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Assembling, Improvisation & Testing of Electric - Cycle

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Abstract - The Project aims to develop an Electric-Cycle which can be an alternative to the conventional modes of transports which runs on petrol and diesel and can be economical in daily life usage. An Electric- cycle is easy to charge and easy to maintain electric vehicle and can be used by every age group and afford by every class of citizen.

The Conventional modes of transports uses fossil fuel as their energy generator for running. Usage of fossil fuels leads to Environmental damage in various ways, and causing Global warming. Considering these issues, Governments across the globe are encouraging citizens to use clean sources of energy even in the commuting and transport. These gave rise to the use of Electric vehicles and making way for various alternatives in the automobile industries one of the most accessible types of Electric vehicle is E-Cycle, which can be available to large number of people at affordable cost. The use of E-Cycle can serve the purpose of daily commutes as well as limiting the damage to the nature. There is a provision for a charging the battery by ejecting it from the main system. The electrical power generated which is used to run the bike can give better fuel economy compared to conventional vehicle, better performance and also causes less pollution.

***Keywords*:** Electric-Cycle, Economical, Fossil fuel, Alternative, Global warming, Pollution etc.

1. INTRODUCTION

1.1. General overview:

Energy crisis is one of the major concerns in today's world due to fast depleting resources of petrol, diesel and natural gas. In combination with this, environmental decay is an additional factor which is contributing to the depletion of resources which is an alarming notification. Our project proposes the solution for these above perilous problems. The system which we innovated is the Electric Bike. This project has various benefits both to the members of the team and also external benefits thereby making awareness of using alternative modes of transport. The Electric Bike which works on the battery that is powered by the motor is the general mode of transport for a local trip. The Electric bike which will be running on battery, the power is supplied by the motor, thereby supplying this power to drive the other equipment such as horn, headlight, digital instrument cluster, etc. The main purpose of using this E-bike is that it is user friendly, economical and relatively cheap. The efficiency of this system undeniable compared to conventional modes of transport.

The electric bicycle is an electrical-assisted device that is designed to deliver the electromagnetic momentums to a present bicycle therefore relieving the user of producing the energy essential to run the bicycle. It contains a strong motor and enough battery power that just needs charging to help in hill climbing, generate greater motoring speeds and provide

Figure 1.1 Electric Cycle

Completely free electric transportation.

The primary principle for the Universities support of the electric powered over the petrol powered has been towards improving air quality, increasing demand for non-polluting mechanized transportation has revived the interest in the use of electric power for personal transportation.

Main reason to identify the need of finding and modifying E-Bike is to overcome the issue of the pollution because of vehicles in metro towns & urban zones is swelling uninterruptedly. Considering the all class of society it is not reasonable for all to purchase (scooters, mopeds or motorcycles).

So, combining both issues, environmental progress supporting and economical affordable alternative would be the best solution. Typical parts of E-bike (Electric Bicycle) are Brushless DC Motor (Hub Motor), Throttle (Accelerator), Battery Storage, Chain Drive, Frame and other common bicycle parts.

An electric bicycle, also known as an e-bike or booster bike, is a bicycle with an integrated electric motor which can be used for propulsion. There are a great variety of e-bikes available worldwide, from e-bikes that only have a small motor to assist the rider's pedal-power (i.e., pedals) to somewhat more powerful e-bikes which tend closer to moped-style functionality: all, however, retain the ability to be pedaled by the rider and are therefore not electric motorcycles. E-bikes use rechargeable batteries and the lighter varieties can travel up to 25 to 32 km/h (16 to 20 mph).

2. Aim and Objective

2.1. Problem Statement:

The Newer modes of commute are required to have pollution free travel within the city. The current gas-powered vehicles emit a large amount of carbon emissions into the air that cause damage to the atmosphere and contribute to environmental problems such as global warming. Energy crisis is one of the major concerns in today's world due to fast depleting resources of petrol, diesel and natural gas.

