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Design and Fabrication of Electric Foldable Bike

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CERTIFICATE

This is to certify that Mr. Akshay Talekar , Mr. Rohan Solanke , Mr. Parth Reddy, Mr. Hritik More has successfully completed the Project Report entitled "Design and fabrication of Electric Foldable Bike" under my supervision, in the partial fulfilment of Bachelor of Engineering (Mechanical Engineering) of Savitribai Phule Pune University.

DATE :
PLACE :

Dr. Sanjay Patel Guide	Internal Examiner
Dr. R.R.Arakerimath	Dr. R. k. Jain
Head of the Department	Principal

I. ACKNOWLEDGEMENT

We take this opportunity to thanks Dr. Sanjay Patel for his valuable guidance and for providing all necessary facilities, which were indispensable in completion of this workFirst of all we are thankful Dr. R.R. Arakerimath (HOD Mech. Engg. Dept.) to give us presentation facility. We are thankful to all staff members of the mechanical engineering department. We would also like to thank the college for providing required journals, books and access to the internet for collecting information related to the project. Finally we are also thankful to my friends and well-wishers for their valuable suggestions.
Mr. Akshay Talekar
Mr. Rohan Solanke
Mr. Parth Reddy
Mr. Hritik More

***Abstract:** In the current lifestyle, man isn't able to dedicate specific time for his health. This importance towards exercise and body fitness thanks to time shortage and stressful life is extremely low. To address the time deficit, we are able to utilize the time spent on commuting efficiently to exercise by using bielectric bikes, thereby also contributing to pollution control. But regular bielectric bikes occupy sufficient space to park and aren't easy to hold around additionally because of the possibility of theft. Transport has been one of the foremost important issues to be restricted within the present day situation, as commuting from place to position within the town has become a tedious and a chic task. it's very difficult to succeed in the closest transport facility and in many cases the destination is very far away from most roads where the general public transport won't be able to commute or it'd be very expensive. To overcome a typical problem faced by the society, a plan is conceptualized*

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to style and fabricate a foldable bielectric bike. We have already seen many foldable bielectric bikes within the global market but the main idea of this project is to supply a foldable bielectric bike which is light & sleek yet rigid & safe. It's easy to handle and straightforward to take care of. Unlike the standard electric bikes, this bielectric bike will occupy very less space and is also very easy to hold around. Also it utilises the regenerative braking system. The most objective is to style and develop a foldable bielectric bike which is comfortable to ride and economical

II. INTRODUCTION

In the present lifestyle, man isn't ready to dedicate specific time for his health, importance is least given to exercise and body fitness thanks to time shortage and stressful life. Obesity is one in every of the common issues seen in society, which results in many health hazards. Exercises are advised for health promotion, and treatment for several diseases. Among the exercises aerobic exercises are appropriate for these purposes. To try and do aerobics many methods are available for example: running, jogging, walking, cycling et al. Transport has been one of the foremost issues in developing cities like Bangalore since commuting from one place to another has become tedious and expensive. With petrol and diesel prices increasing day by day, most modes of transport are getting expensive.

