A PROJECT REPORT

ON

"NAME OF THE TITLE"

Submitted by

AAKIF SARDARMIRZA PANSARE

PRAJAPATI RAHUL JAIKISHAN

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In partial fulfillment for the award of the Degree

Of

BACHELOR OF ENGINEERING

IN

MECHANICAL ENGINEERING

UNDER THE GUIDANCE

Of

Prof. MOHD SIRAZUDDIN KHAN

DEPARTMENT OF MECHANICAL ENGINEERING

ANJUMAN-I-ISLAM

KALSEKAR TECHNICAL CAMPUS NEW PANVEL,

NAVI MUMBAI – 410206

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ANJUMAN-I-ISLAM

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CERTIFICATE

This is to certify that the project entitled

"E - BIKE"

Submitted by

AAKIF SARDARMIRZA PANSARE

PRAJAPATI RAHUL JAIKISHAN

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SAYYED MOHAMMED TAHIR

To the Kalsekar Technical Campus, New Panvel is a record of bonafide work carried out by him under our supervision and guidance, for partial fulfillment of the requirements for the award of the Degree of Bachelor of Engineering in Mechanical Engineering as prescribed by **University Of Mumbai**, is approved.

Internal Examiner **External Examiner**

(Prof. Mohd Sirazuddin Khan) (Prof.____)

Head of Department **Principal**

(Prof. Zakir Ansari) (Dr._____)

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APPROVAL OF DISSERTATION

This is to certify that the thesis entitled

"E - Bike"

Submitted by

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(Internal Examiner) **(External Examiner)**

_____ _____

Date: _____

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Chapter 1

Introduction

1.1 Background

An e-bike, is a bike which uses rechargeable batteries and travels up to a distance of 25 to 32 km/hr. High powered varieties can travel more than 45 km/hr. The rechargeable batteries used in the e-bike generally supplies the current to the motors which makes the bike move. The motors used in the e-bikes are of two types one can be directly fitted on the hub called as hub motor and the other is mounted on the chassis and the transmission is done via chains. Depending on the current also the motors are of two types A.C. and D.C.. Mostly D.C. motors are preferred for e-bikes as it does not requires rectifier because the current supplied by the batteries are in the form of D.C current. And A.C. Motors are used in cars mostly in Tesla.

1.2 Nomenclature of E-Bike

Chassis: A chassis is the load-bearing framework of an artificial object, which structurally supports the object in its construction and function.

Motor: Supplies motive power for a vehicle

Battery: battery Converts chemical energy into electrical energy and used as a source of power in the vehicle.

Throttle: throttle controls the supply of current to the motor thereby helps in increasing or decreasing the speed of the vehicle.

Chain wheel: a Chain Wheel is a wheel transmitting power by means of a chain fitted to its edges

Drive Chain: a drive chain is an endless chain with links that engage with toothed wheels in order to transmit power from one shaft to another in an engine

Wheel: a wheel is a circular object that revolves on an axle and is fixed below a vehicle to enable it to move easily over the ground.

1.3. Motivation

As bikes has became an important mode of transport because of its compactness it is the cheapest mode of transport. Nowadays bikes are used by teens as well as by adults. Results in increase in the numbers of bikes which ultimately increases the usage of non-conventional energy. As the non-conventional energy source is on extinct to overcome this problem use of electric vehicle would be the best solution.

1.4. AIM/OBJECTIVE/PURPOSE OF THE STUDY:

The purpose of the study is to make maximum usage of e-bike i.e. electric bike instead of the bikes which runs on petrol and hence thereby reduces the usage of non-conventional energy sources.

