Chassis Modification of An Electric Vehicle

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Abstract: Due to the increase in the cost of fuels and pollution there has been a need for an alternative (electric vehicles) to conventional Internal Combustion engine powered vehicles. As electric vehicles are environment friendly, they are considered as Green Transportation. In an electric vehicle various component like motor, battery, controllers are used. While designing a electric vehicle the first and foremost component to be selected is an electric motor.

In this paper, vehicle dynamics is considered for selecting the proper electric motor that would provide required power, torque for the traction purpose. Apart from this, proper selection of rating required also contributes in using an electric motor of appropriate size, because the size of the motor depends on the rating. As there are not a lot of accessible modes of transportation for the physically challenged in the existing market, this project is an initiative to design an eco-friendly and suitable alternative. 0.7% of Indian population suffers from movement disabilities, this factor was among the prime deciding factor in selecting such a project. By modifying a tested 2 wheeled electric scooter to a 3 wheeled product, we aim to create a ergonomic and reliable product. Working closely with BuymyEV, we came up with a minimalistic design when compared to the retrofitted market alternatives.

I. INTRODUCTION

An electric vehicle (EV) is a vehicle that uses one or more electric motors or traction motors for propulsion. An electric vehicle may be powered through a collector system by electricity from off-vehicle sources, or may be self-contained with a battery, solar panels, fuel cells or an electric generator to convert fuel to electricity. EVs include, but are not limited to, road and rail vehicles, surface and underwater vessels, electric aircraft and electric spacecraft.

The first mass-produced electric vehicles appeared in America in the early 1900s. In 1902, the Studebaker Automobile Company entered the automotive business with electric vehicles, though it also entered the gasoline vehicles market in 1904. However, with the advent of cheap assembly line cars by Ford, the popularity of electric cars declined significantly.

EVs first came into existence in the mid-19th century, when electricity was among the preferred methods for motor vehicle propulsion, providing a level of comfort and ease of operation that could not be achieved by the gasoline cars of the time. Modern internal combustion engines have been the dominant propulsion method for motor vehicles for almost 100 years, but electric power has remained commonplace in other vehicle types, such as trains and smaller vehicles of all types.

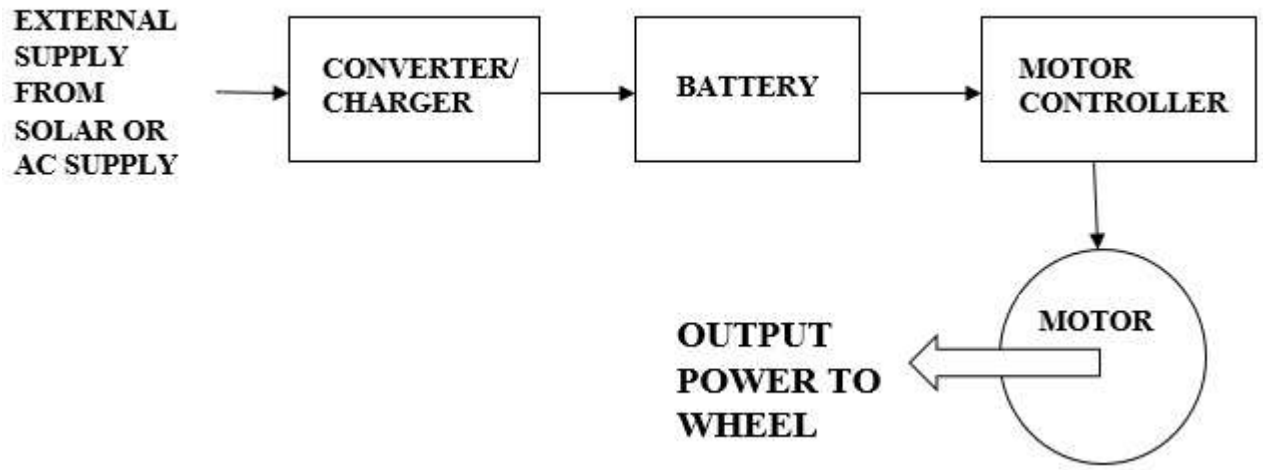

Fig 1. Block diagram of power flow in an electric vehicle

II. LITERATURE SURVEY

1. BRYR RONALDO et, al The project is developed to lessen the stress for people from all walks of life and circumstances. The project developed is made up of locally available materials. The project can be used indoors and outdoors, since it is designed to lessen the stress of some people who walk a great length. It is especially useful in indoor use, within the vicinity of a school, university, shop- ping and the like. It is intended for one rider only. It has 2 very important parts, the hub motor and the controller module. The hub motor is the one that drives the whole scooter assembly while the controller is the brain, commanding the hub, lights, sensors, etc. The scooter is powered using a 48 V rechargeable battery and can run in forward and reverse directions.