It's difficult to achieve the closest transport facility and in many cases the destinations are removed from most roads where the general public transport won't be ready to reach. thanks to the little roads, to avoid which the majority use vehicles of their own, which successively results in issues with parking, traffic, etc. Conventional bielectric bikes occupy sufficient space and hence providing one at work or reception is sort of difficult. they're likely to be exposed to the weather outside and do require frequent maintenance. With all such issues in conventional bielectric bikes, the subsequent possible solution is the usage of foldable bielectric bikes. With foldable bielectric bikes, there's no issue since the bielectric bikes are often folded and carried around to the workplace or perhaps it may be wont to reach the closest conveyance facility and so folded and carried along. Since the bielectric bike is being folded, it occupies very less space and doesn't require any special automobile parking space. they're not exposed to the weather since they will be carried inside buildings with ease and hence vulnerable to less maintenance. The usage of foldable bielectric bikes helps combine the various modes of transport as mentioned above, which helps in reducing some cost involved in travelling. Foldable bielectric bikes are available within the market, but are expensive since they're being imported. There are only a few recognized foldable bielectric bike manufacturers in India. Hence we seized the chance to produce a coffee cost, locally manufactured foldable bielectric bike. The study on the aspects of materials, properties and style of folding bielectric bike frames was performed. The fatigue problem is usually considered because of the main problem regarding the properties of the materials. The coated swing hinge in folding bielectric bikes is taken into account as an improved joint technique within the design and carries benefits to the user to fold the bielectric bike since it overcomes the limited lifeelectric bike and moreover is easy and price effective. Hence we are focused on "Design and fabrication of dual chargeable bielectric bikes" Topic. We got the concept of the Self Chargeable Concept. When the battery is fully charged a speed of 10-15km/hr is obtained. When downhill the charging is achieved in 1hr. Here the motor performs as a Generator. By the appliance of brakes a relay is operated. Hence this induced within the motor recharges the battery with the assistance of a boost converter. thanks to friction driven mechanism wheel wear at a faster rate. Fans are the foremost used items in India despite the widespread availability of Cooler's and air conditioners. Since the initial opportunity cost of solar systems remains quite high, when it involves generating power for a domestic use and energy saving and energy generating may be a major issue for mankind. This paper presents a way of generating power by a ceiling fan. The generated power may be either used or is stored in an exceedingly large battery for powering other devices. By this we use Dynamo to convert K.E. of it's chain wheel by meshing Gear teeth with small gears. By this we generate power.

Differentiation of electric vehicle :

1) *Hybrid Electric Vehicles:* Electric vehicles that employ both electric and gas power. The onboard battery helps gas to be used more efficiently, while gas recharges the battery.
2) *Battery Electric Vehicles (BEVs):* Electric vehicles that are solely electricity-powered and have no backup fuel source.
3) *Extended-Range Electric Vehicles (EREVs):* A vehicle that is powered by battery for a certain number of miles. Gasoline then powers an electric generator for the next several hundred miles of extended-range driving.
4) *Plug-In Hybrids (PHEVs):* A subset of hybrids that allows batteries to be recharged by plugging into an external electricity source. PEVs can operate on a combination of electricity and gasoline, depending on the vehicle's configuration and power needs.

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III. LITERATURE SURVEY

1) Shishir S, Manjunath P, Pavanasudan R, Ravi Sathyajith (June 2015) "Design and Fabrication of Foldable Bielectric bike"

To overcome a common problem faced by the society, an idea is conceptualized to design and fabricate a foldable bielectric bike. We already have seen many foldable bielectric bikes in the global market but the main idea of this project is to provide a foldable bielectric bike which is light & sleek yet rigid & safe, easy to handle and easy to maintain. Unlike the conventional electric bikes, this bielectric bike will occupy very less space and also is very easy to carry around. The main objective is to design and develop a foldable bielectric bike which is comfortable to ride and economical.

2) Shlok Desai, Kavan Mehta, ZinalKheni, Naitik Bhatt, Rahul Patel (May 2019) "Design, Analysis and Fabrication of Foldable Electric Bike"

The purpose of the research is to find an alternative to improvise human comfort, solve global problems and promote sustainable development.

An Electric Bike is a battery-operated vehicle which is economical with low maintenance cost. Using a PMDC motor instead of an IC engine will reduce harmful emissions and reduce weight for easy commuting. This research is based on designing a Foldable electric bike, material optimization using various design & simulation software and fabrication of the electric bike by using aluminium 7075 grade material.

3) Morteza Hanifezade and Arian Ashrafi (April 2014) "Folding and Self-Propelling Bielectric bike".

Recently there are studies on air pollution of big cities and results proved that air pollution is increased in general. This problem is the base of our research and so we should try to decrease this. Regarding to the point that some people for solving this problem use bielectric bikes as a transportation.

4) AnopMundel, Ashwani Gupta, Devansh Dixit, Ganesh Patel, Mayank Aggarwal, Ajay Kumar Dhanopia (2017) "An Introduction to the Design of Foldable E-Bike for Clean& Safe Travelling in Smart Cities".