Electric vehicles have absolutely no emissions from them, which is a wonderful thing for the environment because no further damage is being done. The most affordable and accessible electric vehicle is a Electric-Bike. The main advantage of using a E-bike is that it is user friendly, economical and relatively cheap. The efficiency of this system undeniable compared to conventional modes of transport.

Earlier E-Bikes have been developed using DC motors and Lead Acid batteries. But those E-bikes were lacking the good range in single charge and were noisy in operation because of use of chain drive to power the rear wheel. Lead Acid batteries was slow and inefficient in charging with limited useable life.

Thus, there is a need to develop an Electric-Bike which is efficient, having good speed and range, easy to maintain and user friendly.

2.1. Objective of the Project:

The primary goal is to make electric bicycle operative as it mainly only entails building cost as running cost would only require the charging of the battery. To achieve this goal, the following objectives have been identified:

1. To manufacture an E- cycle while upgrading conventional cycle, which will be more efficient and effective for travelling.
2. To test E- cycles for various conditions like battery capacity for range of specific distance, Top speed, braking system, Hill climb, Pedal assist, etc.
3. To save money on Fuel consumption.
4. To build a E-cycle which can achieve top speed of 30 kmph and Range of 40 – 45 km in a single charge.

2.2. Scope of the project:

1. Smart contracts and block chain technology to create a secure and decentralized system for electric cycle rentals, maintenance, and repair.

2. Developing autonomous electric cycles, which can be remotely controlled or programmed to navigate a predetermined route.

3. We can integrate health and wellness monitoring features into electric cycles, such as heart rate monitors, calorie trackers, and other fitness-related sensors.

4. Focus on developing advanced safety features for electric cycles, such as collision detection and avoidance systems.

5. Life integrating electric cycles with renewable energy sources, such as solar or wind power, to reduce the environmental impact of the bikes.

6. Maintenance and repair systems for electric cycles, including automated diagnostics and repair processes, to ensure that the bikes are always in good working order.

3. Literature review

The main purpose of literature of review is to give an overview on Electric Cycle, its importance, process of improvisation and its fabrication etc.

1. **Ogden Bolton Jr and et al. [1],** of Canton Ohio in A patent application for an "electrical bicycle" explained that the bicycle ran on 10-volt battery power, in which the motor could draw power up to 100 amperes. The hub motor was used placing in the back wheel.

2. **Ranjan Kumar and et al. [2]** researchers describe the "Design and Fabrication of Electric Bicycle" explained that the project is designed to improve the normal bicycle and make it extra efficient. The electric bicycle is a hybrid and so it can run electrically and can also be pedaled thereby still retaining the exercise people drive from riding bicycle. The calculated No load speed of bicycle is = 20.66Km/hr. The Required power is =391.69 watt.

3. **Kunjan Shinde and et al. [3],** author describes the "Literature Review on Electric Bike" explained that with the increasing consumption of natural resources of petrol, diesel it is necessary to shift our way towards alternate resources like the Electric bike and others because it is necessary to identify new way of transport. e. It can be used for shorter distances by people of any age.

4. **Shweta Matey and et al.** [4] author describes the research done on the "Design and Fabrication of Electric Bike" explained that with the increasing consumption of natural resources of petrol, diesel it is necessary to shift our way towards alternate resources like the Electric bike and others because it is necessary to identify new way of transport. The Operating cost per/km is very less and with the help of solar panel it can lessen up more. Since it has fewer components, it can be easily dismantled to small components, thus requiring less maintenance.

5. **Mitesh Trivedi and et al.** [5] author describes about "Design & Development of E-Bike - A Review" explained that Modern world demands the high technology which can solve the current and future problems. Fossil fuel shortage is the main problem now-a-days. Considering current rate of usage of fossil fuels will let its life up to next five decades only. Typical parts of E-bike (Electric Bicycle) are Brushless DC Motor (Hub Motor), Throttle (Accelerator), Battery Storage (12 V), Chain Drive.