CHAPTER 2

LITERATURE REVIEW

The paper presents a review on Portable Electric Bike (PEB). This was first developed in 1890's in US and those were documented within various US patents. On 31st Dec, 1895 Ogden Bolton designed a battery powered cycle. He designed using 6 pole brush and commuter DC hub motor connected to the rear wheel. He was then granted a US patent. Couple of years later, Hosea W. Libbey invented electric bike which was propelled by double electric motor. This motor was so designed that it was attached with the crankset axle. Later in 1990's torque sensors and power controls were developed including some modified versions of bike with NiMH, NiCd and/or Li-ion batteries which offered lighter, density capacities batteries. But this bikes faced decrease in production when petrol and diesel resources came in existence. Taking considerations of recent events of meager resources and facilities at their disposal, over increasing traffic, snags problem of parking and the need to make automobile a more environmental friendly, designers of vehicles are back with a view to hit upon a novel concept that completely alter the conventional design. Recent developments on Electric bike which are pedal operated are tremendously increasing all over the world market. In China 9 out of 10 Electric bikes are sold, thereby proving that they are not only energy efficient but also relative cheaper than other electric automobiles. It enables to ride in hilly areas and also in windy areas with much less human effort. The below table shows and gives the review of the world who have implemented this electric bike system successfully and have been benefited. The table consists of the following; the type of bike, speed limit(km/ hr), watt, weight limit (kg), Age requirements. Thus this report focuses on the review of prevalent literature on the current environmental impact of vehicles, then shifting its way towards electric bike use and designing the required calculations based on standard assumptions.

Chapter 3

Methodology

3.1. Design Consideration

The Chassis is basically designed considering the aerodynamic condition which helps the easy movement of the bike. And thereby reducing the friction caused by the air.

3.2. Material Selection

Depending upon the various condition we have used G.I. (Galvanized iron) Material, as the material is rustless and its weight is low as compared to other materials.

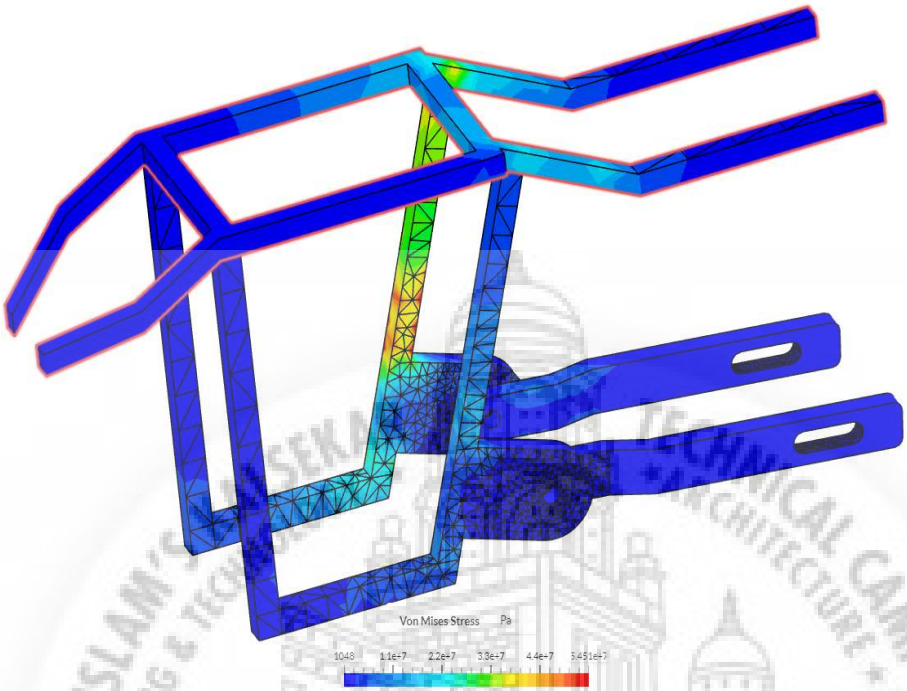
3.3.3-D Modeling and Analysis done on Bike Parts