A foldable electric bike may be a possible solution to these problems. While serving to the needs for ease and speed, it maintains safety. This bike has an upper limit for the power and speed which ensures safety of the rider. This bike can be folded to an extent (25in * 20in * 15in) that it can be stored in a backpack after use.

This foldability makes it compatible for use with public transit, users can use it to travel to the station and then fold & store it in the backpack while travelling from the public vehicle. The weight of the bike is kept such that it may easily be carried on shoulders without the feeling of uneasiness.

5) Arunabh Choudhury, Swapna neel Sarma (2018) "Design and Fabrication of a self charging Bielectric bike".

In this paper, the designing and fabrication of a self- charging bielectric bike is described. The pollution due to automobiles is increasing with every passing day and the use of electric vehicles for short distance travelling will help to reduce the pollution to some extent. These electric vehicles need to be recharged at a power point which is again very time consuming. An attempt is made to eliminate or reduce dependency on recharging from main supply by introducing a Self Recharging Mechanism. The model consists of five separate parts, namely: the Battery, the Dynamo, the DC motor, controller and charging system. The BLDC motor uses electric energy from the battery to provide torque to wheels and the battery receives electric energy from the Dynamo.

6) Prof S.B. Thakre,Akshay S. Dhabekar, Ankush N. Peshne, Akash P. Satpute (2017) "Design and Fabrication of Self charging Bielectric bike".

In the new era the e- bielectric bike has more importance than other fuel vehicles like motorelectric bikes, cars etc. basically for short distance travel the bielectric bike is more useful and e- bielectric bike is effortless. It is also an eco-friendly technology bielectric bike was the most dependent mode of transportation. A self-charging battery electrical bielectric bike which utilizes the mechanical energy to electrical energy of wheels to charge the battery. A system which makes vehicle pollution free. We are using components like hub motor, dynamo, controller, battery, etc. It is pollution free and no fuel consuming type of vehicle and it is good for greenhouse effect. The rider can choose that the bielectric bike can be driven completely with the hub motor or to be driven manually by him with a pedaling.

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A. The German Naturalistic Cycling Study – Comparing cycling speed of riders of different e- bikes and conventional bicycles.

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 the execution 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 peddles 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.

B. Urban Electric Bike

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. See fig.



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.



Figure 4 Hub Motor



Figure 5 Twist Throttle

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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.

C. Campus Mobility For The Future: The Electric Bicycle

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.

D. Design And Fabrication Of Dual Chargeable Bicycle

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.

Another important part is discussed is regarding batteries Electric bicycles industrialized in Switzerland in the late 1980s for the Tour de Sol solar vehicle race accompanied sunlight based charging stations yet these were later settled on rooftops and associated in order to nourish into the electric mains. The bikes were then charged from the mains, as is normal at this point. Battery frameworks being used incorporate lead-corrosive, NiCd, NiMH and Li-ion batteries. Range is a key thought with electric bicycles, and is influenced by elements, for example, engine productivity, battery limit, effectiveness of the driving gadgets, optimal design, slopes and weight of the bicycle and rider. The scope of an electric bicycle is typically expressed as somewhere close to 7 km (tough on electric power only) to 70 km (minimum assistance) and is profoundly subject to regardless of whether the bicycle is tried on level streets or slopes. The vitality expenses of working electric bikes are little, however there can be noteworthy battery substitution costs. In lots of available preferences authors selected 2 lead acid batteries of 12 volt 5 amp because of its easy availability and low cost and connected in series to get an output of 24 volt. Overall experimented results of this paper are: Speed of 10-15 km/hr is achieved when battery is fully charged. When coming down the hill the charging can be achieved in 1hr. Driven mechanism wheel wear rapidly due to friction.

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

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. They connected the solar panel is in the series and it created the additional voltage, which is used to charge battery 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.

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F. Design Of Electric Bike With Higher Efficiency

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.

