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DESIGN AND DEVELOPMENT OF HYBRID ELECTRIC SKATE SCOOTER

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Abstract: As most of the electric moped scooter bikes and scooters comes with high specifications and offers a high price tag there is no such proper electric vehicle in a price segment of a bicycle that is under twenty thousand. Hence our team is looking forward towards this opportunity in developing a pocket friendly electric skate scooter in order to fill this vacant space in the market. This project is an alternate solution to the increasing use of non-renewable energy resources which are leading to various problems such Traffic problems, Parking space problems, emissions of gases due to the burning fuels, noise pollutions which occurs in cities during peak rush hours. People tend to use their private vehicles even for the smallest commutes of 10-12km around cities contributing to the traffic problems. Thereby we are introducing E-SKATE board as an alternate solution in order to tackle these problems. this paper is a complete interpretation about this rechargeable electric skate board. The focus of this paper is to minimize modern day traffic problems and introduction of e-skate board as an alternate solution of travel for distances cutting done the use vehicles which run on fuels.

Index Terms – Electric moped, Hybrid Skate scooter.

I. INTRODUCTION

The hybrid electric skate scooter is a cross over between electric skate scooter and moped scooter which shares a long foot board structure including seat, pedals and handle bar to provide stability, comfortable riding conditions and hybrid ability in riding conditions

While entering in today's technology, there is a major role of EV's in today's vehicle industry.in order to control the pollution and to reduce the adverse effect of fuel vehicles on the environment, people and automotive industries are shifting towards green vehicle and transportation root that is the EV route. Our team is working on project to provide a daily commute electric skate scooter in a very pocket friendly budget so that many individuals can invest and have a fun ride with the EV. Looking toward the Indian market, there is a great advantage in low to mid-range price segment for the vehicle. People here mostly prefer a low budget vehicle rather than an expensive vehicle. As most of the electric moped scooter bikes and scooters comes with high specifications and offers a high price tag there is no such proper electric vehicle in a price segment of a bicycle that is under twenty thousand. Hence our team is looking forward towards this opportunity in developing a pocket friendly electric skate scooter in order to fill this vacant space in the market.

The hybrid electric skate scooter is becoming relatively new type of personal transport device that combines convenience of a hybrid moped skate board with the efficient and versatility of an electric motor. This innovative hybrid device is ideal for commuters, students, campus tours and anyone looking for fun and eco-friendly way to get around town.

One of the key benefits of the hybrid moped skate scooter design is its versatility over traditional skate board or electric skate scooter. The hybrid model is capable in handling wide a range of terrains and environments. The large and wider wheels provide excellent traction and stability on rough surfaces and the electric motor helps in providing required torque in easily climbing some updates and maintaining a constant uniform speed in regular condition whereas the hybrid-ability of pedals provides additional torque required in the transmission to support a motor power while heavy climbing.

Another advantage of a hybrid electric skate scooter is its eco-friendliness with zero emissions and minimal environmental impact. This unique design provides and innovative option for the consumer who requires a budget friendly electric vehicles for short and daily commute.as this product will lie between the prize range of 18 to 22 thousand Rupees pocket friendly budget which is comparable with regular cycle opening a new cost segment in this vast emerging Electric vehicle Market.

II. LITERATURE SURVEY

Sr.No	Author	Year	Findings
01	N Sriram, D Praveen Chandar	March 2017	Design Factors to develop electric skate for rough terrain.
02	Amand Avictors	December 2020	Notes parameters for skate scooters
03	Not Mentioned	August 2021	First Indian college start-up in making low end EV's
04	T. Jagadishwar Reddy	January 2022	Created a guide of components to make electric cycle
05	Prof. Bhausaheb N. Rajole	May 2022	Created a small demo and general construction for E-skate.

III. PROBLEM DEFINITION

In the EV industry ever vehicle in two-wheeler segment we see is a high-cost electric vehicle with a limited battery life which restricts the journey and the high cost makes it unsuitable for various customers to buy an EV. In the current market there is no such option which provides a full-fledged EV in a price segment under 20000 Rupees. To take advantage of this situation and looking forwards the opportunity in this price segment our team is working on creating such an EV which have characteristics of a cycle and a skate scooter in the electric form. Which is drivable for any age group consumer right from the teenage to higher adult age and which is also capable of attaching various attachments and accessories according to the user requirements.

To overcome the present problem, solution is to develop the scooter by providing it a peddling option so that is the battery restricts itself the driver wont. He could continue the journey by peddling it, hence making it a hybrid.