6. **Jaromir Konecny and et al.** [6]**,** In this study, "Developing of an E–Bike Testing Station and Measuring of Efficiency of E–Bikes" explained the testing of Electric- Bike. Quality check in industrial process is required in more and more fields. One of such field is electric bicycle. Electric bicycles become more popular for general public due comfortable and ecologic possibility to transport. Before the electric bike leaves the factory, it should be tested. This chapter shortly described E-bike test procedure. The four basic tests are presented in this article. 1) Support test 2) Quick stop test 3) Reverse pedals spinning test 4) Load test.

7. **Ming Shen and et al.** [7]**,** author describes about "A review on battery management system from the modeling efforts to its multiplication and integration" explained Progress in battery technology accelerates the transition of battery management system (BMS) from a mere monitoring unit to a multifunction integrated one. It is necessary to establish a battery model for the implementation of BMS's effective control. With more comprehensive and faster battery model, it would be accurate and effective to reflect the behavior of the battery level to the vehicle. On this basis, to ensure battery safety, power, and durability, some key technologies based on the model are advanced, such as battery state estimation, energy equalization, thermal management, and fault diagnosis.

8. **Omkar Chitnis and et al.** [8]**,** author investigated in "A Review on Battery Management System for Electric Vehicles" explained the purpose of the BMS is to guarantee safe and reliable battery operation To maintain the safety and reliability of the battery, state monitoring and evaluation, charge control, and cell balancing are functionalities that have been implemented in BMS.

4. Methodology

Planning and scheduling of the events which are sketched down are essential to carry. The project work in proper order with precision and completing it in allotted time.

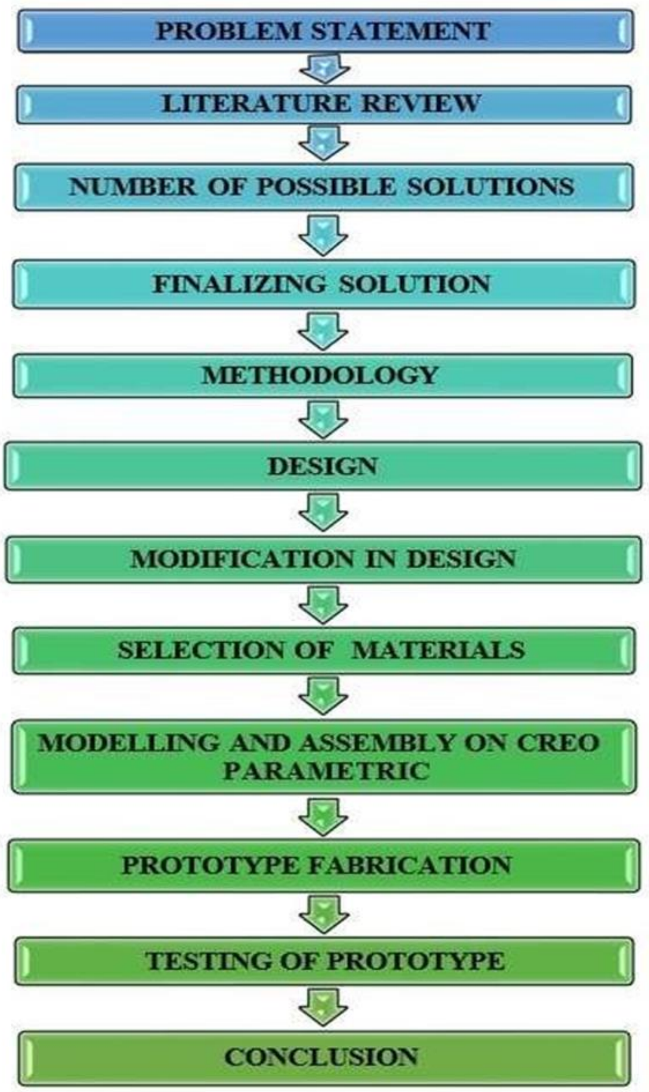


Figure 4.1 Sequential Flowchart

4.1. PROBLEM STATEMENT:

In this step Thrust areas were studied and problems existed were marked out. With proper survey, effects of problem identified were studied. Identified problem was further studied, understood, and need to solve the problem was discussed

4.2. NUMBER OF POSSIBLE SOLUTION:

In this step number of possible solution were find out after so much research. A large number of research paper and information related to problem statement were compile together tofind out the various possible solution.

