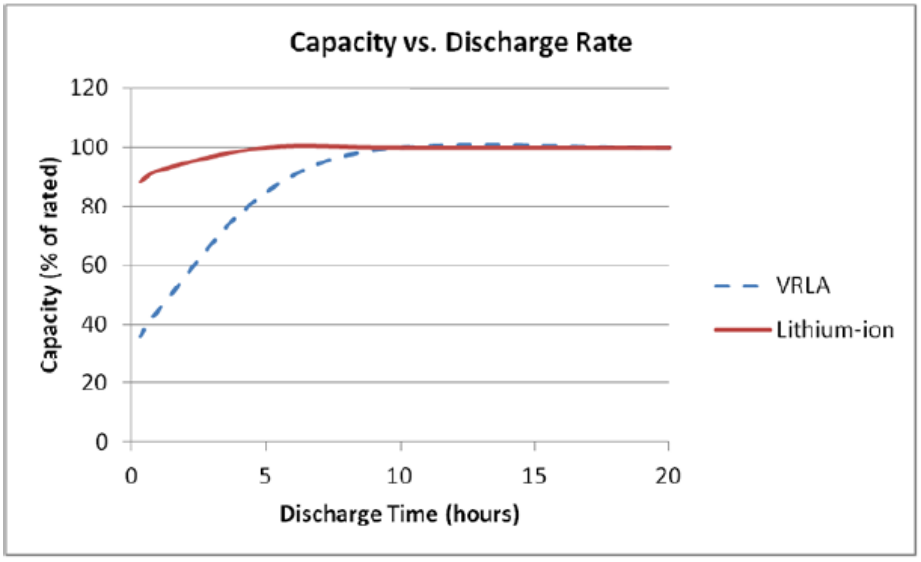

Figure No. 06 Capacity vs. Discharge Rate

5.3 ENVIRONMENTAL IMPACT

Lead acid batteries compare poorly to lithium-ion with regards to environmental friendliness. Lead acid batteries require many times more raw material than lithium-ion to achieve the same energy storage, making a much larger impact on the environment during the mining process. The lead processing industry is also very energy intensive, leading to large amounts of pollution. Although lead is highly hazardous to human health, the manufacturing methods and battery packaging make the human risk negligible.

Lithium is not without its own environmental problems. The major components of a lithium-ion cell require the mining of lithium carbonate, copper, aluminium, and iron ore. Lithium mining specifically is resource intensive, but lithium is only a minor portion of the battery cell by mass, so the aluminium and copper environmental impacts are much more significant. The lithium-ion recycling industry is only in its infancy

right now, but the cell materials have shown high ability for recovery and recyclability, so it is expected that lithium-ion recycling rates will rival lead acid.

5.4 SAFETY

Lead acid and lithium-ion cells are both capable of going into "thermal runaway" in which the cell rapidly heats and can emit electrolyte, flames, and dangerous fumes. The likelihood and consequences of an event are higher for lithium-ion as it has a higher amount of energy in a smaller volume. Multiple cell and pack safety precautions are taken to prevent trigger events, such as short circuits and overheating.

Table No 2. Comparison of batteries and solar panels.

Sr. No	Parameters	Lithium ion battery	Lead Acid Battery
1	Weight	Light in weight	3 times weight of li-on battery
2	Resilience / discharge	Less vulnerable to high discharge and climate change	Damages through excessive discharge and extreme temperature
3	Life	Excellent	Good
4	Efficiency	High	Low
5	Replacement	6-7 years	1.5-2 years
6	Cost	Very High	Average
7	Power density	125 W/Kg	40 W/kg
8	Usable Energy	80%	50%
9	Voltage per cell	3.2 V	2 V
10	Maintenance	Basic annual Maintenance	Regular Maintenance every 3 months

CONCLUSION

With increasing prizes of fuel and pollution alternative choice can be available which is traditional but in new modify version of cycle. In this research paper we are able to design and modify an e-bike which may be the solution to our problems which we are experience now a days like traffic congestion, parking difficulties and pollution from fossil fueled vehicles. We have modify and assembled the devices required the cycle and make the less prize Electric cycle compared to market. It has been noted that the electric bicycle is not only an alternative for transportation, but also a way of practicing daily sports to promote healthy living. After completing the analysis on e-cycle; it is observed that the life of people is very fast so no one can purchase e-cycle. Only the countries with a large number of inhabitants are interested in electric bicycles because they are a sustainable form of mobility, transport, and countries with high environmental awareness. Now the data analyzed related to the electric bicycle shows an increase in scientific and technological interest in this subject because people promoted by the attraction caused by the price, much less than a scooter, and by its speed and lightness in use, in addition to having a simple and inexpensive recharge. Researcher modify an idea to develop an e-bike which is manually operated as well as automatic on electric battery. This paper presents the less costly, light in weight, pedal can be used when power not in use and effectively use of e-cycle. This paper identifies potential barriers of electric bicycle. This project is designed to improve the normal bicycle and make it extra efficient. The electric bicycle is hybrid and so it can run by electrical energy, solar energy, and dynamo and can also be pedalled thereby still retaining the exercise people drive from riding bicycle. As EVs are becoming more widely accepted, consumers will be able to save money, be energy independent, have a lower impact on the environment, pollution, and greenhouse Gases etc. Lithium mining specifically is resource intensive, but lithium is only a minor portion of the battery cell by mass, so the aluminium and copper environmental impacts are much more significant. The lithium-ion recycling industry is only in its infancy right now, but the cell materials have shown high ability for recovery and recyclability, so it is expected that lithium-ion recycling rates will rival lead acid.

FUTURE SCOPE

Future research and development is needed to continue improving the specific energy and energy density of batteries being used by vehicles, while at the same time reducing the cost of the technology. Infrastructure to support widespread adoption of electric vehicles will also need further development and implementation. Efforts, such as those noted above, can add to alleviating range anxiety for consumers and potentially change overall perceptions of electric vehicles, and as a result, EVs will have better market penetration leading to a dramatic change in the automobile industries.

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