G. Design And Development Of Solar Assisted Bicycle

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. It can be worked all during year that time for nothing out of pocket. The supreme noteworthy highlight of this bike is that it doesn't ingest valuable petroleum derivatives along these lines sparing crores of outside economic forms. It can be said to be environmental-friendly and less contaminated, as it doesn't have any emanations. Furthermore it is silent and can be energized with the AC connector if there should be an occurrence of crisis and overcast climate. In this paper, the working expense per kilometer is depicted as negligible around Rs.0.70/km. It can be fueled by manual accelerating if there should be an occurrence of any tricky circumstance with the close planetary system. It has littler sum parts, can be effectively mounted or gotten off, consequently requires less support.

H. Design, Fabrication And Performance Analysis Of Solar Power Bicycle

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..

IV. METHODOLOGY

A. Methodology Of Working Process

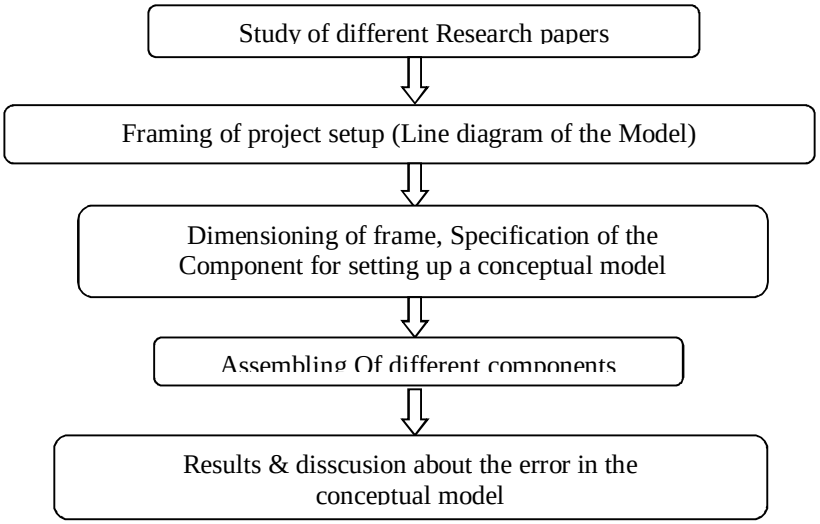


Fig. 5 Flow Chart For Working Process

B. Formulation Of Methodology

The plan is to create a foldable part within the middle part of the electric bike, to line a robust lock within the folding part of the electric bike. subsequently we analyzed the capacity of the electric bike, that is, what quantity weight it can tolerate. The lock on the foldable part of the electric bike is formed of soft-cast steel. The forethought is to figure the electric bike with a 12 Volt 30 Ampere motor which is 250 watt. The electric bike may be charged in two ways either by pedaling or regenerative braking, additionally with the charging port.

The regenerative braking will be made possible by fixing a relay at the position of the brake. Once we apply the break, a relay is operated, then the circuit to the boost converter is completed. Through this the charging is made possible. The accelerator is employed by a trigger, which is connected to the controller and this controller is connected to the motor. The controller consists of a 555 IC circuit. The acceleration is completed by the heart beat width modulation method. The electric bike is meant to hold a weight up to 80kg, whether it's man or object.