3.3.1 Analysis done on chassis

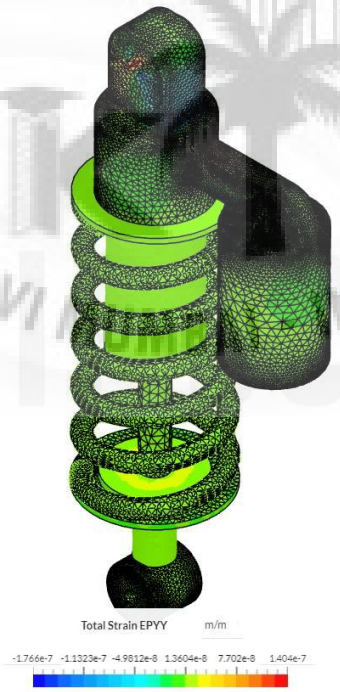
To confirm the strength of the designed motorcycle frame, the stress analysis using Ansys was performed. In prior to the analysis of the designed frame, a simple calculation was conducted, using a cantilever model of 100 mm x 100 mm cross-section and 1,000 mm length with the force of 50 N at the tip. The calculation by hand is 0.3 MPa and the result by FEM is 0.29 MPa. This result is considered to be enough to perform the FEM stress analysis for the motorcycle model.

The conditions for the analysis are as follows, (1) Weight: Person of 80kg, Battery of 6.48 kg/one, Motor of 12 kg (2) Fixed portions: 2 portions of the front frame steering head and the rear front swing-arm attachment. (3) Material of GI: Tensile strength of 400 MPa, yield strength of 230 MPa, and fatigue strength of 180 Mpa. The maximum stress origination is 166.7 MPa at the main frame.

The safety factors are 2.4 for tensile strength, 1.4 for yield strength, and 3.6 for fatigue strength. The safety factor for yield strength may not be enough. However, by conducting the experiments, the modification will be considered.

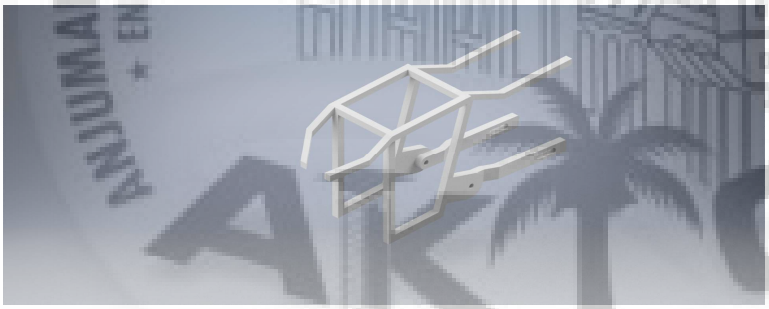


3.3.2 Analysis done on Shock Observer



3.3.3 3 D Model of Chassis

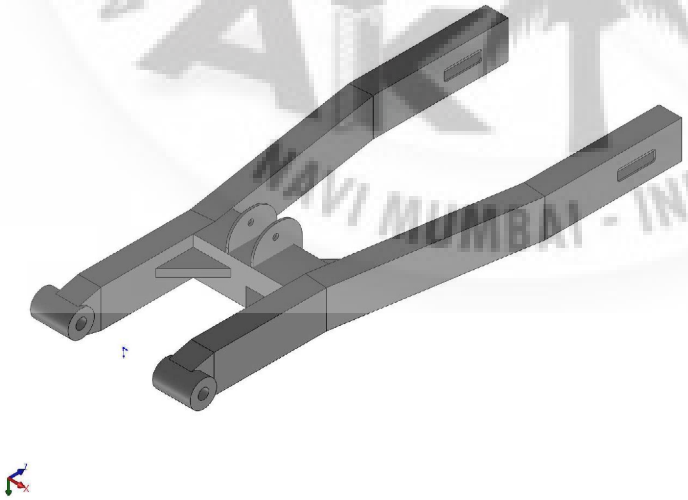
- The frame is a double-deck one to maintain the enough space to install four batteries inside. This frame configuration aims to obtain the enough strength. So, the size is determined to be 1,200mm in length, 250mm in width, and 700 mm in height.
- For the frame configuration, the design was conducted by using Solidworks. The design of light-weight and easy maintenance is the target. The material used is rectangular pipes, because they are stronger than round pipes when the motorcycle subjects to bending due to cornering.
- In this project, the rectangular pipes of 40 x 20 mm and 25 x 12 mm and the square pipes of 19 x 19 mm and 25 x 25 mm are used. The material is GI.
- Figure shows the main frame designed, in which the strength for bending and the space for the motor and batteries were taken into consideration. The other figure shows the rear frame, which needs the strength against stresses at the swing-arm attachment portion.