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2. K SOMESHWARA RAO [2017] In this paper a new technology is proposed, and it is analyzed by software named Solid works. In this an electrical three-wheel vehicle is designed for disabled persons. The chassis analysis is carried out in Solid works simulation tool by applying two materials namely 1015 steel and 1020 steel. 1015 Steel material has yielded less stresses compared to 1020 steel material. Also, its stresses are within in the limits. The displacement is less for 1015steel compared to 1020 steel. So, the best material among these two is 1015 steel.

3 DHWANIT KIKANI [2016] et, al It discusses in detail about the main components of this electric moped and its working operation. on road pollution is increasing day by day along with the growth of population, the need of
alternative source of transport which can help surfing easily in crowdie areas and produce
zero on road pollution is emerging. So, this paper discusses in detail about design, fabrication methodology and characteristics of compact three-wheeled foldable electric moped. It also discusses in detail about the main components of this electric moped and its working Operations. Electric vehicles are considered to be 97% cleaner, producing no tailpipe emissions that can place particulate matter into the air.

III. PROBLEM OBJECTIVES

In the literature review, it is found that greener and pollution-free energy is not been utilized properly during design and developing vehicles for handicapped people. This research gap found in the literature review can be solved with the following objectives:

To facilitate ease of travel for persons with lower limb disabilities to ride the vehicle for longer duration.

- To develop a reliable product so that the startup can improve their customer base.
- To find out the reason why consumers prefer to use electric vehicles over others.
- To understand the perception of disabled people to implement their views for our product.

IV. METHODOLOGY

1) Research phase
2) Planning
3) Design phase
4) Fabrication and Assembly
5) Testing and Modification

Research Phase

- Visiting the manufacturing Industry
- Mining information and data of present vehicle from industry
- Studying production drawing of present chassis and identifying the requirements for new product chassis
- Learning basis of FEM and ANSYS which will be required for Design and analysis.

Planning

Define the problem and device our solution to it and to put out various designs and finalize on the safest and feasible design iteration possible and to reviewing the design based on its pros and cons

Design phase

- Selecting and comparing various material for chassis and body frame work
- Creating geometric model and finite element model of the rear frame using suitable CATIA/SOLIDWORKS software
- Carrying out various calculations on the design such as Load calculations for various conditions
- Selecting the best suspension geometry which are also used commonly
- Complete analysis of chassis using the ANSYS Software

Fabrication and Assembly

- Fabricating the rear frame and assembling it to the main frame
- Assembling suspension and brakes to the frame
- Assembling the power train
- Mounting the wheel assembly and the battery pack
- Hooking up all wiring connections.

Testing and Modification

- Validating the calculated performance with actual performance through test runs
- Testing maximum load carrying capacity
- Checking the range of the vehicle and modifying the parameters if required

V. DESIGNING OF MODEL USING SOLID WORKS

SolidWorks is a solid modeller, and utilizes a parametric feature-based approach that was ab initio developed by PTC (Creo/Pro-Engineer) to make models and assemblies Solid Works files (previous to version 2015) use the Microsoft Structured Storage file

format. this suggests that their square measure numerous files embedded inside every SLDDRW (drawing files), SLDPRT (part files), SLDASM (assembly files) file, as well as preview bitmaps and data sub-files. Shape-based options usually begin with a 2nd or 3D sketch of shapes like bosses, holes, slots, etc. This form is then extruded to feature or move take away material from the half. Operation-based options don't seem to be sketch-based, and embody options like fillets, chamfers, shells, applying draft to the faces of a vicinity, etc

