VIVEKANAND EDUCATION SOCIETY'S

POLYTECHNIC

Chembur, Mumbai -400071

Electric Bike

A PROJECT EXECUTION REPORT

Submitted By

Mr. Abdulaziz Shaikh

Mr. Harshad Sonavane

Mr. Pratham Mehta

Mr. Akshat Kunder

In Partial fulfilment for the award of the degree of

DIPLOMA IN MECHNAICAL ENGINEERING

UNDER THE GUIDENCE OF

MR. MANGESH BIDKAR

DEPARTMENT OF MECHNICAL ENGINEERING

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MSBTE

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION

CERTIFICATE

This is to certify that **Mr. ABDULAZIZ SHAIKH** From **V.E.S POLYTECHNIC** (Institute Code:0004) having EnrollmentNo: **1900040458** has completed Project of final year having title **Electric Bike** during the academic year 2021-2022. The Project is completed in a group consisting of 4 Candidates under the guidance of the faculty guide.

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ABSTRACT

This study is based on e-bikes, mainly the 'Electric bike' (under Swedish standards). is the category of e-bikes which indicates electric bicycles, electric Bike etc. That has specific standard in terms of motor power and speed limitations. We are concerned with respect to Sweden, in the analysis, especially because though it is already defined by EU for Europeans, it still varies in some countries, within Europe itself. In this research and experiment, we have brought useful revelations about its features in terms of power, comfort and cost. Likewise, our efforts have been to test its reliability on technical grounds, geographical conditions, people's awareness and interests. Similarly, on effective grounds, ratio of bike users, import conditions, its growth and declines trends, and other influencing factors have been analyzed to understand e-bike's possibilities in Sweden.

To highlights e-bike's features and importance, we have done a thorough investigation, taking comparative analysis with ordinary bicycles and normal vehicles, by using common elements like cost effectiveness, power efficiency, leisure service, easy accessibility, environment effects and so on. The findings have proven e-bikes to be the most effective solution on various grounds than any other transport alternatives especially in short distance and inner city traveling. In theoretical details on e-bikes, we have introduced details about the components applicable in e-bike, how they operate, their importance in terms of effectiveness with respect to power consumption and energy dispatching (motor capacity), quality of performance (types of components and features) and other comparative technical aspects.

To understand the ground reality better, a short survey have been conducted to give some understanding about the awareness people are having regarding e-bike, their remarks towards this product, and based on their conclusions, our predictions report on its development and popularity chances in Sweden. While analyzing facts in general, we discovered that Electric bike for US may not be Electric bike for Sweden, because of standard varies from country to country. According to European classification standard, a Electric bike must have the motor capacity up to 750 W, and must stop the motor when the speed is above 25 km/h.

ACKNOWLEDGEMENT

It gives us immense pleasure presenting this report for the project. We profoundly thank our HOD **Mr. Himanshu Raghav** for giving us support throughout the course and thus made us capable of being worthy of recognition and extend every facility to us for making and completing this project smoothly.

We owe our deep gratitude to **Mr. Mangesh Bidkar** our project guide for rendering her valuableguidance with the touch of inspiration and motivation. He has guided us quite a lot in negotiating through the hurdles by giving us plenty of early ideas and which resulted in present fine work.

We would like to thank all the faculties, Lecturers and Non-teaching Staff of our college for providing sufficient information which helped us to complete our project successfully.

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CHAPTER - 1

Introduction

Some of the major challenges that the present world economy faces are energy security, sustainability, pollution and climate change impacts. Some authors and organizations have defended a transition to a 100% renewable economy as a way to achieve an ultimate and lasting solution to these challenges that choice is based on the fact that renewables are already proven technologies, are experiencing rapid development and potentially have a zero-carbon footprint. This last feature makes them especially appropriate to address climate change, which is probably the most urgent challenge that the global society faces. In the medium term any renewable energy transition will probably be supported by intelligent use of fossil fuels, especially natural gas, which is a low-carbon dispatchable source that can complement intermittent renewables.

However, in the long term, our economy should become fully renewable according to some of the aforementioned studies.

It would involve a major restructuring of infrastructure and an internationally coordinated policy action that would take between 40 and 50 years.

Although such transition is urgently needed to avoid catastrophic climate change, governments have not yet supported such a coordinated policy initiative. García-Olivares and Balla brera assumed that a plausible date for the beginning of a global renewable transition might be the peak of all the fossil fuels production that is projected for between 2020 and 2036 by different authors, and its completion would take place in the second half of this century.

Figure 1.1: General View of Vehicle

All the vehicles in the market cause pollution and the cost of fuel also goes up day by day. In order to compensate for the ever-changing costs of fuel and pollution we need a little better solution, namely our transportation system. Due to the burning of hydrocarbon fuel in a car, sometimes difficulties such as wear and tear may be high and extra attention is needed to maintain it properly. Our car is easy to carry and there is no fuel cost to other vehicles available. For the past two decades lawmakers and policy makers around the world have become increasingly concerned about the urgent need for environmental protection, environment and humanity, and there has been a dramatic increase in greenhouse gas emissions, especially CO_2, which is causing global climate change. Vehicles contribute about 14% of CO_2 to all sources other than that, pollution caused by both petrol and diesel engines caused by CO emissions, no combustible hydrocarbons, particulate matter and tetra ethyl oxide, lead is harmful to the environment around. from car engines to a steady income until the year 2000 and beyond, car manufacturers have been forced to meet these standards by designing clean, fuel-efficient engines and providing air conditioning. So, satisfy and overcome these two problems namely Pollution and Prosperity.

Fabrications

P = Power

N = revolution per min

T = Torque

σ_s = Shear stress

σ_t = Tensile stress

σ_{ut} = Ultimate Tensile Stress

FOS = Factor of safety

What is Electric Bike?

The Electric bike is a bike which is driven with the help of battery which is coupled to electric motor.

Main principle: It works on the principle that the electromotive force of an A.C. motor which receives electrical energy stored in D.C. battery is converted with the help of D.C. to A.C. converter.

Working medium: Here for the motivation of prime mover the chemical reaction takes place from which an energizing current is evolved which is responsible for the working. The working medium is sulphuric acid which is separated into columns of H ions and negative SO4 ions when mixed with water. If the poles of the cell are connected by a load, the flow of the electrons is from negative to positive. A bivalent positive lead is produced from neutral lead when combined with bivalent negative of SO4 group to form lead sulphate. This results due to scarcity of electrons at negative pole. Through the electron supply a bivalent positive lead is produced at positive pole from quadrivalent positive lead. A combination of SO4 comes into existence thereby ruling the combination of O2 which leads to formation of PbSO4. The atoms of oxygen and hydrogen from electrolyte are released together to form water thereby decreasing the density of battery acid.

1.1 History

First models of electric bicycles appeared in late 19th century. US Patent office registered several e-bike patents since 1895 to 1899 (Ogden Bolton patented battery-powered bicycle in 1895, Hosea W. Libbey patented bicycle with double electric motor in 1897 and John Schnepf patented electric motor with roller wheel). Models with torque sensors and power controls became available rduring late 1990s. One of the first commercially successful e-bike models appeared in 1997 with the name “Select”.

Year after that there was over 49 different e-bike models available on the market. In the early 2000s, two big Japanese companies Yamaha and Panasonic became their worldwide mass production.
With creative and industrious minds working, many designs for electric bikes were drafted but many of them never reached production, often sitting in patent offices and on the drawing board until they expired or were discarded. Due to the explosion in growth and popularity of the automobile and combustion engines, electric bicycles were left on paper for the most part.

Main design of e-bike consists of the traditional bicycle frame (with or without pedals) and a small electric motor (up to 750 watts) powered with light rechargeable batteries (lead-acid, NiCd, NiMH and Li-ion). Power of those motors is limited to produce maximal speeds of 24 to 32 km/h (15 to 20 mph). There are several types of motors currently in use most notably direct-drive and geared. Transmission to the wheel is done with chain drive, belt drive, hub motors or friction drive.

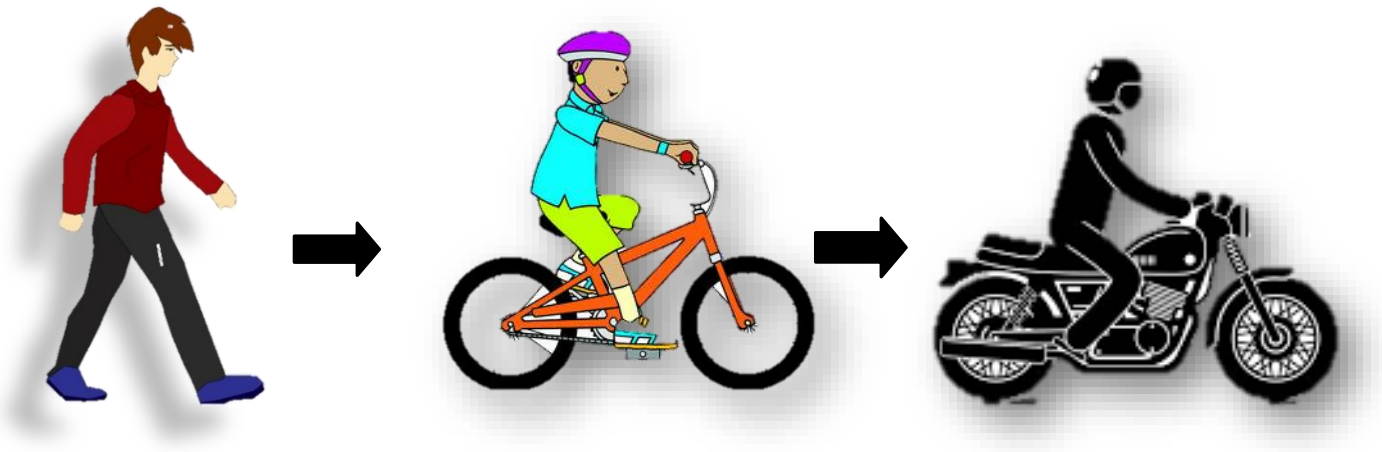


Figure 1.2: Evolution of the Project

1.2 Working Principle:

It works on the principle that the electromotive force of an A.C. motor which receives electrical energy stored in D.C. battery is converted with the help of D.C. to A.C. converted. An electric motorcycle works essentially the same way a gas-powered motorcycle works it is propelled by an engine, and that engine requires fuel. The main difference is that the gas fuel in a conventional motorcycle is replaced by either batteries or fuel cells in an electric version. The operating principle of an electric motor is quite similar to that of a gas engine. In both cases motorcycles are powered by mechanical energy, but only in one case are they powered by rechargeable batteries. Electric vehicles run on electricity, that causes a pole into the motor to spin it. It isn't so much a fuel-powered motor but rather a battery that can travel a range of 40 to 100 miles between charges. When, the battery is ON the current flows to the motor and the power is transmitted to the rear wheels with the help of chain drive shaft.