IV. METHODOLOGY

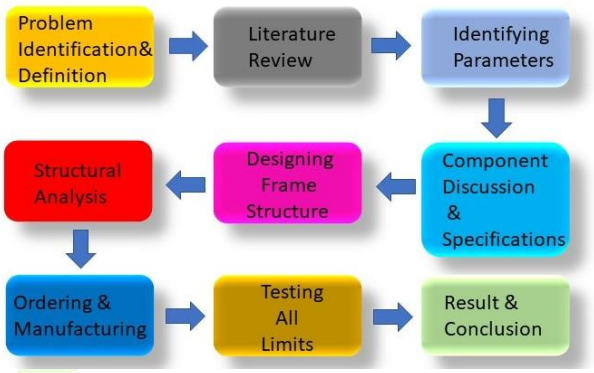

Fig 4.1 Flowchart of process

4.1 Design requirements

- While designing the scooter a major preference is given towards selection of the components in order to achieve the required power and output from the product we construct. Major components that involve in the product are Motor, controller and Battery. In order to gain the required outcome, we have selected the motor with specified configuration of 24V, 250W geared dc motor which delivers sufficient amount of 8Nm of torque at 300 rpm which is capable to deliver a speed of 20-25 Km/hr which is a safe speed for an electric skate scooter.
- For the power supply to the motor, we have selected two pair of 12V lead acid battery which gives an output of 24V and 10Ah that can run the scooter providing the range of 10-12 Km at a single charge which is sufficient for campus drives and short distance drives. to control all the activities i.e., the acceleration and other factors like battery charging, current supply, circuit breakup while braking to prevent motor coil damage etc we have selected a 24V.

4.2 Motor selection

Considering Various parameters in calculations like rolling resistance(Fr)=5.886N, Aerodynamic drag(Fw)=10.869N, Rolling friction(Fg)=0N, Acceleration Resistance(Fa)=0N and Total force acting on vehicle(F_{total})=Fr+Fw+Fg+Fa=16.755Nm.

This gives the total power demand P_{Demend}=92.99W for the range of 20km at speed of 20Km/hr.

Calculating the required RMP for tyre so size 90/90-10 we get the required rpm to be 285.36rev/min.

Hence selected 24 V and 250 W standard DC motor is selected having 8 Nm torque and 300 rpm

Fig.4.2 24 V and 250 W standard DC motor

4.3 Other Components

1. Battery

A two pair of 12V 8 Ah battery pack is used which provides estimated range of 10-12kms.
(Here lead acid battery is used since for single unit construction required quantity of lithium-ion battery costs much high. Also, all the parameters such as IR rating, charge, discharge of every cell and grading should be checked properly for maximum output from the battery which causes high budget.)

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Fig.4.3 12V 8 Ah battery pack

2. Handle Bar (Cruiser Bar)

Cruiser bars are essentially curve bars that rise from the centre clamp area. This type of bicycle handlebar are pretty common on fixed gear and mountain bikes. cruiser bars are also typically wider than flat bars. This is because such type of handlebars is commonly used in trail biking since it allows the rider to stay more upright.

Fig.4.4 Handle Bar (Ref.5 Cruiser Bar)

3. 16-inch wheels

Apart from this bike 16” bikes wheels are most spotted on BMX bikes and folding bikes for the normal rider looking to use a folding bikes as primary travelling road bikes 20” bike wheel Can be an inconvenience for a few reasons. The extra-long handlebar stem of a small wheel bikes leads to handling problems from small turns radius. However, this size is ideal for BMX bikes looking for an extra sensitive steering column that supports arial trick and bore.

Fig.4.5 16-inch wheels

4.4 Design and Model

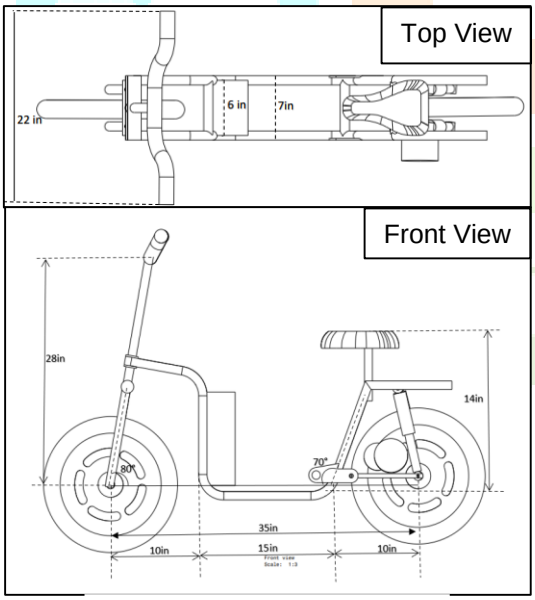

Fig4.6 Dimensions and

Fig4.7 Actual model

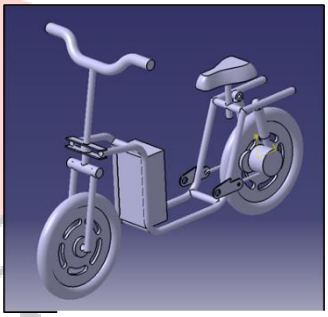

Fig4.8 Cad model

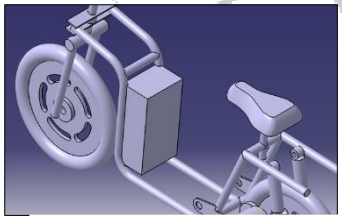

Fig4.9 Battery placement

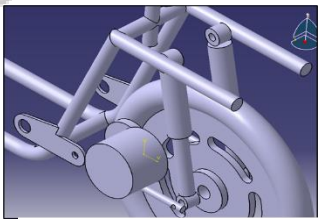

Fig4.10 Motor placement

4.3 Structural Design analysis

To do model analysis and find out mode shapes using Finite Element Analysis Software we use Ansys Workbench. By using Ansys software the analysis become fast and several repetitions of processes arrive to best possible results. Considering 80 Kgs of weight i.e., 784 N of force was applied on the frame at the saddle bar to analysis it for equivalent stress, total deformation and to check factor of safety.