4.3. FINALISING THE SOLUTION:

After finding out various possible solution, the most efficient and economical solution is chosen and finalized for further research.

4.4. DESIGN OF COMPONENTS:

We have done design of each part of oxyhydrogen generator for fulfilling following purposes:

A. To select proper materials and best suited shapes,

B. To select the dimensions based on the loads on machines and strength of the material,

C. Specify the manufacturing process for the manufacture of the designed components.

4.5 ASSEMBLY PROCEDURE:

In this step the manufactured components are assembled with proper care and procedure.

4.6. DETAILED MODELLING AND ASSEMBLY:

In this step we have done 2-D drawings of each device components and their 3D modeling on Cero or Solid works software.

4.7. FABRICATION OF PROTOTYPE:

In this step, fabrication of prototype take place in the CAD model is converted into realmanufactured product by using various processes.

4.8. TESTING OF PROTOTYPE:

After fabrication, manufactured product is check for its proper function by conducting the experiments on the device.

4.9. RESULTS AND CONCLUSION:

After experimentation and testing of product, results are taken and calculated further. Afterfinal results made, conclusions were concluded in this final step

5. Principle of working

An electric cycle works by providing assistance to the riders pedaling. When the rider starts pedaling, sensors on the electric cycle detect the pedaling motion and send a signal to the electric motor to start providing assistance. The motor then kicks in and provides additional power to help the rider pedal. The electric cycle is powered by a rechargeable battery, which is usually located on the frame of the cycle. The battery stores energy and provides power to the electric motor when the rider pedals. The electric motor is usually located in the hub of the cycle's rear wheel. The motor uses the energy from the battery to provide assistance to the rider's pedaling, making it easier to ride uphill or over longer distances. The controller is the brain of the electric cycle. It regulates the power output of the battery to the motor and

Controls the speed of the cycle. The controller also communicates with the sensors that detect the pedaling motion and adjust the power output of the motor accordingly. Electric cycle also has a throttle, which allows the rider to control the speed of the cycle without pedaling. The throttle is usually located on the handlebars and can be used to adjust the speed of the cycle by simply twisting it. Additionally, electric cycle has a display that shows information such as speed, battery level, and distance traveled. Overall, the working process of an electric cycle is designed to make cycling easier and more efficient, providing riders with an enjoyable and environmentally friendly mode of transportation