1.3 Basic Definitions

There are some basic terms you need to understand related to machine design, electrical equipment and design, that will serve as requirements for a clear understanding of the project.

1. Chassis:

   Chassis is the main support structure of the vehicle which is also known as 'Frame'. It bears all the stresses on the vehicle in both static and dynamic conditions. In a vehicle, it is analogous to the skeleton in living organisms. It's form obviously varies with the vehicle type.

   Functions:

   1. To support the load of the body
   2. To withstand the forces caused due to acceleration of the vehicle
   3. To withstand the stresses caused due to the bad road condition.
   4. To carry the load of passenger or goods carried in the body.

2. Motor:

   An electric motor is a device used to convert electrical energy into mechanical energy. Scientifically speaking, the electric motor is a unit used to convert electric power into motive energy or electrical energy into mechanical energy.

   A DC motor is an electrical machine that converts electrical energy into mechanical energy. In a DC motor, the input electrical energy is the direct current which is transformed into the mechanical rotation.

3. Battery:

   A battery is a power source consisting of one or more electrochemical cells with external connections for powering electrical devices such as headlights, horns and electric vehicle motors.

   i) Lead – Acid Battery:

      Lead-acid batteries are only currently being used in electric vehicles to supplement other battery loads. These batteries are high-powered, inexpensive, safe, and reliable, but their short calendar life and poor cold-temperature performance make them difficult to use in electric vehicles

4. Electric vehicle:

   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.

5. Torque:

   Torque is the rotational equivalent of linear force. It is also referred to as the moment, moment of force, rotational force or turning effect, depending on the field of study.

6. Rpm:

   Revolutions per minute (abbreviated rpm, RPM, rev/min, r/min, or with the notationmin−1) is the number of turns in one minute. It is a unit of rotational speedor the frequency of rotation around a fixed axis.

7. Total Deformation:

   Change in the shape of a body caused by the application of a force (stress).

8. Maximum Principal Elastic strain:

   The utmost strain that induces temporary deformation acting along the shear principal planes.

9. Maximum Principal stress:

The highest value of stress generated provisionally along the shear principal planes.

10. Principal stress:

From elasticity theory, an infinitesimal volume of material at an arbitrary point on or inside the body can be rotated such that the shear stresses come down to zero and the only normal stresses remain in the volume. Such stresses are called as principal stress.

Figure1. 4: Front Look of Electric Bike

1.4 Electric Vehicles

An electric vehicle (EV) is a vehicle that uses one or more electric vehicles to continue. It can be powered by a collector system, with electricity from extravehicular sources, or can be powered by a battery (sometimes charged with solar panels, or converting fuel into electricity using fuel cells or generator).

EVs include, but are not limited to, road and trainvehicles, up and submarines, electric aircraft and electric spacecraft. EVs first appeared inthe mid-19th century, when electricity was in the middle of popular methods of driving, which offer a level of comfort and ease of operation that cannot be achieved by current petrol vehicles.

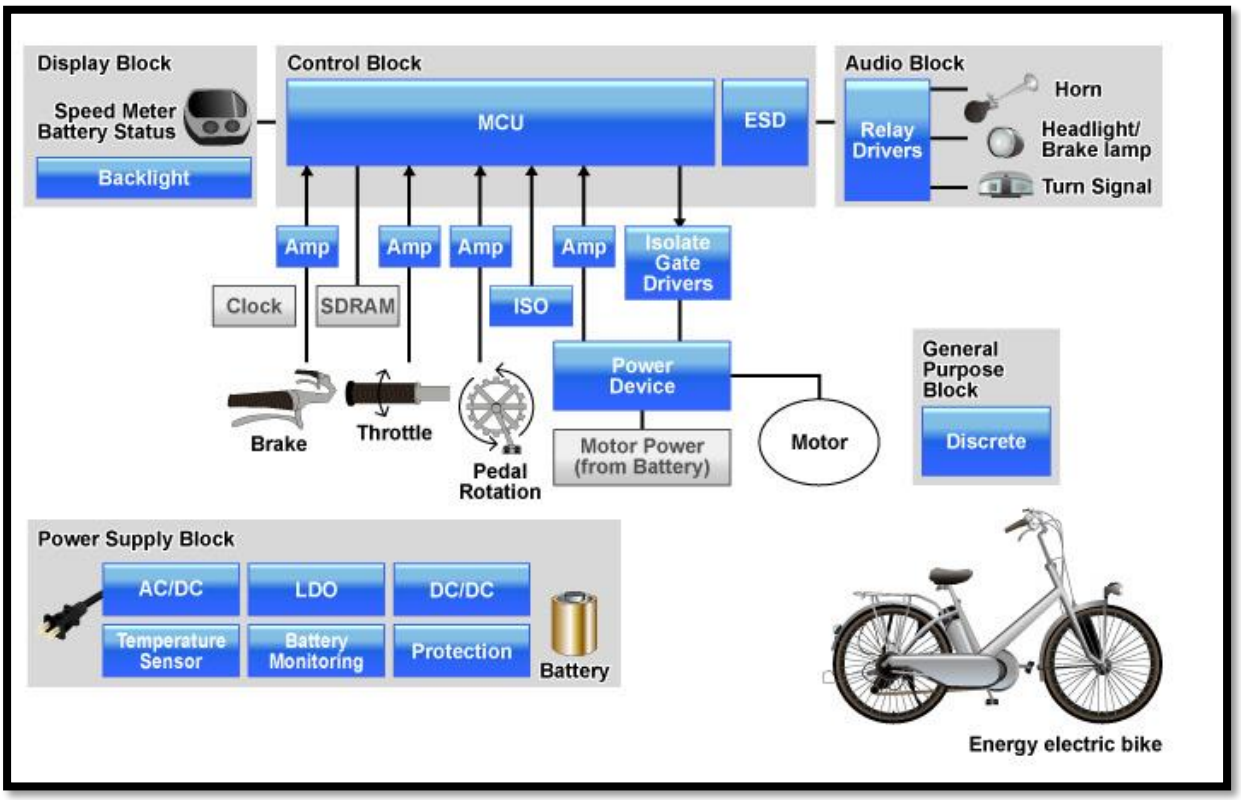
Inside burning engines were the best way to drive cars and trucks almost 100 years, but electric power is still common in some types of vehicles, such as trains andsmall cars of all kinds.

In the 21st century, EVs saw a resurgence in technology development, too increased focus on renewable energy and reduced material mobility impact on climate change, air pollution, and other environmental issues. Project Drawdown describes electric vehicles as one of the 100 best modern solutions coping with climate change.

Government incentives to increase adoption were the first launched in the late 2000's, including in the United Statesand the European Union, leading to the growth of the car market in the 2010s.

During the COVID-19 epidemic, the closure of Lockdown reduced the value of the greenhouse gases from gasoline or diesel cars. The International Energy Agency said in 2021 that governments should do more to meet climate targets, including complex policies electric cars. Sales of electric vehicles are likely to increase from 2% of global shares in 2016 to 30% by 2030. Much of this growth is expected in markets such as North America, Europe and China; A review of the 2020 textbooks suggests that electricity consumption growth 4- wheeled vehicles seem economically impossible in developing lands, but that is growth of 2 electric wheels is possible.

There are 2- and 3-wheel EVs larger than any otherkind. Most electric cars use lithium-ion batteries (Li-Ions or LIBs). Lithium-ion batteries have higher energy density, longevity and higher energy density than many others activebatteries. Complex elements include safety, durability, temperature deterioration and costs.Li-ion batteries should be used within safe temperatures and power levels to operate safelyand effectively.