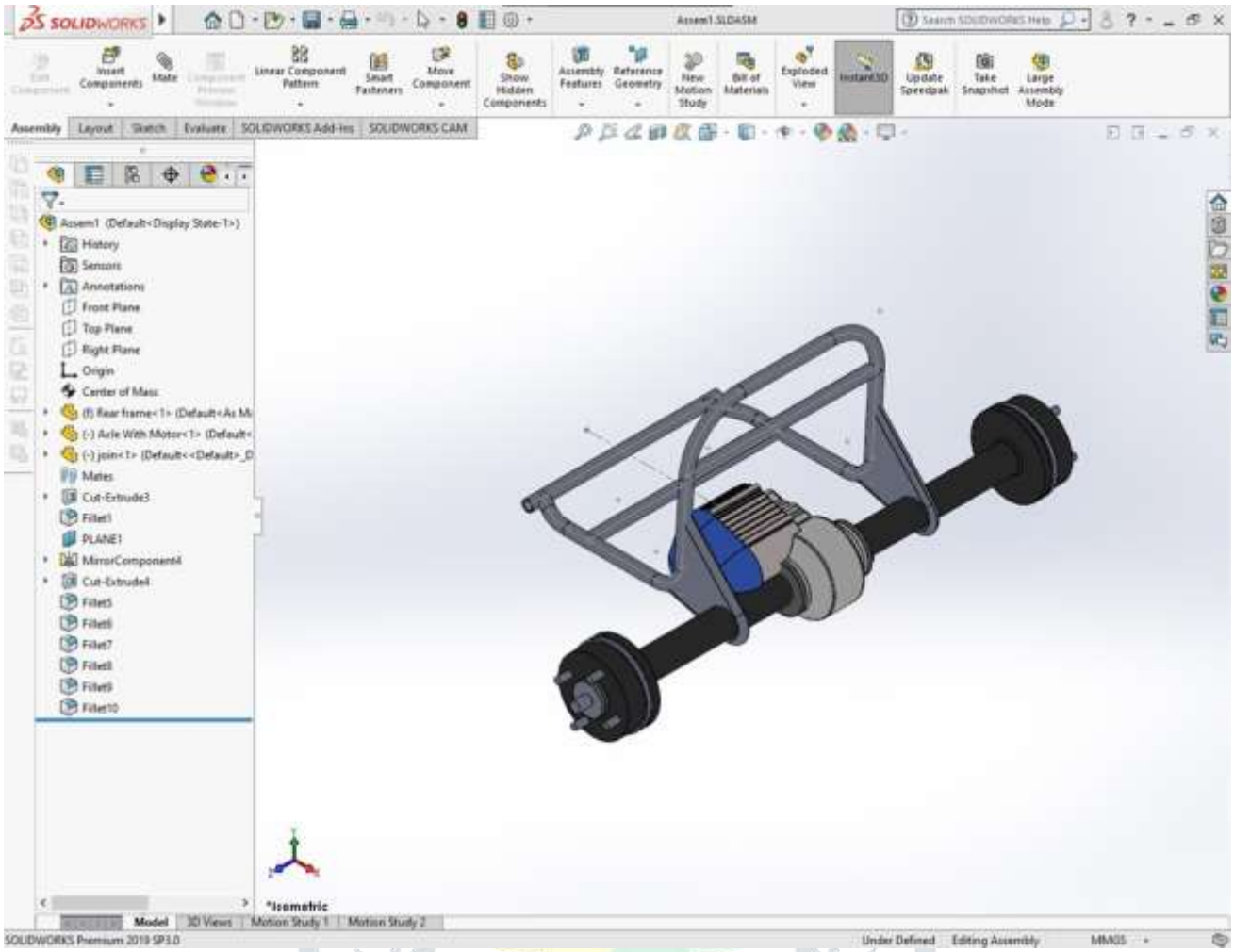

Fig 2. Assembly of the Rear frame with Differential motor axle

VI. RESULT AND DISCUSSION

STATIC STRUCTURAL ANALYSIS:

A static structural analysis determines the displacements, stresses, strains, and forces in structures or components caused by loads that do not induce significant inertia and damping effects. A static structural load can be performed using the ANSYS, or ABAQUS solver.