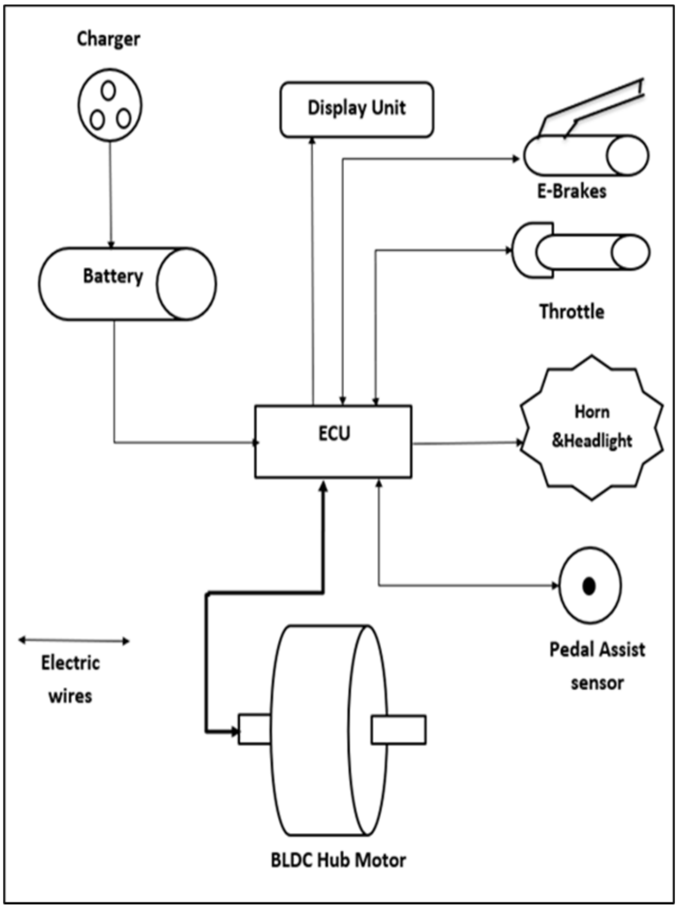


Figure 5.1 General Layout Electric Cycle

5.1 Battery:

The electric cycle is powered by a rechargeable battery, which is usually located on the frame of the cycle. The battery stores energy and provides power to the electric motor when the rider pedals. There are several types of batteries used in electric cycles, each with its own advantages and disadvantages. Some of the most common types of batteries used in electric cycles include:

Lithium-ion (Li-ion) batteries: As mentioned earlier, lithium-ion batteries are popular due to their high energy density, long cycle life, and low self-discharge rate.

Nickel-metal hydride (NiMH) batteries: NiMH batteries are a more affordable alternative to lithium-ion batteries. They have a lower energy density and shorter cycle life than Li-ion batteries, but are still widely used in electric cycles.

Lead-acid batteries: Lead-acid batteries are an older technology and are less commonly used in modern electric cycles. They are heavy and have a shorter cycle life than Li-ion and NiMH batteries, but are still used in some lower-cost electric cycles.

Lithium polymer (LiPo) batteries: LiPo batteries are similar to Li-ion batteries, but are more flexible and can be made into different shapes and sizes. They have a higher energy density than Li-ion batteries, but are more expensive and can be more volatile.

Sodium-ion batteries: Sodium-ion batteries are a newer technology that offer a lower cost and higher safety than lithium-ion batteries. However, they are still in the early stages of development and are not yet widely used in electric cycles. Overall, lithium-ion batteries are the most popular choice for electric cycles due to their high energy density and long cycle life. However, other types of batteries may be more appropriate for certain applications, depending on factors such as cost, weight, and safety.

5.1.1 Lithium-ion battery

Lithium-ion batteries are commonly used in electric cycles due to their high energy density, long cycle life, and low self-discharge rate. The battery is made up of multiple cells that contain a positive electrode (cathode), negative electrode (anode), and an electrolyte solution. During charging, the lithium ions from the cathode move through the electrolyte to the anode, where they are stored. During discharge, the ions move back to the cathode, producing an electric current that powers the motor of the electric cycle.

Figure 5.2 Lithium-ion Cell

Lithium-ion batteries are lightweight and compact, making them a good choice for electric cycles where weight is an important factor. They also have a high energy density, which means they can store a large amount of energy relative to their size and weight. This allows electric cycles to have a longer range and more power than other types of batteries. Lithium-ion batteries also have a long cycle life, meaning they can be charged and discharged many times without significantly degrading their performance.

However, lithium-ion batteries require careful handling and charging to ensure their safety and longevity. Therefore, it's important to use a charger designed specifically for the battery and to follow the manufacturer's instructions for proper handling and storage. With proper care, lithium-ion batteries can provide reliable and efficient power for electric cycles.

5.1.2 Battery Calculation:

The weight of cycle (mass) is 100 kg and maximum speed is 45 kph. The kinetic energy KE is at 36 is $1/2 \times m \times v = 1/2 \times 100 \times 315 = 1750$ Joules.

To accelerate to 45 kmph into 12 seconds required.