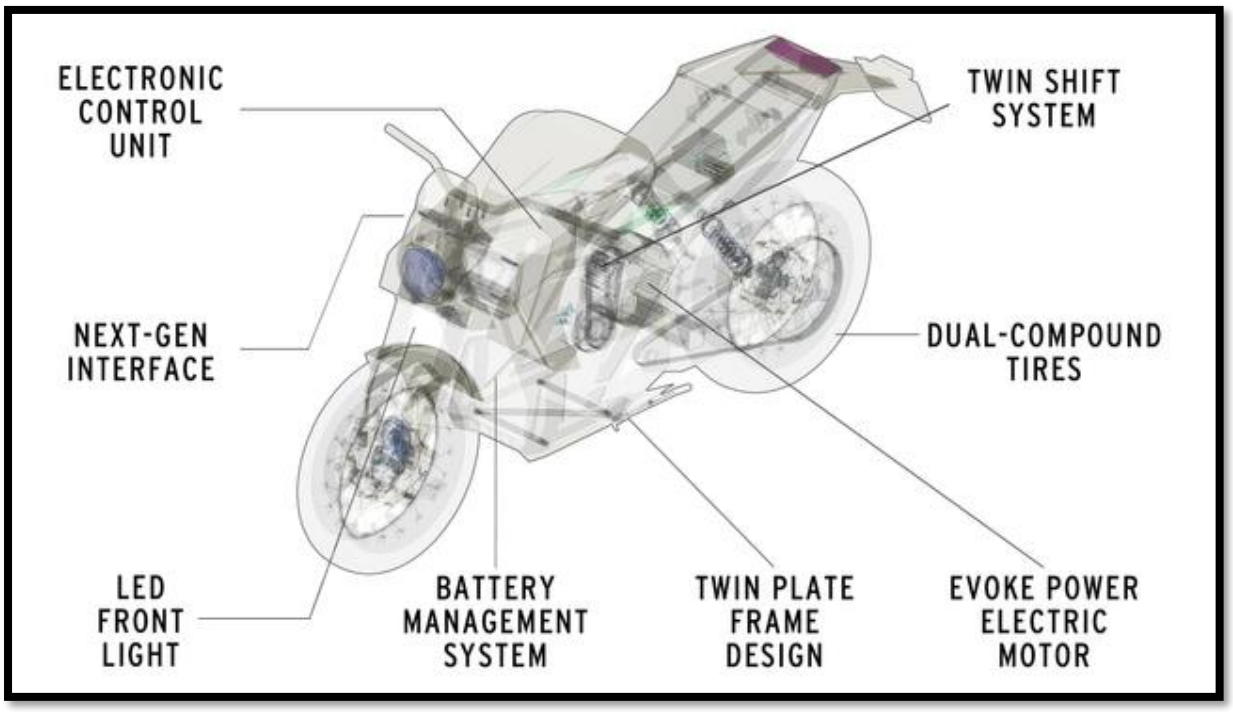


Figure 1.5: Interior Structure of an Electric Vehicle

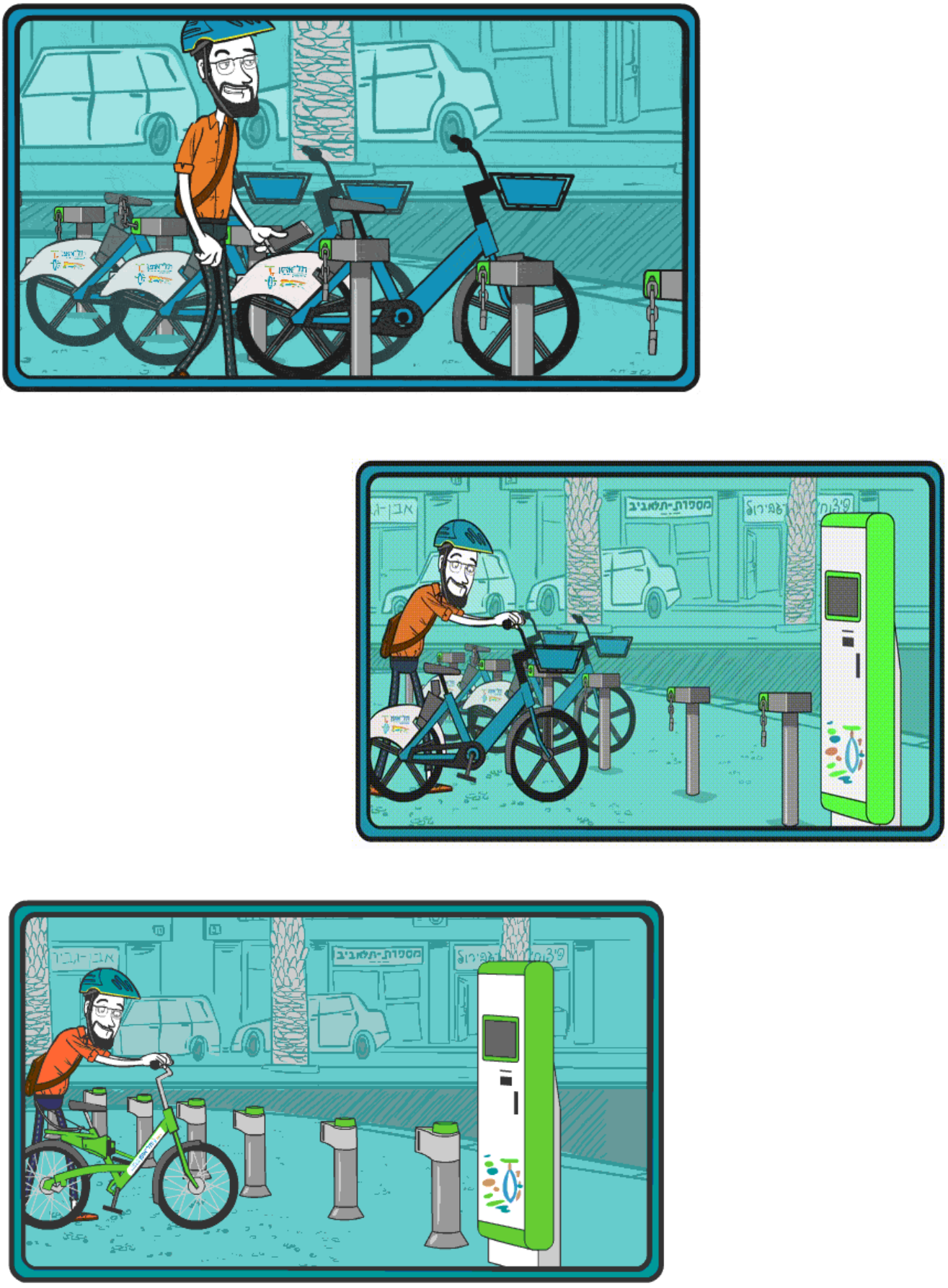


Figure 1.6:Charging of an Electric Vehicle

CHAPTER - 2

Literature Survey

A literature review is a comprehensive summary of previous research on a topic. The literature review surveys scholarly articles, books, and other sources relevant to a particular area of research. The review should enumerate, describe, summarize, objectively evaluate and clarify this previous research. Some research papers, dissertations and theses that displayed certain degree of pertinence with the project are conferred below:

Various research paper are available is to present the idea of harnessing the various energy and use it in today's existence of human life. For human being travelling has become vital. In order to sustain in this fast forward world he must travel from place to place. It is very important that time taking for travelling should be less, also it should be economical and easily available.

A. **Sun et al. [1] - (2020)** Found that after e-bike adoption, conventional bike use reduced significantly. Although car use reduced less strongly, a net environmental gain was still reported after ebike adoption. In Norway, when kindergarten parents were provided with access to bikes and e-bikes with trailers, they increased cycling and decreased car usage for trips to work and kindergarten, even during winter, and the effects were greater for e-bikes. More experimental research in Brighton (UK) that loaned participants e-bikes for 6–8 weeks resulted in the overall reduction in car mileage by 20%. However, there was also reduction in bus trips and walking.

B. **De Kruijf et al. [2] - (2018)** Reported mixed environmental, congestion, and public health effects after the implementation of e-bike monetary incentives in the North-Brabant province of the Netherlands. Although e-bike trips increased from 0% to 73% after half a year of participating in the program, half substituted car trips and the other half conventional cycling trips. In a recent meta-analysis, Bigazzi and Wong (2020) reported e-bike mode substitution to be the highest for public transit (33%), followed by conventional bicycle (27%), automobile (24%), and walking (10%).

C. **MacArthur et al. [3] - (2018)** A National Australian study of 478 e-bike owners indicated that 70% of them were 50 years old or older. Furthermore, a survey of 217 e-bikers from the Netherlands found that 73% were 55 years old or older.

   Qualitative study on the potential of e-bikes to support mobility among older adults found that they increase convenience and reduce physical exertion and reliance on a car (Leger et al., 2019). The reviewed above studies on private use of e-bikes may imply that the implementation of e-bike BSSs could potentially substitute car trips and be popular among older-adults.

D. **Pravin Kumar Singh et al. [4] - (2017)** It This paper describes the design and fabrication of Electric bike vehicle. The Self balancing two-wheeler is based on the principle of Segway. It describes the way to balance a electric bike using a supporting wheel is an eco-friendly mode of transport which causes zero pollution**.** This project was implemented with an idea to find an effective solution to the transportation problem. The main objective isto achieve space utilization and minimize the fuel consumption especially for short distances. It focuses on parts that can be minimized so that weight can be minimized.

E. **Mahadik et al. (5) - (2019)** Studied about batteries, and introduced the concept of electric scooter.He studied that there are three ways of charging an electric scooter i.e by means of wall charging, solar charging and the mechanical pedal. His main focus was on system

architecture, operational concept and battery management. Use of PIC15F72 controller was used for over current protection and under current protection which is helpful.

F. **Trevedi et al. (6) - (2018)** They identify the need of E-Bike in recent time. They beat the issue ofthe pollution in view of all class of society. It was not sensible to purchase scooters, mopeds and motorcycle for everyone. Thus combination of both issues environmental as well aseconomically affordable option would be the best solution. Objective of there research was to explore the acceleration speed and electric powered bicycle under balance.

G. **Vignesh M. (7) - (2020)** How the design and analysis of the frame was done, based on the requirement of the customer. The collection of data consists of several factors such as availability, machinability, cost, reliability, feasibility and ergonomics. The total length, height and weight were also taken into considerations, for further calculation this values were used.

Sr.no	Author	Year of Publication	Learning Outcomes
1.	Sunet	2020	Found that after e-bike adoption, conventional bike use reduced significantly. Although car use reduced less strongly, a net environmental gain was still reported after ebike adoption. In Norway, when kindergarten parents were provided with access to bikes and e-bikes with trailers, they increased cycling and decreased car usage for trips to work and kindergarten, even during winter, and the effects were greater for e-bikes. More experimental research in Brighton (UK) that loaned participants e-bikes for 6–8 weeks resulted in the overall reduction in car mileage by 20%. However, there was also reduction in bus trips and walking.
2.	De Kruijf	2018	Reported mixed environmental, congestion, and public health effects after the implementation of e-bike monetary incentives in the North-Brabant province of the Netherlands. Although e-bike trips increased from 0% to 73% after half a year of participating in the program, half substituted car trips and the other half conventional cycling trips. In a recent meta-analysis, Bigazzi and Wong (2020) reported e-bike mode substitution to be the highest for public transit (33%), followed by conventional bicycle (27%), automobile (24%), and walking (10%).
3.	Pravin Kumar Singh	2016	It This paper describes the design and fabrication of Electric bike vehicle. The Self balancing two-wheeler is based on the principle of Segway. It describes the way to balance a electric bike using a supporting wheel is an eco-friendly mode of transport which causes zero pollution**.** This project was implemented with an idea to find an effective solution to the transportation problem. The main objective isto achieve space utilization and minimize the fuel consumption especially for short distances.

4.	Mahaik	2019	Studied about batteries, and introduced the concept of electric scooter.He studied that there are three ways of charging an electric scooter i.e by means of wall charging, solar charging and the mechanical pedal. His main focus was on system architecture, operational concept and battery management. Use of PIC15F72 controller was used for over current protection and under current protection which is helpful.
5.	Trevedi	2018	They identify the need of E-Bike in recent time. They beat the issue ofthe pollution in view of all class of society. It was not sensible to purchase scooters, mopeds and motorcycle for everyone. Thus combination of both issues environmental as well aseconomically affordable option would be the best solution. Objective of there research was to explore the acceleration speed and electric powered bicycle under balance.
6.	Vignesh M.	2020	How the design and analysis of the frame was done, based on the requirement of the customer. The collection of data consists of several factors such as availability, machinability, cost, reliability, feasibility and ergonomics. The total length, height and weight were also taken into considerations, for further calculation this values were used.
7.	MacArthur	2018	A National Australian study of 478 e-bike owners indicated that 70% of them were 50 years old or older. Furthermore, a survey of 217 e-bikers from the Netherlands found that 73% were 55 years old or older. Qualitative study on the potential of e-bikes to support mobility among older adults found that they increase convenience and reduce physical exertion and reliance on a car (Leger et al., 2019). The reviewed above studies on private use of e-bikes may imply that the implementation of e-bike BSSs could potentially substitute car trips and be popular among older-adults.

CHAPTER - 3

Problem Definition, Objective & Scope

3.1 Problem Definition

From Literature review, automobile usage is beginning to grow at a much faster than the human population, with saturation nowhere in sight. If present trends continue, overtime 3 billion vehicles should be in operation by the year 2050. As we all know, in this fast developing and growing of countries there is shortage of fuel as this a non- renewable energy source and in the more 20-30 years the fuel and the crude oil is going to be extinct and electric vehicles are the future of the world. This initiates a concern our hearts that vehicles powered by other sources of energy is not a nice to have but absolutely a necessity. Hence a solution is being proffered in the electric bike.