From the result, the stress induce in the frame is minimum and factor of safety is greater than the limit. Ultimate strength of material is also greater than equivalent stress (Refer Fig 3.9). Thus, the frame design is safe and structure is strong.

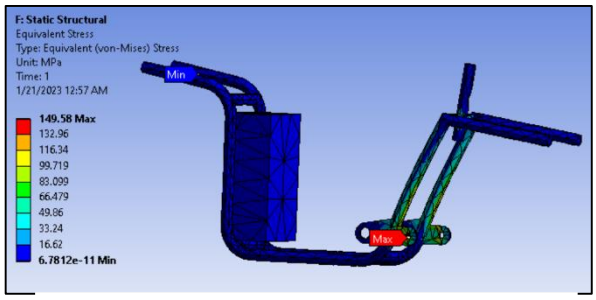

Fig4.11 Equivalent Stress on Frame

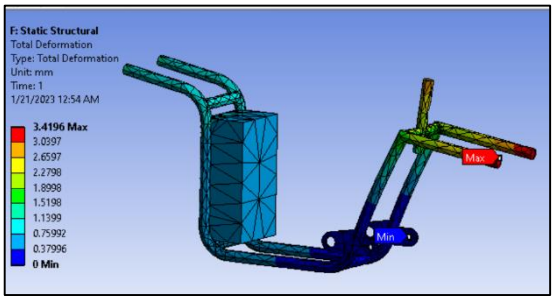

Fig4.12 Total deformation

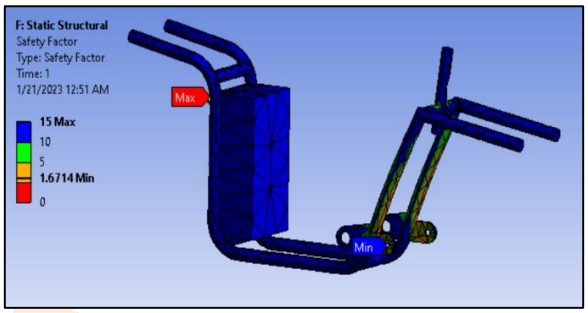

Fig4.13 Factor of safety

4.4 Cost estimation of project

Table 4.1 Cost estimation of project

Sr.No	Components	Quantity	Specifications	Price (₹)
1	Motor kit	1		5000
	a. motor		24V, 250W	
	b. controller		24V	
	c. chain		-	
	d. free-wheel and flywheel		-	
	e. mounting		-	
	f. brake lever		-	
	g. headlight and horn		-	
	h. lock		-	
2	Mechanical disc Brakes	2	-	700
3	12V 8Ah Battery	4	24V, 16Ah	3400
4	Raw material	-	-	500
5	Other building expenses	-	-	1000
6	Accessories	-	-	1000
7	Battery Charger	1	24V, 3Amp	500
				Total: ₹12100

V. RESULTS AND DISCUSSION

5.1 Results of hybrid electric skate scooter

Table5.1 Result table

Sr. No.	Specifications	Outcome
1	Peak Torque	8 Nm
2	Top Speed	15 Km/hr
3	Charging Duration	2 hours
4	Mileage	20 Km
5	Max. load carrying capacity	80 Kg

5.2 Discussion

Testing has been done applying 80 Kgs of weight on inclined surfaces as well as the sustainability of frame is tested in potholes in rough terrain. Average speed achieve is 15 Km/hr at loaded condition also there is no lag found while climbing the vehicle at incline surfaces. Thus 8 Nm torque is sufficient for this EV.

VI. CONCLUSION

Using the structure and design of this project and looking forward for its design, development, manufacturing and production of pocket friendly electric vehicles can be achieved. Providing innovative idea and reliability by its hybrid ability. Comes with attachments which is beneficial in carrying items benefits for multi purposing. Can be driven by any age groups since no registration is required. It is safe as it is a low-speed vehicle. Provides an efficient for daily short commutes, market visits and campus drives.

VII. FUTURE SCOPE

1. Use of Lithium-ion batteries for mass production that will reduce the weight and will increase range.
2. Using more simpler component in mass production in order to reduce assembly efforts and decreasing the cost.
3, Using BLDC Mid drive motor in order to increase efficiency.
4. Designing a solar sheet roof as an attachment in order to increase the range.
5. Integrating smart technology such as GPS tracking and digital monitoring system for advance user experience.

Many of the people are willing to purchase an electric vehicle but they restrict themselves due to their high costs and low reliability regarding range. Our project is a solution on both of these problems as it is designed for short commutes and for low speeds and as it is suitable for every age category people will move more towards the cleaner environment due to this new category which fills the vacant space in the EV market.

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