V. SYSTEM CAD DESIGN

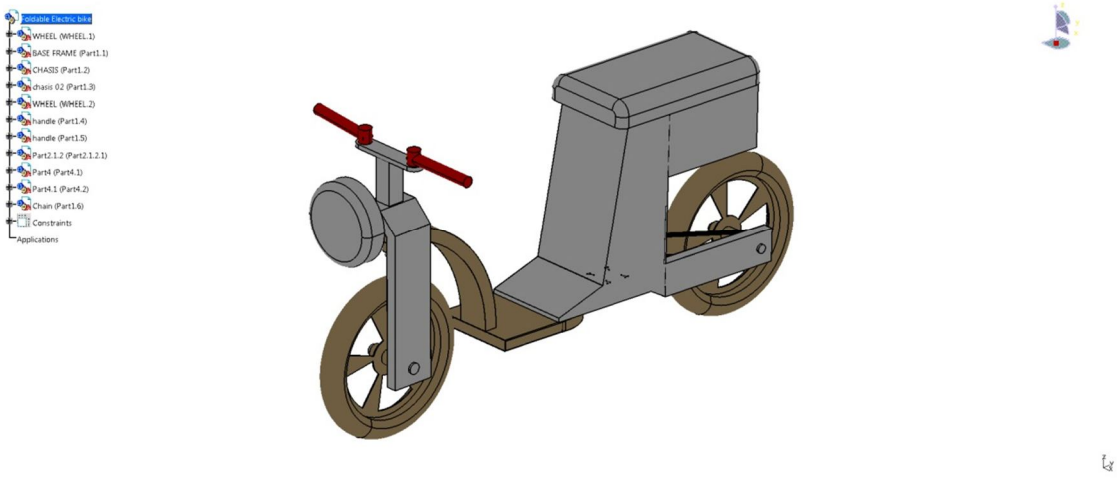


Fig. Designed using CATIA V5R20

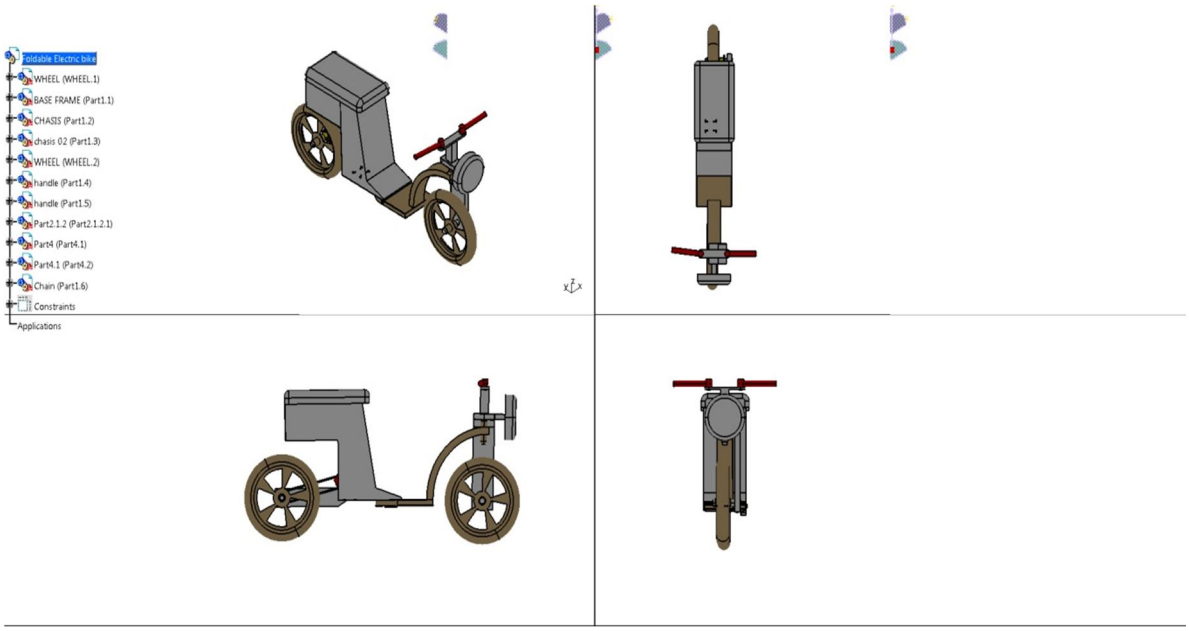


Fig . all views of cad design F.V, S.V, T.P, Iso- metric View

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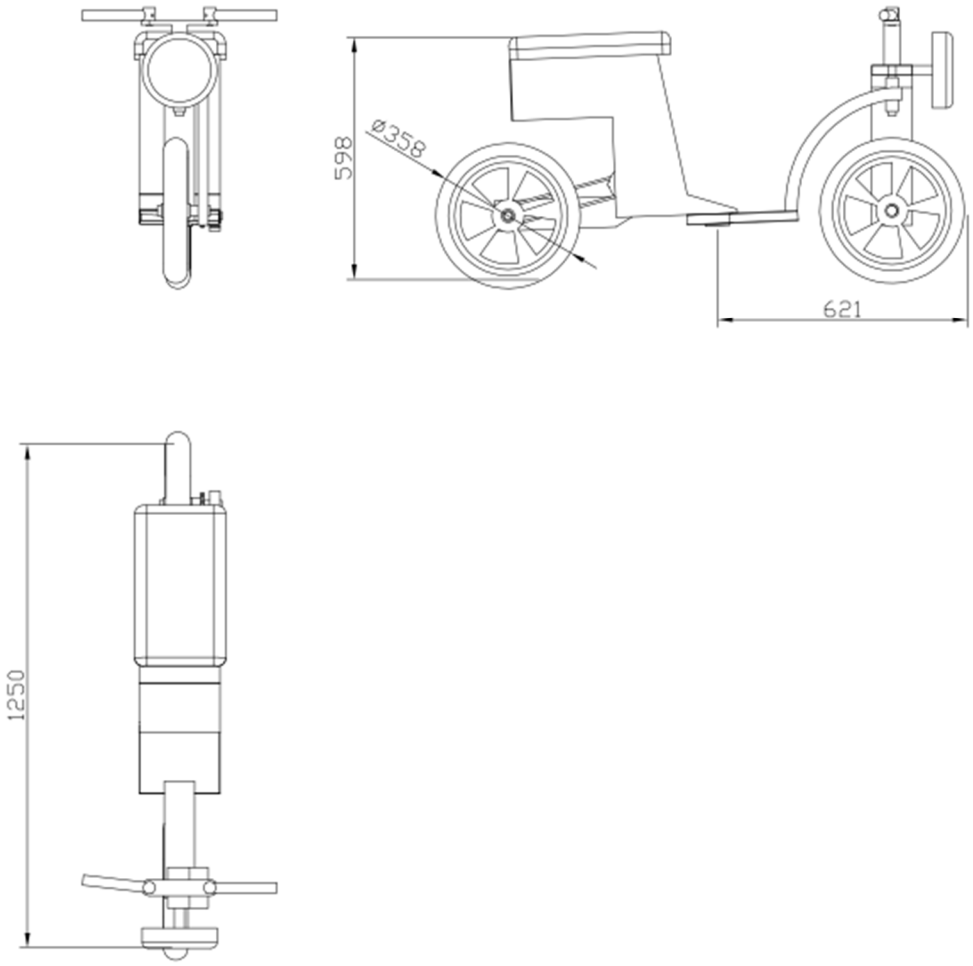
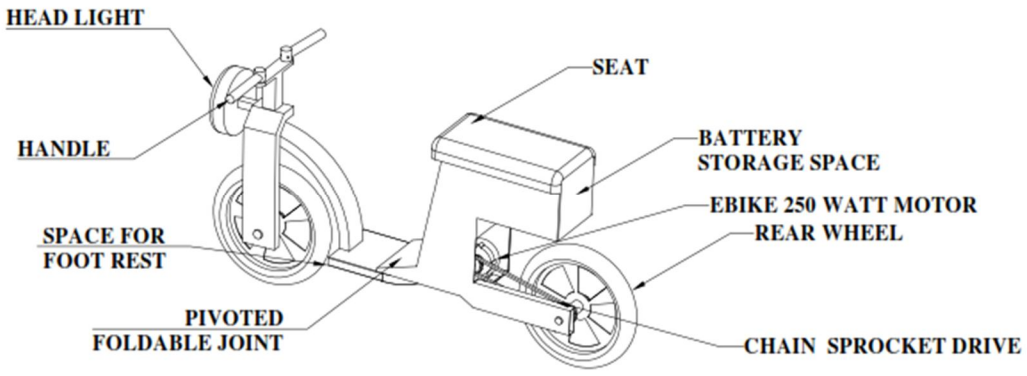


Fig. Drafting view of Foldable Electric bike

VI. WORKING PRINCIPLE

An electric car is powered by an electric motor instead of a petrol engine. The electric motor gets energy from a controller, which regulates the amount of power—based on the driver's use of an accelerator pedal. The electric car (also known as electric vehicle or EV) uses energy stored in its rechargeable batteries, which are recharged by common household electricity.