Knowing that the gasoline powered tricycle is a major means of transportation in the Countries.
An efficient replacement such as this will definitely reduce the dependency on automobiles. Already there are many electric bikes and cars are available in the market of much reputed company such as Tesla and Ola. But the thing is this is that all the bikes are above Rs. 100000. And as we know that all the people can't afford it.

The aim of the project to develop and manufacture a cheap and efficient bike. In electric, the aim of the project is to produce at low cost and highly efficient rate. Also, to prepare the bike on mechanical and electric based. In this bike, there is no use of complex equipment and programming part so, it is easy to build up and handle also.

The solution for this is to

▪ Become more productive: more work can be done by using the product versus walking.

▪ allowing you to be better seen and giving the rider better sight lines, over cars in a parking lot or boxes in a warehouse.

▪ Low operating costs: no need for gas and inexpensive battery charging (A complete cycle charge will take three or four hours.)

▪ A clean, green, eco-friendly machine! (Zero emission).

3.2 Objective

- ✓ To prepare a bike without using complex and electronics parts such as microcontroller, battery.
- ✓ To prepare a bike at low cost and highly efficient.
- ✓ To equip the vehicle with modern amenities like speedometer, headlight and battery indicator.
- ✓ To apply and utilize all existing knowledge acquired throughout the degree programme in designing and manufacture an electric scooter.
- ✓ To make the scooter cost effective and easily purchased by public
- ✓ To analyze and reduce pollution produced by IC engine.
- ✓ To make ease for the person driving the electric bike, by making it lightweight.

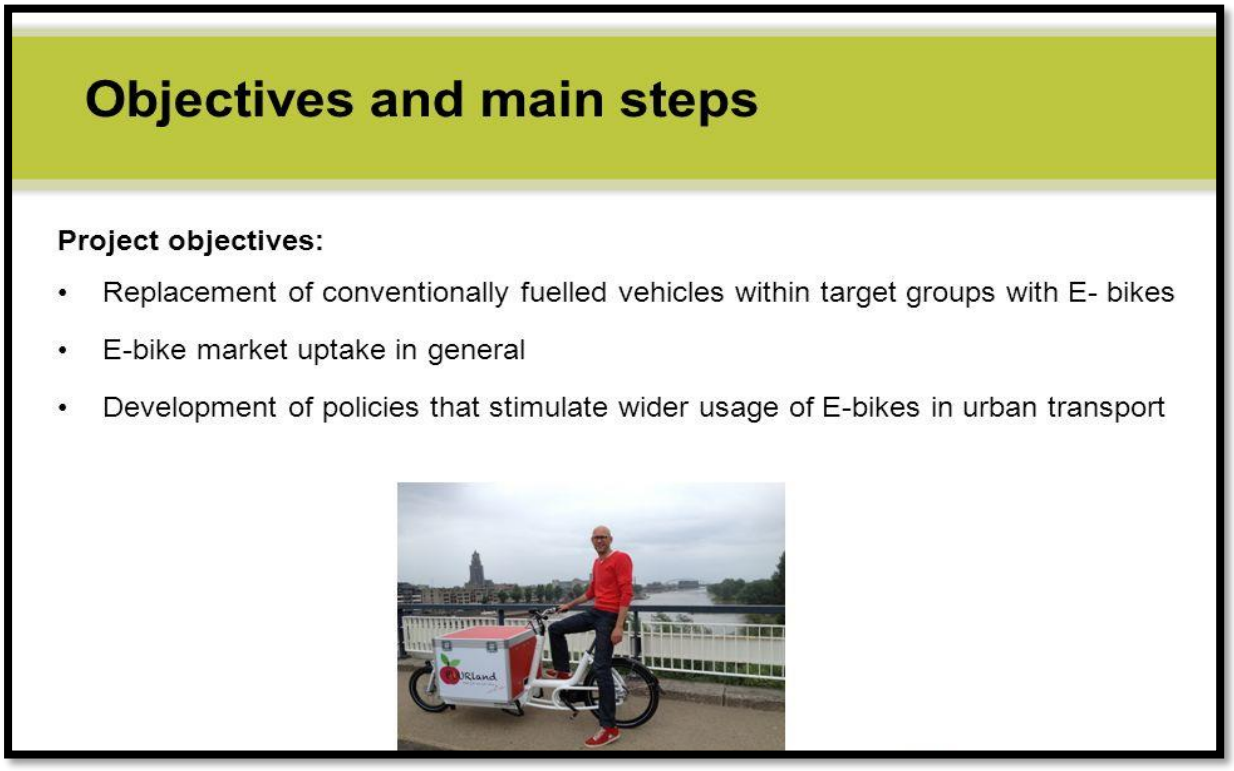


Figure 3.1.Objective and mains Steps

3.3 Scope of the Project:

Scope of the project:

In this project design of electric bike shows future scope of electric bike in India which is looking very promising. Here are the few reasons such as: -

1) Can be used as a reference for further development.

2) Development related to electric car using renewable energy sources.

3) No Pollution

4) Easier travelling for short distance

5) Availability of similar products on Indian market

CHAPTER – 4

Methodology

The research project is dissected in to eight chapters, each part provides essential lead to the one before it. This approach consequently contrasted on what was to be done and what was not done. The first chapter basically introduced the research project and layout the objectives to be covered by the research. The next chapter which was the literature review provided a wealth of information on different ways the objectives of the project could be reached. In this chapter similar previous research project's success and failures were closely studied. This chapter basically surfaced the pros and cons of the research project.

4.1 Assumption

Following assumptions have been made during investigation of Electric Scooter.

1. Weight of the human was considered around 100 kgs.
2. Average speed of the Electric Scooter is equal to 35 kmph.
3. The Electric Scooter should run at least 75 km per charge.
4. The factor of Safety was considered as 2.

4.2 Parameters

Basically, to Design an Electric bike, Wheel diameter was used to calculate the circumference of wheel. Using the universal formula ($2\pi r$)

a) Circumference

The circumference of a circle is the distance around the circle. This is also how far the circle rolls on flat ground in one rotation. For example, a bicycle wheel with a diameter of 24 inches has a circumference of 24π inches and will roll 24π inches (or 2π feet) in one completerotation.

Circumference = $2\pi r$

b) Wheel Rpm

To find out wheel rpm, we assumed the target for 80km. So how many revolution does wheeltakes in 60 min to cover the distance of 80km

To complete 80km,

= 80000 ÷ 60 (m/h)

= 1333.34

Wheel RPM = $\frac{1333.34}{1.27}$ = **1049.87**

c) Motor Rpm

RPM is a measurement used to describe a motor's speed. It stands for revolutions per minute and describes the rate at which the rotor is revolving, which is the number of times the rotor shaft completes a full rotation each minute. It can be used to measure

the speed of motors, Torque, Power and other equipment. Is the amount of times the shaft of a DC motorcompletes a full spin cycle per minute. A full spin cycle is when the shaft turns a full 360°. The amount of 360° turns, or revolutions, a motor does in a minute is its RPM value.

Motor RPM = (Gear ratio) × Wheel rpm

= (Driven/drive) × (1000)

= (21/9) × (1000)

= **2400 rpm**

A gear ratio is the ratio of rotation. A gear with fewer teeth must rotate more times when itmeshes with a gear that has more teeth.

Forces acting on the body of Electric scooter are rolling force (resistance) and drag force

d) Rolling Resistance

Rolling resistance, sometimes called rolling friction or rolling drag, is the force resisting the motion when a body (such as a ball, tire, or wheel) rolls on a surface In analogy withsliding friction, rolling resistance is often expressed as a coefficient times the normal force.

Rolling resistance (Fr) = Cw

C= Rolling resistance coefficient W=M×a

M = Mass of body in kg

a = Acceleration of gravity (9.81 m/s^2)

C =0.004 on asphalt road

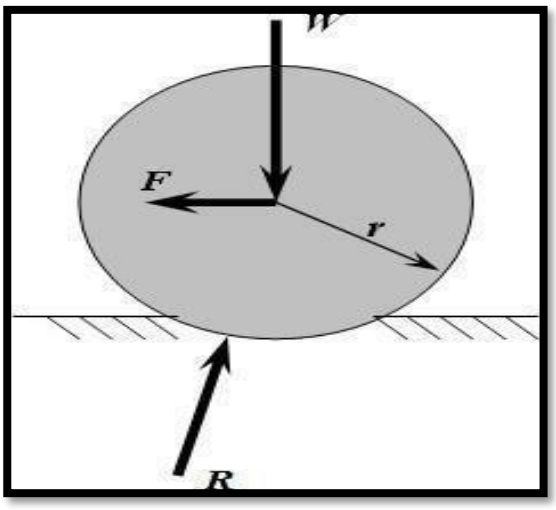


Figure 4.1 Rolling Resistance

e) Drag Force

A drag force is the resistance force caused by the motion of a body through a fluid, such aswater or air. A drag force acts opposite to the direction of the oncoming flow velocity. This is the relative velocity between the body and the fluid.

$$\textbf{Drag force (Fd)} = \textbf{cd } \frac{\textbf{1}}{\textbf{2}} \textbf{ p (v} \times \textbf{v) a}$$

Cd = Drag coefficient (0.9)

P = Density of fluid (1.2 kg/m3 for air at

NTP)V = Flow velocity (m/s) (11.11)

A= Frontal area of body (m^2)

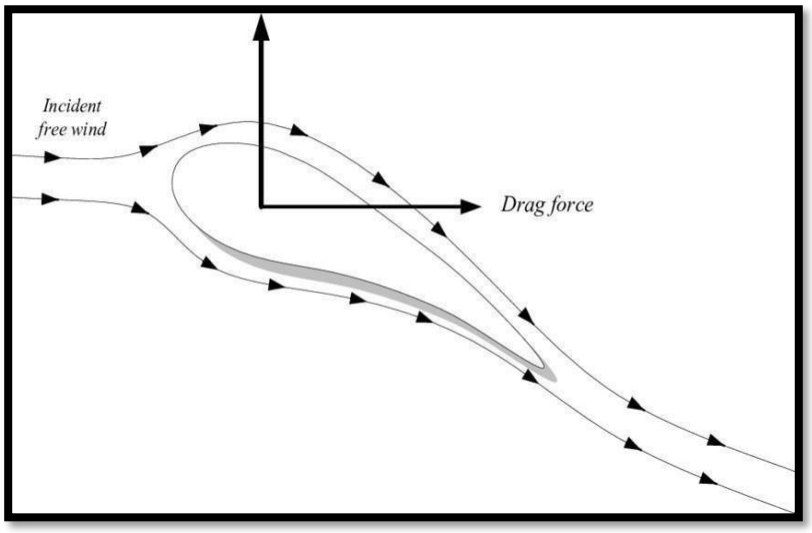


Figure 4.2 Drag Force

f) Torque

Torque, also called moment of a force, in physics, the tendency of a force to rotate thebody to which it is applied.