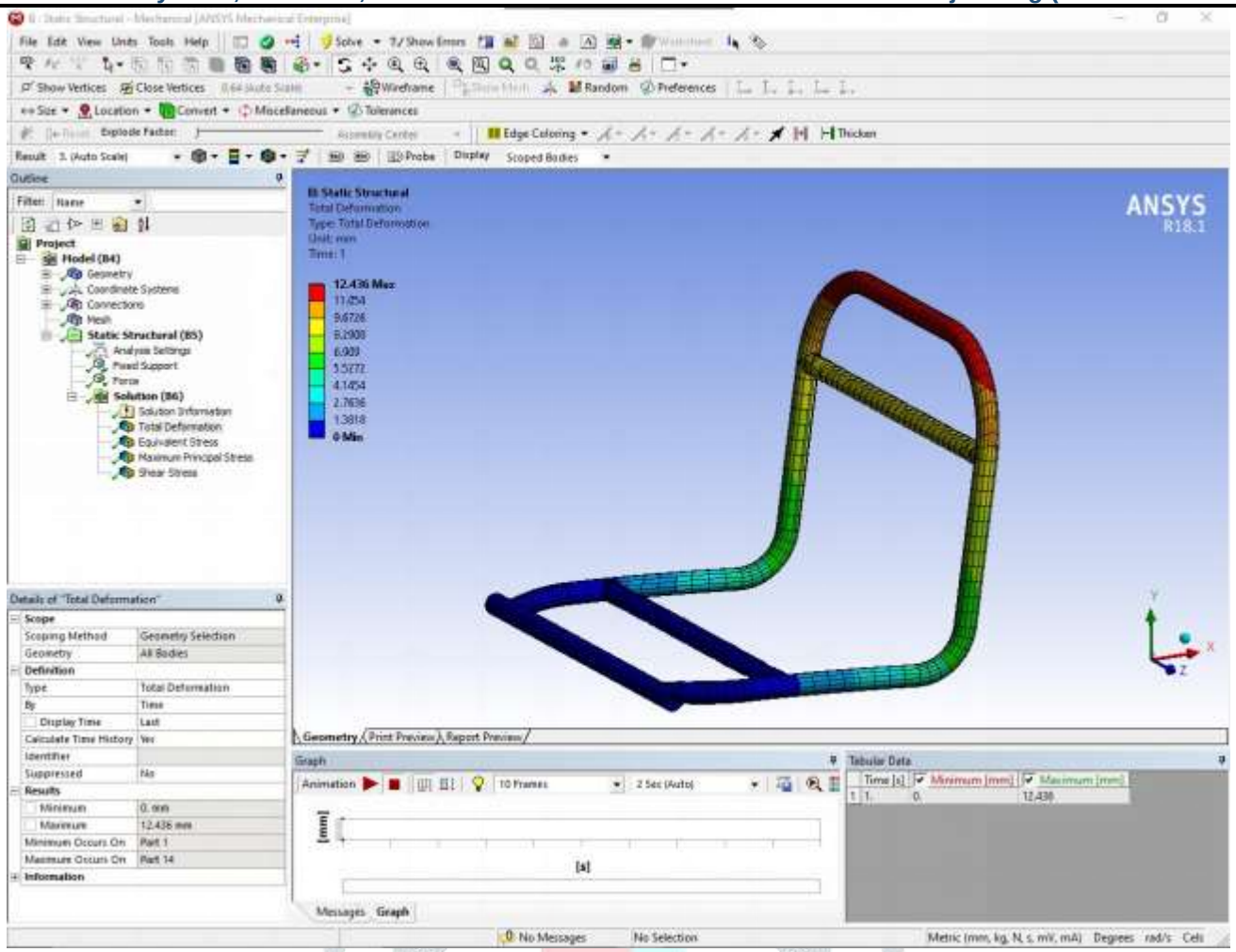

Fig 3. Maximum Displacement

MODAL ANALYSIS

In the paper, 3-D FE analysis is carried out on the modal analysis of chassis frame. And the FME software ANSYS WORKBENCH was used to simulate the modal analysis. The results of natural frequencies and mode shape were obtained. The first 10th-order natural frequencies of a structural frame are extracted.

Mode	Frequency [Hz]
1.	39.631
2.	67.905
3.	118.48
4.	123.96
5.	237.82
6.	386.53
7.	443.5
8.	456.39
9.	503.61
10.	648.67

TABLE.1. NATURAL FREQUENCIES

Each natural frequency of respective mode shapes is listed in the table. If any one of the natural frequency matches with excitation frequency the frame doesn't satisfies the dynamic characteristics.