Actual Model of Chassis

3.3.4 3 D Model of Shock Observer

3.3.5 3 D Model of Swing Arm



3.3.6 3 D model of tyre

3.4 Motor (BLDC 48V 750W)

In choosing an motor for electric bicycle, which is Brushless DC motor (BLDC), there is few method will be used, the method is torque calculation, Losses, efficiency.

Torque Calculation: Before using any motor for Electric Bicycle, torque calculation is necessary to be considering, this is because each motor have its own torque limit for the motor to hold certain load. If a motor were used without calculating its torque or how much torque can the motor provide amount of torque to the electric bicycle.

Peak Torque ($\boldsymbol{Tp}$) Requirement:-

The peak torque or also called maximum torque is required for the application, it can be calculated by summing the load torque (TL), torque due to inertia (TJ) and the torque need to overcome the friction (TF).

◊ TP = (TL + TJ + TF)*1.2 [N/m]

The torque due to inertia(TJ) is the torque that required accelerating the load from rest or from lower speed to higher speed. This can be calculated by using the product of load inertia, with the rotor inertia and load acceleration.

◊ TJ = JL + M * α [N/m]

Where: JL + M is the sum of the load and rotor inertia α Is the required acceleration.

Efficiency:

Efficiency is defined as the ratio of output power and input power.

Ƞ = $POut/PIn$

Where PIn = mVI and $POut$ = $Tload\ \omega r$.

In term of power flow,

$PIn = Pcu + PFe + Pmec + Pout$ [watt]

Where $Pcu = mRI\ 2$ is the copper loss due to winding resistance.PFe the iron loss due to hysteresis and eddy current and $Pmec$ the mechanical loss due to windage and friction.

Torque-Speed Characteristic:

The torque-speed characteristic of the motors referred to as permanent magnet, it is either brushless or brushed, and it either ac or dc shunt motor. The current that flow in the motor armature, and the magnetic flux that the armature is exposed to, is the cause for torque and motion. From this method, it can know that the behavior of torque is also depends on the current and voltage also.

3.5 Battery (Lithium Ion Battery)

BATTERY In this project we are using LITHIUM ION BATTERIES. There are 1 LI batteries of 48V 24mAh. Lithium Ion batteries, invented in 1991 by Sony and Asahi Kasei, are the oldest type of rechargeable battery.

Despite having a very low energy-to-weight ratio and a low energy-to-volume ratio, their ability to supply high surge currents means that the cells maintain a relatively large power-to-weight ratio. These features, along with their low cost, make them attractive for use in motor vehicles to provide the high current required by automobile starter motors.

DC ELECTRIC MOTOR: An electric motor converts electrical energy into mechanical energy. A 750W brushless type DC motor is used in electric bicycle. A brushless DC motor is an internally commutated electric motor designed to be run from a direct current power source.

PRINCIPLE OF OPERATION: The construction of a simple BLDC motor is shown in Figure. All BLDC motors are made of the same basic components: a stator, rotor and a commutator. Stator: The stator generates a stationary magnetic field that surrounds the rotor.