Torque = Force × Perpendicular distance of wheel

g) Power

Power in mechanical systems is the combination of forces and movement. In particular, power is the product of a force on an object and the object's velocity, or the product of a torque on a shaft and the shaft's angular velocity.

$$\mathbf{P} = \frac{2\pi NT}{60}$$

N is number of rotation calculated in rpm

T is torque or twisting moment calculated in Nm

So, the power transmitted by a circular shaft rotating at n rpm under action of torque t is $2\pi Nt/60$ KW. This power is calculated in SI units.

Parameters	**Value**
Wheel Diameter	406.4 mm
Drag force Coefficient	0.95
Torque	24 Nm
Power	6 kW
Motor RPM	2400 rpm
Wheel RPM	1000

4.3 Selection of Motor:

According to the weight, wheel size, speed, rpm etc. a proper motor to be selected for the vehicle (Hover board), that can give us a suitable and satisfactory speed result.

- ❖ Make the vehicle more user friendly, efficient and reliable aesthetically good

1) To make some space for carrying extra load:

Adding Cart/Basket in hover board makes the traveller easy to ride with its load and thus vehicle will be more reliable.

2) To Attach headlight:

Adding headlight in hover board will make the user easier to travel at night, and also can be used for long distance travelling.

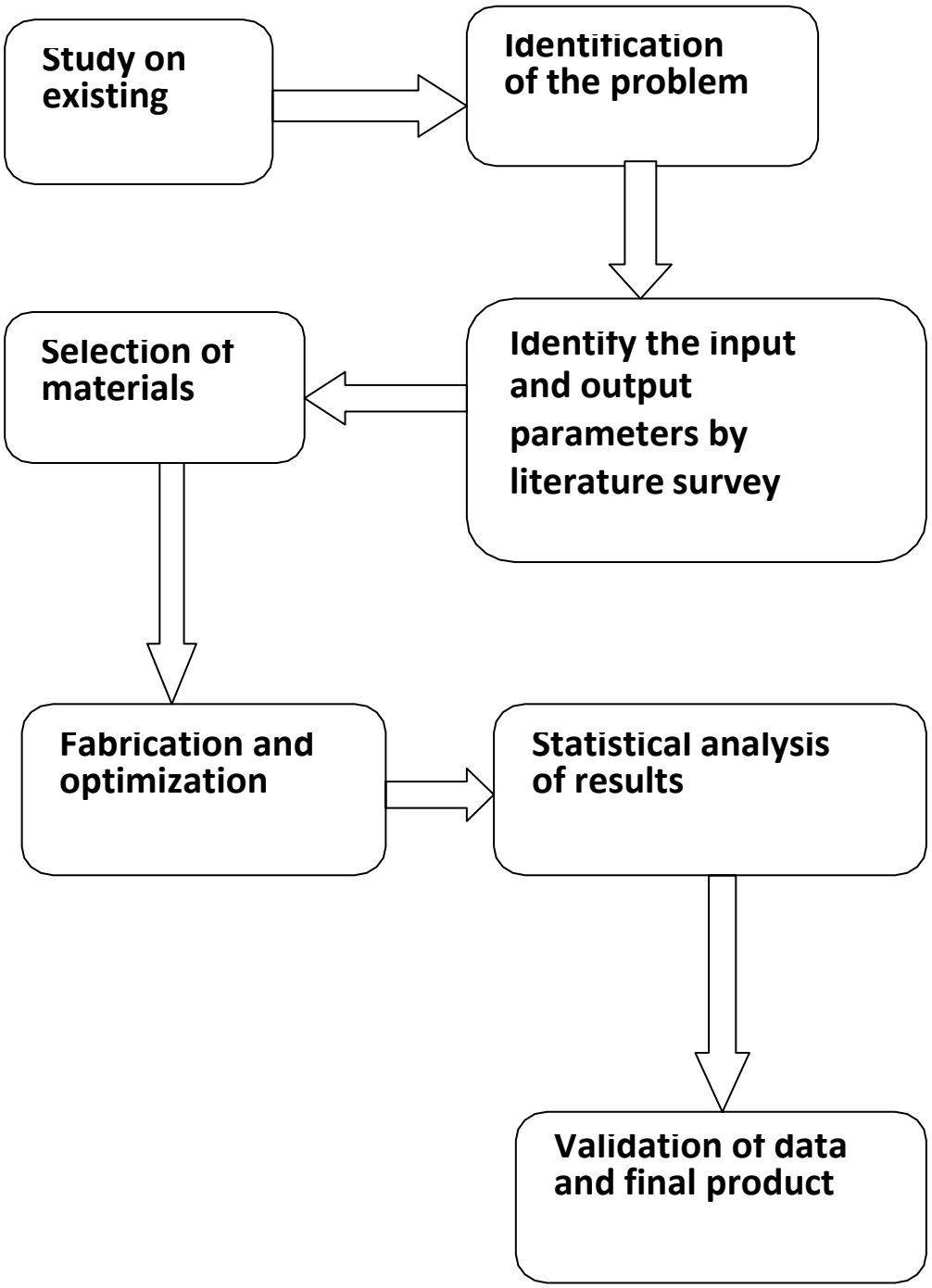
3) Easy Balance:

Balancing the vehicle will be easier by attaching small front and back wheel (trolley wheel).

4) Adding horn:

Vehicle will be safer and user friendly if we attach horn to warn others of the vehicle's approach or presence, or to call attention to some hazard.

4.4 Methodology chart



4.5 Proper Methodology of Executing the Project

Figure 4.3: Original Model

Figure 4.4: Disassembly of bike

Figure 4.5: Actual Frame/ Chassis

Figure 4.6: Actual Frame/ Chassis

Figure 4.7: Dismantle Bike

Figure 4.8: Making Battery Bracket

Figure 4.9: Making Battery base frame

Figure 4.10: Welding

Figure 4.11: Modify Bike

Figure 4.12: Modified Bike

4.1 Assembling of the Project

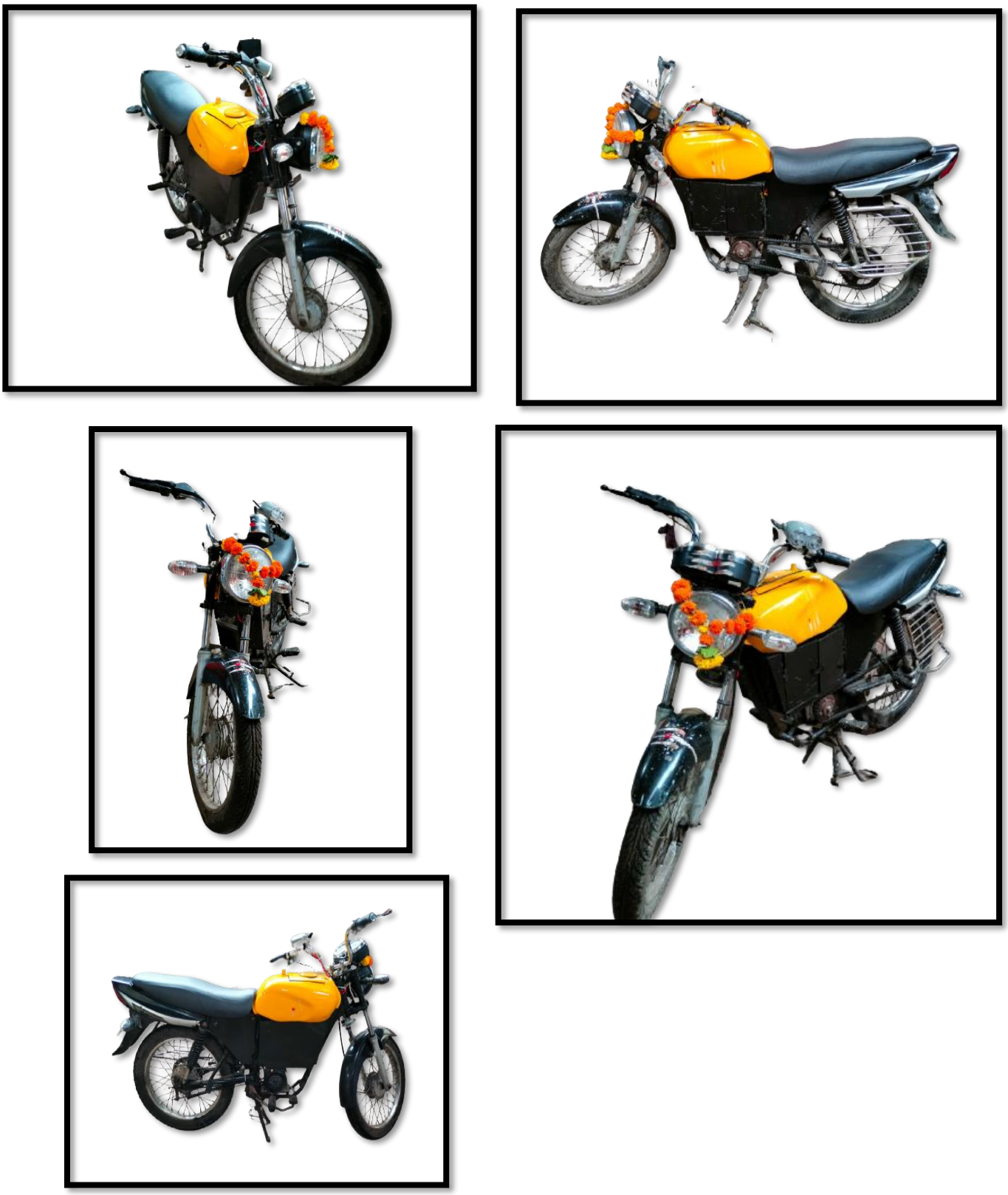


Figure 14.13: Assembling of the Project

CHAPTER – 5

Details of design, Working and Process

5.1 Construction & Main Components

- A.C servo/ Brushless d.c motor
- Microcontroller
- Chassis of a 100 cc motorcycle
- Dry lead batteries
- A chain system
- Insulation
- Wiring and protection system
- Sprockets
- Braking System
- Bulbs, indicator and speedometer and other electrical components of a bike