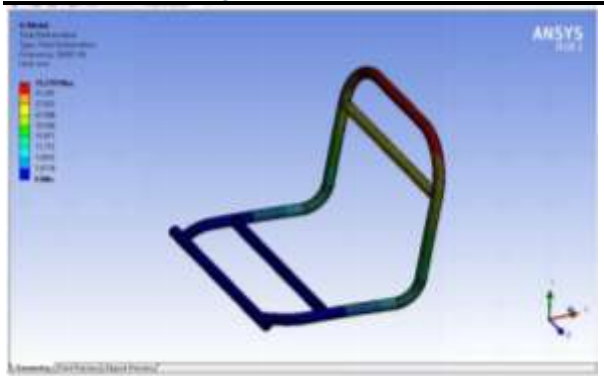

Fig 4. Mode Shape 1

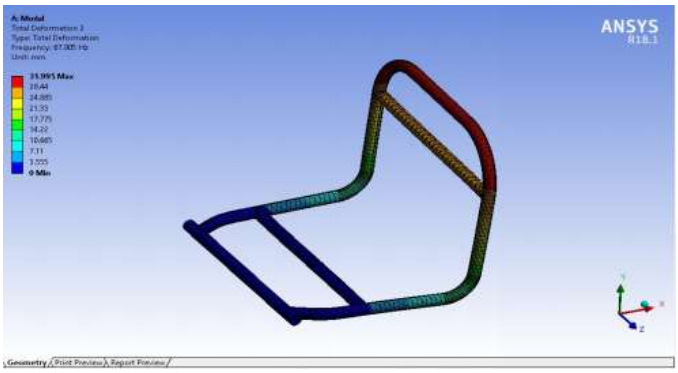

Fig 5. Mode Shape 2

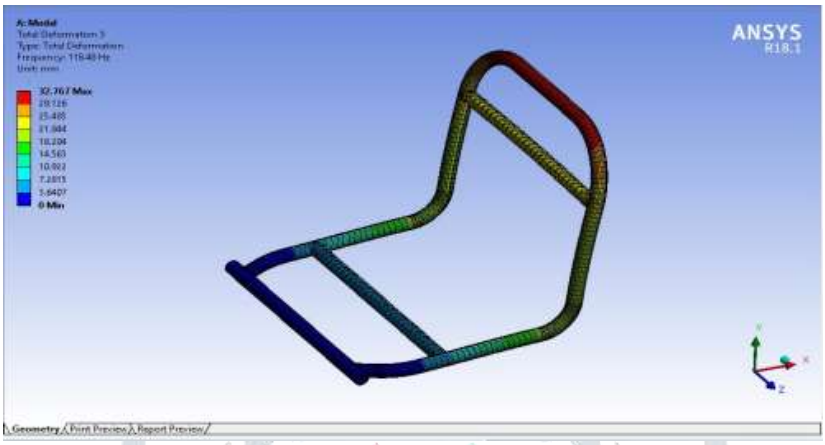

Fig 6. Mode Shape 3

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VII. SOFTWARE USED

Engineering as a discipline often requires more integration than large amounts of original development. In a typical subject, writing new code presents significant challenges, and the number of features shared between projects means that it is possible to create shared components with implement common features. A library or an existing module shows the use of well developed and tested components, which saves significant resources in the implementation of the project. The programs and tools we choose for this project are all open source, and use international standards which allowed us to rapidly develop the features needed.
The project software system consists of:

1. SOLID WORKS

2. ANSYS

3.CATIA

A 3D CAD (Computer Aided Design) package is especially useful to any engineer with a focus on design. Finite Element Analysis (FEA) is useful to any engineer that needs to perform structural analysis. Once the geometry is built, a mesh is created to discretize the structure into elements. Mechanical engineering and design software helps engineers and designers visualize, analyze and communicate design intent before building a physical prototype. Mechanical engineering software is employed across an array of disciplines, from manufacturing and architecture to sustainability.

VII. CONCLUSION:

1) The purpose of this project was to look beyond the objectives of mechanical engineering and to bring about a prototype that could benefit the physically challenged.
2) Since this newly developed product can be easily retrofitted to their sub frame, the company could easily cater to its wide customer base and will also result in significant savings over the long run.
3) The design was done with keeping minimalism in mind so as to achieve the purpose of the project and to provide ease of use for the intended customers.
4) The successful completion of the project is an example of right use of technology for the benefit of society.

VIII. SCOPE FOR FUTURE WORK

1) The main objective behind this project was to develop an accessible product.
2) With future iterations, the chassis bay can be further lowered to increase the ergonomics.
3) A costlier version of the same product can be enabled with IOT to streamline the process.
4) The 3-wheeler can also be modified for easy ingress and egress directly from a wheelchair.
5) The portion where acceleration and braking controls are housed can be repositioned to even accommodate persons with upper limb disabilities.

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