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Thus an electric vehicle will have three basic components :

1) Energy Storage Unit
2) Controller
3) Propulsion system

The energy storage unit will have a way to store power. A chemical battery is the most common energy storage technology currently, although it can be different - for example - A fuel cell (which gets its electricity from hydrogen rather than a battery pack), can be used instead of a chemical battery as the energy storage unit. The controller acts as a pipeline or gateway to the electric motor.. The controller will do other things too - it moderates the power, will also act as a converter - converts power from DC to AC, or it might also increase or decrease the amperage etc. The controller is the brains of the system. The electric motor, which is the propulsion system, converts the electric power and converts this into physical energy for movement. The whole system is a much simpler, more efficient device than the combustion engine found in most cars, enabling you to get the most mileage for your charge.

Block Diagram

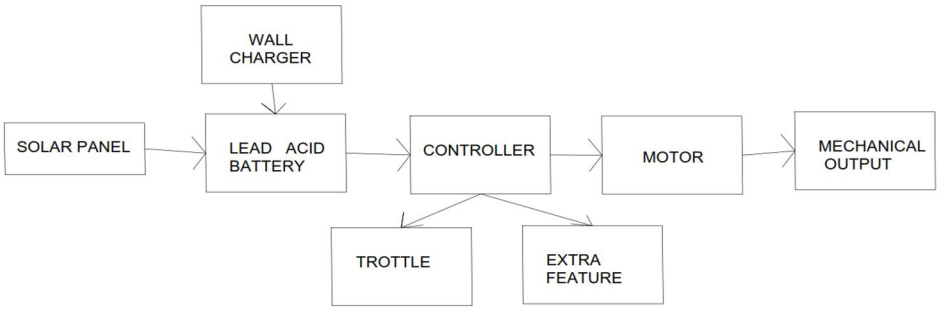


Figure 6 Block Diagram of E-bike design requirement

A. Merits of Foldable Electric bike

1) Easy to transport
2) Easy storage
3) Security
4) Environmental benefits
5) Eco friendly

B. Demerits of Foldable Electric bike

1) High initial cost compared to normal bike
2) Maintenance cost is high
3) More weight compared to normal bike

Bill Of Material

Sr. No	Component Name	Qty	Cost
1	250 watt DC Power 24 Volt 12 Amp Motor	1	5000*
2	Controller 250 watt	1	1850*
3	Hand Throttle	1	1250*
4	Battery Lead Acid 12 volt 12 Amp	2	3500*
5	Metal Bike chasis	1	15500*
6	Front wheel	1	3200*
7	Rear wheel tyre	1	1650*
8	Front Shock Absorber	1	1250*
9	Rear single Shock absorber	1	1850*
10	Electronic Kit	1	2500*
	Total Cost		37550*

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C. Future Prospects

1) It will be used in big industries to reduce worker's transportation time
2) It will be used at airports, railways for easy commuting.
3) It will reduce traffic and parking problems in this fast growing population.
4) It will promote use of electric vehicles.