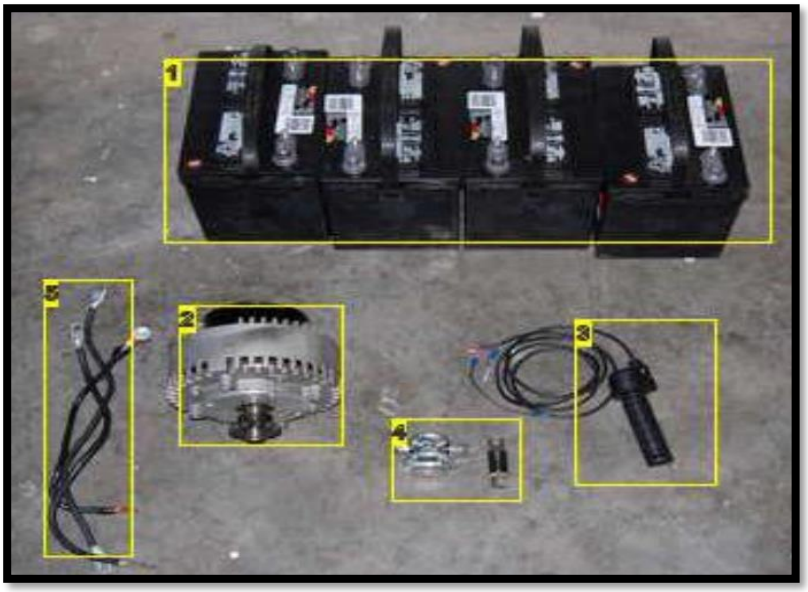


Figure 5.1. Various components used

1. Lead Acid batteries
2. BLDC motor
3. Throttle
4. Fuse
5. Connecting wires

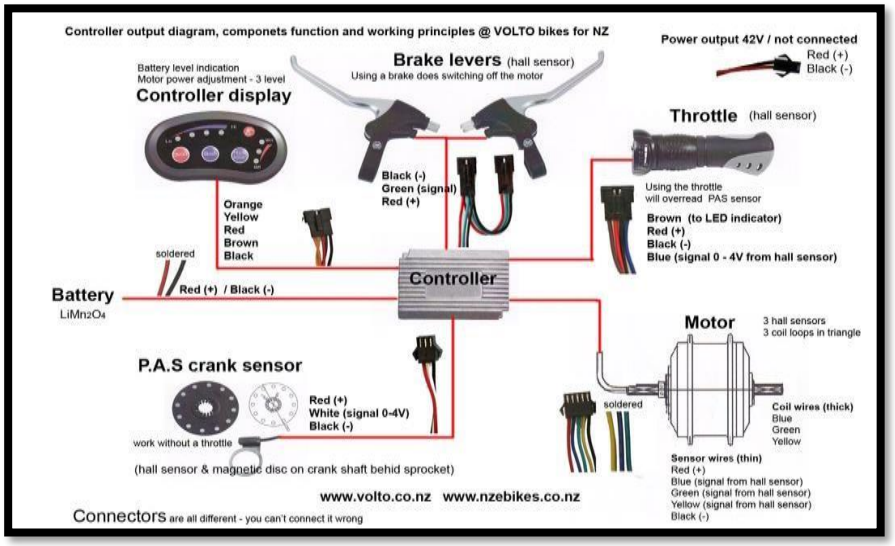


Figure 5.2 Wiring and Working Construction

Working And Specification Of Each Component:-

1. **BLDC motor**: The motor is having 750 watt. Capacity with maximum 400 rpm. Its specifications are as follows:
   - Current Rating: 13.4 A
   - Voltage Rating: 48 Volts
   - Cooling: Air – coo
   - led
   - Bearing: Single row ball
   - Rated Speed: 400 Rpm
   - Efficiency: 80

Figure 5.3 BLDC Motor.

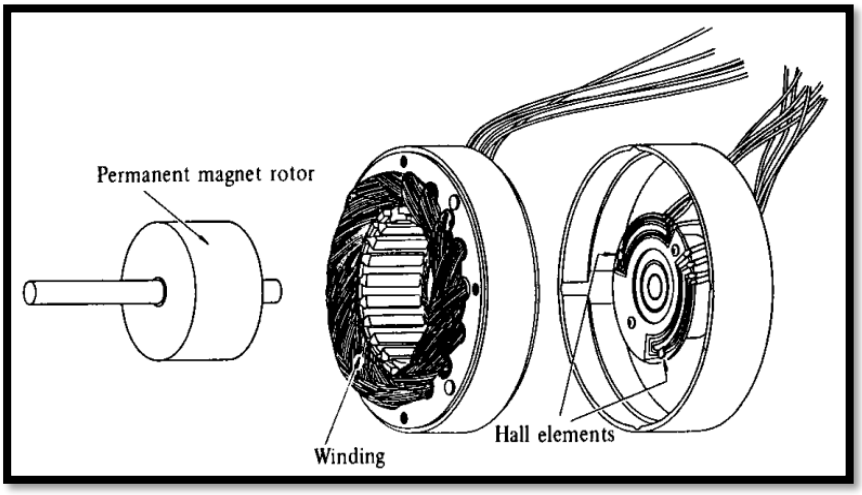


Figure 5.4 Structure of a BLDC motor.

BLDC Motor Advantages:

• High Speed Operation – A BLDC motor can operate at speeds above 10,000 rpm under loaded and unloaded conditions.

• Responsiveness & Quick Acceleration – Inner rotor Brushless DC motors have low rotor inertia, allowing them to accelerate, decelerate, and reverse direction quickly.

• High Power Density – BLDC motors have the highest running torque per cubic inch of any DC motor.

Rotor

The rotor is made of permanent magnet and can vary from two to eight pole pairs with alternate North (N) and South (S) poles; we have 8 magnets on rotor and eight poles windings on Stator. Based on the required magnetic field density in the rotor, proper magnetic material is chosen to make the rotor. Circular core with rectangular magnets inserted into the rotor core Unlike a brushed DC motor, the commutation of a BLDC / AC Servo is controlled electronically.

2. **Microcontroller:** A motor controller is a device or group of devices that serves to govern in some predetermined manner of performance of an electric motor. A motor controller might include a manual or automatic means for starting and stopping the motor, selecting forward or reverse rotation, selecting and regulating the speed, limiting or regulating the torque, and protecting against overloads and fault. In this project we are using "sine wave vector controller". The battery block is interfaced with the motor controller block. The motor controller controls all the functional capabilities and is the central component of the system. The basic requirement for the control is to regulate the amount of power applied to the motor, especially for DC motors. The motor controller can be adjusted to synchronize with other brushless motors.

SPECIFICATIONS OF CONTROLLER USED

Max Current – 35 A

Under Voltage 42 + OR – 0.5 %

Phase Angle - 120 degree

Figure 5.5 Microcontroller.

3. **Frame:** The Frame is made up of M.S. along with some additional light weight components. The frame is designed to sustain the weight of the person driving the unit, the weight of load to be conveyed and also to hold the accessories like motor. Also it should be design to bear and overcome the stresses which may arise able to due to different driving and braking torques and impact loading across the obstacles. It is drilled and tapped enough to hold the support plates.

Figure 5.6 Bike Frame.

4. **Battery:** The battery also acts as a condenser in a way that it stores the electric energy produced by the generator due to electrochemical transformation and supply it on demand. Design and Fabrication of Electric Bike. Battery is also known as an accumulator of electric charge. This happens usually while starting the system.

(Lead Acid Pack of 4 Battery in Series)

Figure 5.7. Battery

We have used four used batteries from the manufacturer – Each battery is with rated voltage of 12V and 18 Ampere-hours. Thus those four batteries connected in series give us a total of 48V.

The batteries are dry Lead batteries and together weigh 22 kilograms. They have a full charging time of 6 hours and give us a range of 40 – 45 kms on a full charge

The advantages of SLA batteries are mentioned below:-

a) Sealed/Maintenance-Free

The valve regulated, spill-proof construction of these batteries allows trouble-free and safe operation in any position. There is no need to add electrolyte, as gases generated during overcharge are recombined in a unique "oxygen cycle."

b) Design Flexibility

Batteries may be used in series and/or parallel to obtain choice of voltage and capacity. Due to recent design breakthroughs, the same battery may be used in either cyclic or standby applications.

c)Deep Discharge Recovery

Special separators, advanced plate composition, and a carefully balanced electrolyte system have greatly improved the ability of recovering from excessively deep discharge.

d) Economical

SLA batteries are economical in their class.

e) Compact- The high energy density results in superior power/volume and power/weight ratios.

5. **Chain Drive**: A Chain is an array of links held together with each other with the help of steel pins. This type of arrangement makes a chain more enduring, long lasting and better way of transmitting rotary motion from one gear to another.

Figure 5.8 Chain Drive

The major advantage of chain drive over traditional gear is that, the chain drive can transmit rotary motion with the help of two gears and a chain over a distance whereas in traditional many gears must be arranged in a mesh in order to transmit motion.

Thus we used a single gear system of which the gear were of sizes 15 spokes and 47 spokes on motor shaft and rear tyre respectively. We got the original RX 100 15 spoke gear wielded by bronze wield on the shaft of the motor and used a customized 47 spoke gear on the rear wheel to increase the starting pick up of the bike. A suitable customized chain was used for the system.

6. **Braking System:** For the braking system it is convenient to use braking system used in band brake system which consist of spring loaded friction- shoe mechanism, which is driven with the help of hand lever.

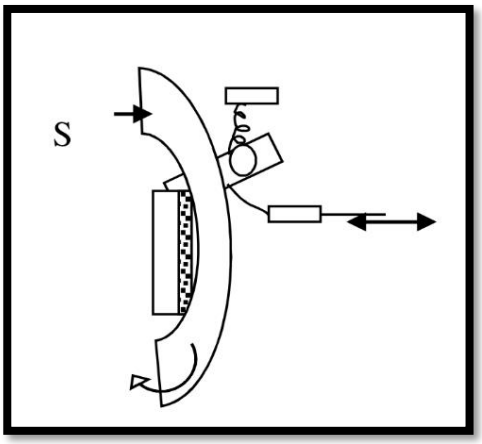


Figure 5.9 Braking System.