3.6. 48 V 750 W Controller

3.7 Total Costing

The total cost was considered to be around Rs. 25-30,000, including all the maximum possible parts required for a fully functional E-bike.

The costing of the main functioning parts such as the battery was Rs.7000, also the electric motor was around Rs.10,000. The circuit costs is included in the motor.

The self made chassis as well as bike tyres and front shock absorbers with handle bar pricing was around Rs.5000-6000.

A speed controller as well as a V brake and throttle with a battery charger was included in the total costing process.

Any other parts or materials were chosen specifically for the bikes better performance and durability.

Results

Commuting with low fatigue at a top speed of 35-40 kmph. Extends the riding range – 60kms on a single charge. Lesser maintenance cost. Detachable battery can be taken inside the house for charging. Throttle - simple to operate and less strain on hands.

The fan produce electricity and hence the battery is charged. No noise - no vibration - no smog - no smog checks. No Registration - no insurance – no driver's license No gasoline - no oil - no tune-ups.

Our group was able to perform a positive outcome on the project with cost efficient and durable materials and parts. We were able to perform various activities, research as well as engineering values and also team work.

The project provided a hope for future development and prevention of pollution of the country.

E-bike was successfully enhanced in paper work as well as 3D modelling with many useful features.

Future Scope

One approach to reduce the greenhouse gas emissions in the transport sector is to change transportation modes to become more electric. With the development of infrastructure, technology and power source there are chances of a shift towards EVs.

There is a wide scope for EVs in two wheeler market, auto rickshaws, goods vehicle, bus as well as four wheelers. All of this market is awaiting for the change.

E-bikes are of a great use for day to day life leaving zero traces of pollution. As increasing growth in pollution and also to protect our environment E-vehicles are the better options over any other vehicles.

Many countries have also made assumptions as well as laws towards the increase in the production and compulsion of electric vehicles around 2030.

Hence the future is ELECTRIC.

Conclusion

During the semester the electric bike project has provided an opportunity to grasp the full scope of what it means to Design an automotive product. This opportunity allowed an initial idea/goal to be realized in a team environment. The idea developed as research and various other information on the topic was obtained.

The initial design, of the electric bike, carried along with it constraints that had to be worked around. The constraints were mainly financial in nature. They represent pieces of equipment in the design that had to be carried over from other semesters. The constraints on the equipment consisted of the battery, motor, and the bike frame. The motor bike relationship could not be altered, mainly due to the type of mounting on the motor.

The goals were divided among the team members. In order to meet the deadline for the final project, progress was monitored weekly and individual goals were readjusted as needed. With communication between the team, and hard work, the final objective was obtained. The design project provided the team with valuable experience in design and teamwork. It allowed the team members to develop skills that will be useful in future endeavors.

The design and fabrication completed on this project will be done taking into consideration all the situations. Our aim is to manufacture a required component, support, Bearing cap, pulley, selection of sprocket wheel, for the making of Electric bicycle.

We will collect standard parts required for our project. We will make the assembly of the Electric bicycle with minimum space as the new machine takes.

Our group has taken continuous effort to the project work as to be 100% succession.

Reference

- MPU-6000 and MPU-6050 Product Specification
- MMA7455 DataSheet. ADXL 335 Datasheet. MMA8452 Datasheet.
- GY 85 Datasheet. MFRC522 Datasheet.
- PN532 Datasheet. EM 18 Datasheet.
- M274 Datasheet. SS49E Datasheet. ACS712 Datasheet.
- SIM28 Datasheet. GY-NEO6MV2 Datasheet.
- Quectel L70 Datasheet. GT-511C1R Datasheet. HC-08 Datasheet.
- Prices of all sensors obtained from eBay, Amazon, or other online sellers.
- Arm CortexM0 Datasheet. Lecture slides by Prof. S. P. Dixit, COEP.
- Lecture notes on Testing of Embedded System, IIT Kharagpur, NPTEL.