Sr No.	Objectives	Sept	Oct	Nov	Dec	Jan	Feb	Mar
1.	To Prepare Extensive Literature survey	✓	✓	✓				
2.	To Prepare Flowchart of given system		✓	✓				
3.	Estimating cost of project			✓				
4.	Drafting design			✓	✓			
5.	To analyze design of components					✓	✓	
7.	To analyze the propose system systematically to identify characteristic						✓	
8.	CFD/CAE analysis							✓

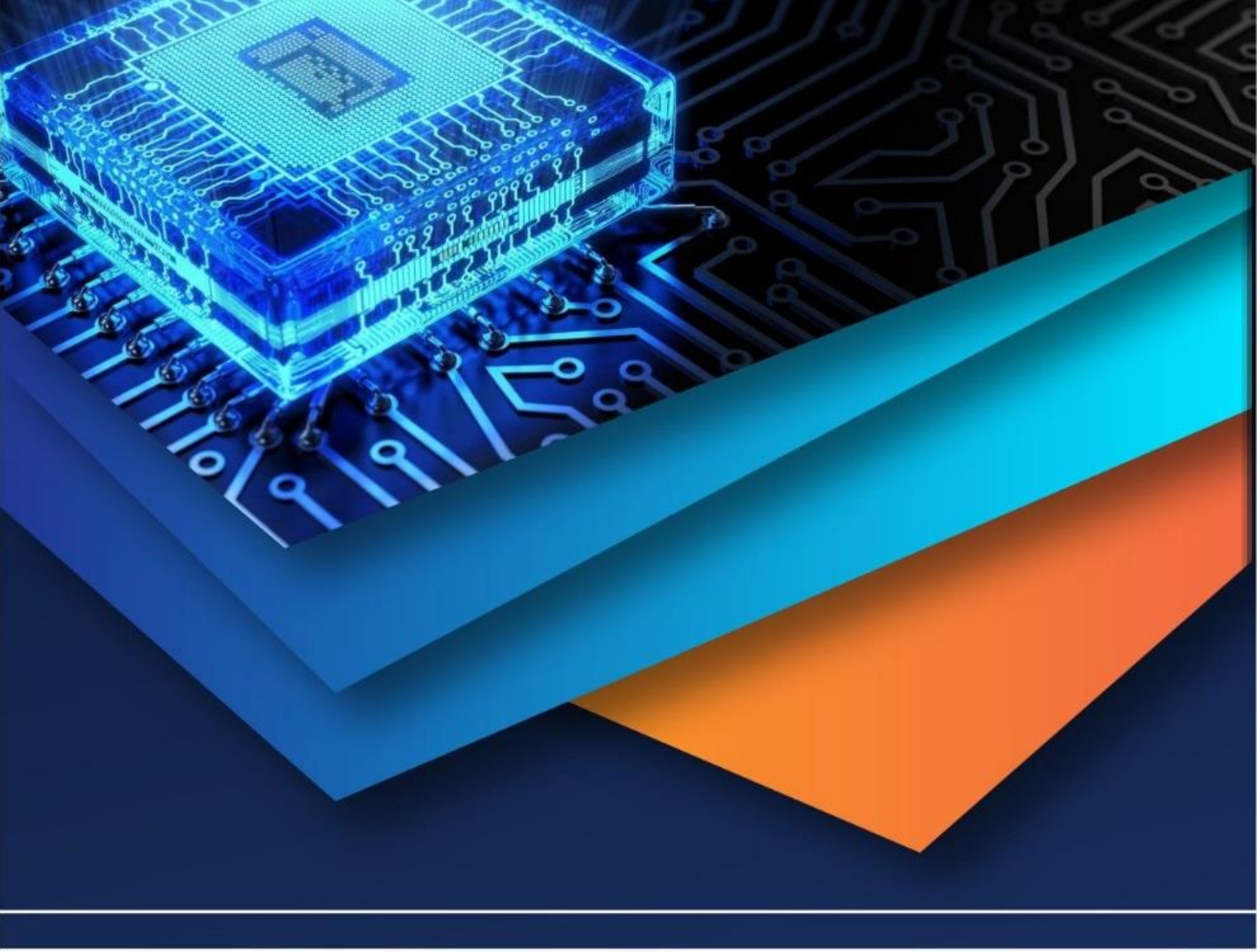
VII. EXPECTED OUTCOME & CONCLUSION

1) The better design and cost-efficient E-bike will be designed by the team.
2) The bike will have range of about 35 km and it can be charged up to full capacity in 40 min.
3) The top speed of bike will be around 32 km/hr**.**

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