7. **Sprockets:** The chain with engaging with the sprocket converts rotational power in to rotary power and vice versa. The sprocket which looks like a gear may differ in three aspects:

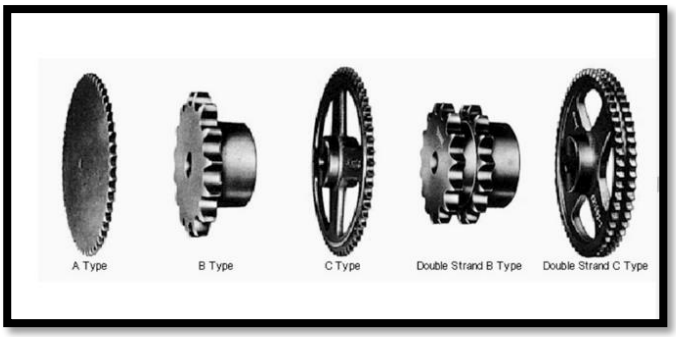


Figure 5.10 Various types of Sprockets

- Sprockets have many engaging teeth but gears have only one or two.
- The teeth of a gear touch and slip against each other but there is basically no slippage in case of sprocket
- The shape of the teeth are different in gears and sprockets.
- (Barve, Design and Development of Solar Hybrid Bicycle, March 2016)

8 Electrical Wire

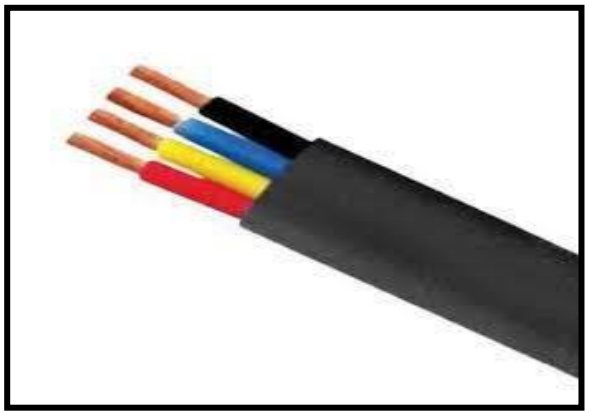


Figure 5.11 Electrical Wire

This type of wiring is typically less expensive to manufacture than a multi-stranded wire as it does not require as much processing.

Single stranded wire is not as flexible as the alternative. This lack of flexibility can increase the likelihood of metal fatigue and the wire snapping as a result. Because of this, single stranded wires are best suited for products that won't encounter much movement.

8. MCB

Miniature Circuit Breakers, The MCB is an electromechanical device that switches off the circuit automatically if an abnormality is detected. The MCB easily senses the overcurrent caused by the short circuit. It automatically switches OFF electrical circuit during any abnormal condition in the electrical network such as overload & short circuit conditions. However, fuse may sense these conditions but it has to be replaced though MCB can be reset.

Figure 5.12 MCB

9. Speedo Meter

speedometer, instrument that **indicates the speed of a vehicle**, usually combined with a device known as an odometer that records the distance traveled. A speedometer, **A speedometer measure the speed of a vehicle in motion**. It records the speed in km/h. Odometer records the distance travelled by the vehicle. **Mechanical speedometers measure the speed of a car by being linked mechanically with the gearbox output shaft**

Figure 5.13 Speedo Meter

10. Horn

The patented **Hornit dB140** is the loudest cycle horn on the market and puts the cyclist in control of their own safety. It's small, sleek and enables cyclists to alert distracted drivers and pedestrians to their presence.

It is unlawful to install loud/power horns, horns of varying sounds, sirens (wangwang) and other similar devices on all types of vehicles traversing along the thoroughfares of Metro Manila.

Figure 5.14 Horn

11. Indicator

Some motorcycles have direction indicators combined with the position lamps. In these cases the position lamp does not have to switch off when the relevant direction indicator is switched on.

Indicator lights are **a type of illuminating device that is commonly used to signify that equipment is either receiving power or that there is some form of malfunction**. We have all seen the red light come on when you power on a device. That is an example of an indicator light.

Figure 5.15 Indicator

12. Relay

Relays are the switches which aim at **closing and opening the circuits electronically as well as electromechanically**. It controls the opening and closing of the circuit contacts of an electronic circuit.

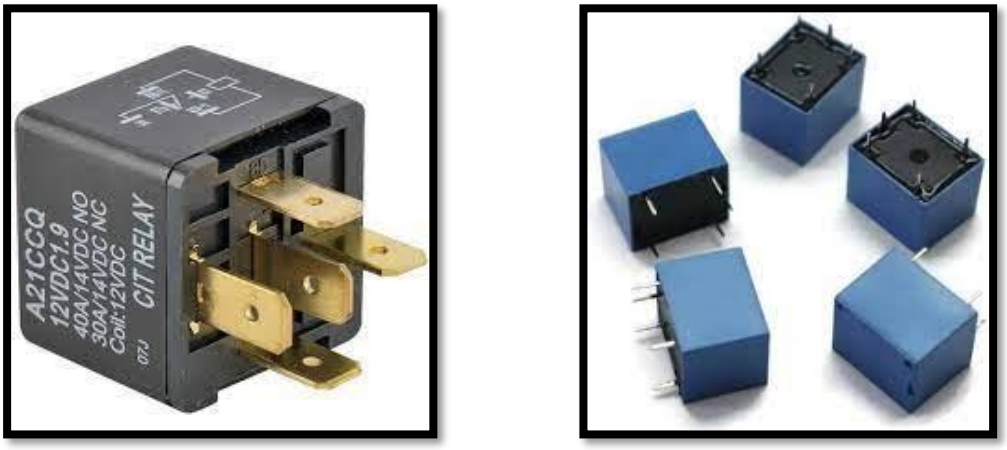


Figure 5.16 Relay

5.2 **Cost Estimation:**

Sr. no	Name of the component	Quantity	Cost (Rs.)
1.	BLDC Motor Kit	1	10,000
2.	Battery	4	9000
3.	Frame / Chassis	1	6000
4.	Battery bracket	1	4000
5.	Speedometer	1	1000
6.	Hardware Accessories	-	1000
7.	Electrical Accessories	-	1000
	Total		32,000/-

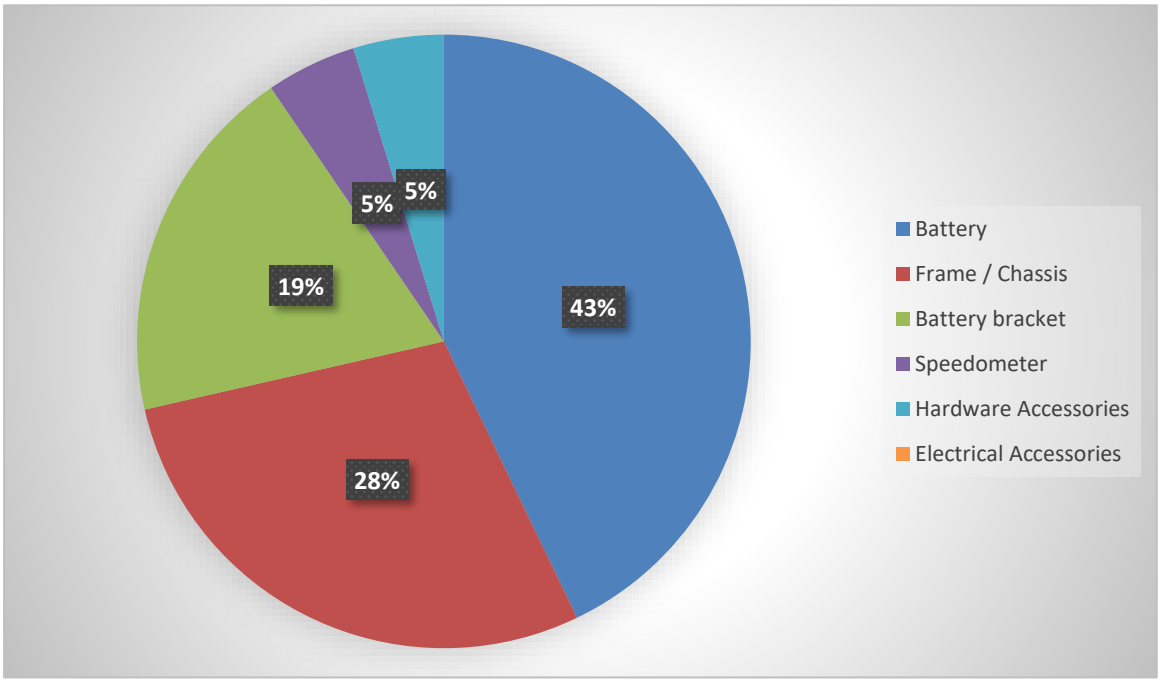


Figure 5.17: Chart of Cost Estimation

5.3 Advantages, Disadvantages & Applications:

➢ Advantages:

1. Stability
2. Easy riding
3. Less maintenance
4. Economical
5. Pollution free / zero emission
6. Helps to improve the posture while riding.

➢ Disadvantages:

1. Slow, having a max speed
2. Does not exactly say how far the Segway will go with riders of different masses
3. Heavy, weighing around 100lbs
4. Unlike bicycles, a drained Segway cannot be pedaled home or a charger

➢ Applications:

Electric bikes offer extended range and ease of use, which **allow riders to commute without arriving at work sweaty, haul heavier goods, use bikes for more errands, and take larger trips**. They also make it easier for older riders and those with disabilities to access Cycling.Personal Vehicle.

- Police forces for patrolling.
- Sports purpose.
- Off roading.
- Tourism industry

CHAPTER – 6

Results

The project parameters were analyzed in detail and based on the observation of this project will be manufactured with a reduced cost. It will give maximum average speed which have a time of Maximum with a maximum payload of 80-100 kgs. The main problem of higher cost will be reduced. The feasibility of a product in a market is essential for its development and this project definitely has a higher scope in the near future. The price of a Personal electrical vehicle that is available in the market is very higher for its range, it uses cutting edge technologies which has increased the price. In this project the manufacturing methods have changes. For balancing purpose, a gyroscopic sensor is used in the Hoverboards available in market, but in this project a support wheel is used to balance the vehicle. The charging time ishigher in this project as solid battery is preferred to reduce the cost.

Result obtained by load test carried out is the vehicle is able to gain load up to140 to 150kg. Speed Test: Result obtained by speed test carried out is that the vehicle is reached maximum speed. Up to 30 to 35km/hr.

CHAPTER – 7

Conclusion

From the above survey we have been designing an electric cycle. With the increasing use of natural resources of petrol, diesel it is important to shift our way towards alternate resources like the Electric cycle and others because it is essential to identify new way of transport. It will help to reduce carbon emission due to IC engines and its costs really less then a scooter. The system introduced is an innovative step to increase the sales of electric cycle.

Nowadays, utilization of fuel vehicles is increasing drastically which may result into more air pollution. To control the utilization of fuel, electric scooter should be promoted as its cheaper then usual scooter and eco-friendly.

We calculated Torque and power to select Motor for the scooter. From this study we understood how to design an Electric cycle.

Basically, this investigation has successfully achieved the objective with an acceptable outcome. The main goal of this project was to build two functional wheels and a two-wheeled support vehicle and this goal has been achieved. Overall, the performance and performance of the vehicle has been carefully monitored with multiple test drivers. The car has been tested for many different weights. This project begins with the idea of finding an effective solution to the transportation problem.

Personal electric vehicles are technically feasible now. However, suppliers have not yet arrived at a set of practical vehicles that best match technical feasibility and consumer demand.

• Part of the challenge is to under-stand the relative trade-offs among cost, weight, range and other dimensions of vehicle performance.

CHAPTER – 8

Future Scope

E-bikes have grown so has the level of acceptance -some would say tolerance- of e-bikes throughout cycling circles and wider society. As the well-known saying goes.
In future we can also attach solar panel to charge the battery. The future scope of this research can be aimed towards design of hybrid karts, solar powered karts, fuel cell powered karts, and hydrogen powered karts in order to reduce the use of fast depleting fossil fuels. Future weather proofing of battery box, motor controller needs to be considered and implemented.

As we know every automobile industry is going electric, It is more efficient. It is also eco-friendly as it doesn't emit any smoke. Electrical engines are low maintenance; just require the lead-acid or lithium-polymer batteries to charge after every run. Some karts are even fit with hydrogen fuel cells. Over the last five years, we have seen a great market spike in business of go kart. The industry is flourishing. Many big companies are willing to invest in this sector as its popularity is growing immensely. Even in India, we have seen the same growth as worldwide. Many small industries are trying to make their presence in this industry. They are making small spare parts and contributing the industry

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Appendix A

CERTIFICATE

This is to certify that Mr. **Abdulaziz Shaikh** from (Institute) V.E.S POLYTECHINC having Enrolment No: **1900040458** has completed Project Reporthaving title Electric Bike Individually/ in a group consisting of **4** Candidates under theguidance of the faculty guide.

Name & Signature of Guide

…….

Appendix—B

PROGRESSIVE ASSESSMENT (PA) OF CAPSTONE PROJECT — EXECUTION AND REPORT WRITING

Evaluation Sheet for Internal Assessment

Name of Student: Abdulaziz Shaikh

Name of Programme: Mechanical Engineering **Semester:** Sixth

Course Title: Capstone Project Execution and Report Writing **Code:**22060.

Title of the Capstone Project: Electric Bike

A. POs addressed by the Capstone Project (Mention only those predominant POs)

PO1: Basic and Discipline specific knowledge: Apply knowledge of basic mathematics,science and engineering fundamentals and engineering specialization to solve the engineeringproblems.

PO2: Problem analysis: Identify and analyse well-defined engineering problems using codified standard methods.

PO3: Design/ development of solutions: Design solutions for well-defined technical problemsand assist with the design of systems components or processes to meet specified needs.

PO4: Engineering Tools, Experimentation and Testing: Apply modern engineering tools and appropriate technique to conduct standard tests and measurements. 18

PO5: Project Management: Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about welldefined engineering activities.

PO6: Engineering Practices for Society, sustainability and Environment: Apply appropriate Technology in context of society, sustainability Environment and ethical practices

PO7: Life long Learning: Ability to analyse Individual needs and engage in updating in the context of Technological changes.

B. COs addressed by the Capstone Project (Mention only those predominant POs)

a) Implement the planned activity individually or as a team

b) Select, Collect and use required information/knowledge to solve the identified problem

c) Ensure quality in product

d) Prepare project report after performing due plagiarism check using appropriate tools.

C. OTHER LEARNING OUTCOMES ACHIEVED THROUGH THIS PROJECT

1 . Unit Outcomes (Cognitive Domain)

a) To identify various automobile components and their location on the given vehicle

b) To identify the major components of the given transmission system

c) Select the relevant battery for the given application

d) To select the relevant service tools for relevant service operation

2. Practical Outcomes (in Psychomotor Domain)

a) To dismantle/assemble the wheel and tyre assembly

b) Maintain given simple automobile component using various service tools

c) To dismantle/assemble the steering mechanism

d) To test the lead acid battery

3. Affective Domain Outcomes

a) ……

b) ……

c) ……

d) ……

PROGRESSIVE ASSESSMENT (PA) SHEET		
S. No.	Criteria	Max Marks
1	Project Proposal / Identification	10
2	Punctuality and overall contribution	
3	Project Diary	
4	Execution of Plan during sixth semester	20
5	Project Report Including documentation	15
6	Presentation	05
Total		50

APPENDIX – B

Suggested Rubric for Capstone Project – Execution and Report Writing

S. No.	Characteristic to be assessed	Poor	Average	Good	Excellent
1	**Problem/Task Identification (Project Title)**	Relate to very few POs Scope of Problem not clear at all	i. Related to some POs ii. Scope of Problem/Task vague	i. Take care of at-least Three POs ii. Scope of Problem/task not very specific	• Take care of more than three POs ii. Scope of problem/task very clear
2	**Literature Survey /Industrial Survey**	Not more than ten sources (primary and secondary), very old reference	At-least 10 relevant sources, at least 5 latest	At –least 15 relevant sources, most latest	About 20 relevant sources, most latest
3	**Project proposal**	Methods are not appropriate, All steps not mentioned, Design of prototype not started (if applicable).	Appropriate plan but not in much detail. Plan B for critical activities not mentioned. Time line is not developed. Design of Prototype is not complete. (if applicable)	Appropriate and detailed plan with Plan B for critical activities mentioned, but clarity is not there in methods, time line is given but not appropriate. Design of prototype is not detailed (if applicable)	Appropriate and detailed plan with Plan B for critical activities mentioned, clarity in methods with time line, Detailed design of prototype (if applicable)
4	**Project Diary**	Entries for most weeks are missing. There is no proper sequence and details are not correct.	Entries for some weeks are missing, details are not appropriate, not signed regularly by the guide.	Entries were made every week but are not in detail. Signed and approved by guide every week	Entries were made every week in detail, signed and approved by guide every week
5	**Final Report Preparation**	Very short, poor quality sketches, Details about methods, material, precaution and conclusions	Detailed, correct and clear description of methods, materials, precautions and	Conclusions. Sufficient Graphic Description.	Very detailed, correct, clear description of methods, materials, precautions and conclusions. Enough tables,
		omitted, some details are wrong			charts and sketches
6	**Presentation**	Major information is not included, information is not well organized .	Includes major information but not well organized and not presented well	Includes major information and well organized but not presented well	Well organized, includes major information ,well presented
7	**Defense**	Could not reply to considerable number of question.	Replied to considerable number of questions but not very properly	Replied properly to considerable number of question.	Replied to most of the questions properly

Photographs

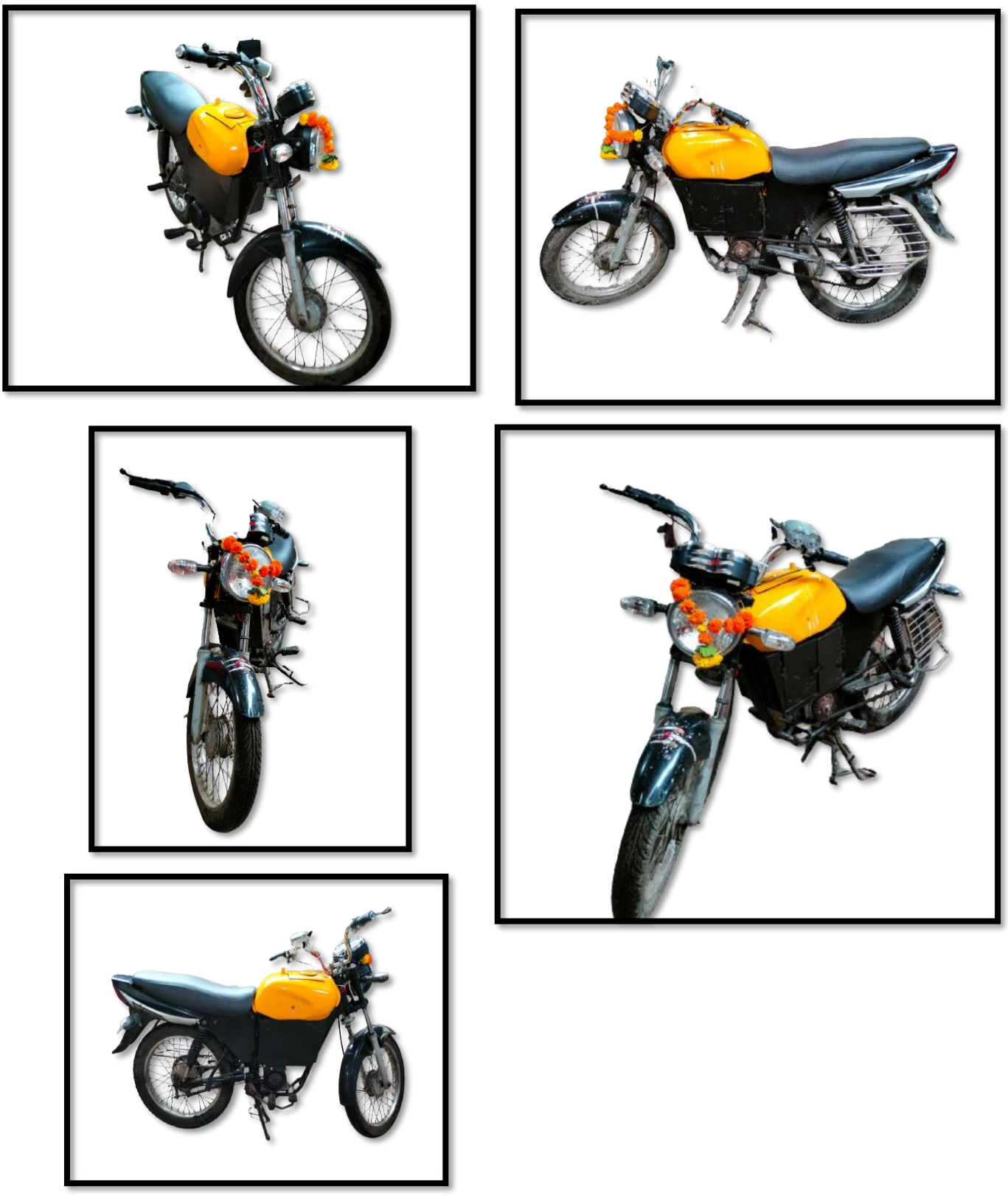

Figure 8.1 : Actual Model of our Project

Group Photo

Students Profile

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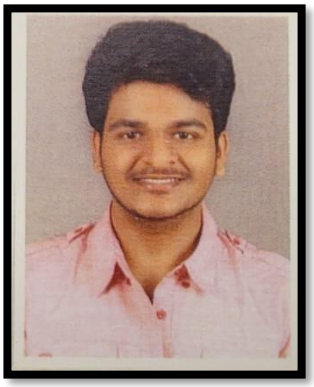

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