Current consumption by motor:

$P = V \times I = 250$

$I = 250$

0.25 N/ 42V

Watt Hour Calculation:

Assume running time 1 Hr

P = 250 watt × 1 = 250 watt- Hr

Amp Hour Calculation:

Source must have 20% - 30% more energy, assume 20% energy

Watt Hr = 250watt × 1.6 = 400

Ampere Hr = Watt-Hr / Battery terminal

= 400 / 42

= 9.52 Ah

Battery Rating = 9.52 Ah and 42 volt

Theoretical Calculation:

Designing Battery Pack for 40 km travel

Motor 250 watt BDLC motor

Efficiency considered 80%

Speed considered 30 kmph

For 40 km = 40/30 = 1.33

Figure 5.2.2 Lithium-ion Battery pack

Battery Pack Capacity = Power × Travel Factor / (motor + battery pack efficiency)

= 250 × 1.33 / (0.90 + 0.85)

Battery Pack Capacity = **434.64 watt**

5.2 Battery Charger:

Lithium-ion battery charger is a device used to recharge the lithium-ion battery that powers an electric cycle. Lithium-ion batteries are commonly used in electric cycles due to their high energy density, lightweight, and long lifespan. The charger should have safety features to prevent overcharging, overheating, and short circuits. These features may include

Figure 5.3 Battery Charger

overcharge protection, thermal protection, and short circuit protection. A portable and lightweight charger can be more convenient for users who need to charge their electric cycle's battery while on the go. The charger should be compatible with the electric cycle's lithium-ion battery, and it is recommended to use the charger provided by the cycle's manufacturer. A charging indicator can help the user monitor the charging progress and ensure that the battery is fully charged before disconnecting the charger.

Here are essential considerations for an electric cycle's lithium-ion battery charger:

i. Voltage and Current Rating: 36V and 3.2 Amp
ii. Charging Time: 3Hr 15Mins

Time required for full Charging of battery

Charger Ampere = (A) = 3.2 Ampere

Battery Capacity (Ah)= 10.4 Ah.

Charging time = Battery Capacity ÷ Charger Ampere

Ah÷A = 10.4 ÷ 3.2 = 3.25 Hr

Time required for full charging of battery is 3 hours 15 min

Battery life span:- 800 life cycle

1 life cycle = Full charging from 0% to 100%

Battery form 0% to 100% can charged upto 800

After that efficiency will reduce to 10%

5.3 BLDC Hub Motor:

A BLDC (Brushless Direct Current) hub motor is a popular type of motor used in electric cycles. Compared to traditional brushed motors, BLDC hub motors are highly efficient and durable, making them an excellent choice for electric cycles. These motors are designed to provide high torque and power output while minimizing energy consumption.

One of the main benefits of a BLDC hub motor is its efficiency, with efficiency rates of up to 95%. This means that they can provide high power output while minimizing energy consumption. The power output of a BLDC hub motor can vary depending on the size and specifications of the motor. Higher power output motors can provide faster acceleration and higher top speeds.

Figure 5.4 BDLC HUB Motor

Another important feature of a BLDC hub motor is its high torque. This makes it ideal for climbing hills or carrying heavier loads. Additionally, some BLDC hub motors feature regenerative braking, which can help recharge the battery while slowing down or braking the electric cycle.

5.3.1 Motor Calculation:

Here are essential considerations for an BDLC HUB Motor:

Power = 250 Watt

Voltage = 36 V

Torque = 40 N

➢ **Rolling Resistance Force (Fr):**

Fr = m × g × Cr

Where,

m = Mass

g = Gravitational Force = 9.81 m/s2

Cr = Coefficient of Rolling Resistance

Value of coefficient of rolling resistance is depend upon following factors:-

- Weight of Vehicle
- Speed Of Vehicle
- Tire Pressure

Surface roughness of Road = Rubber Tire hardness & conditions

Therefore,

Cr = 0.01 for 500 kg weight

Cr = 0.02 for 500-1500 kg weight

Cr = 0.03 above 1500 kg weight

Bicycle tire:

- on Paved Road = 0.008
- on Wooden Track = 0.001
- on Concrete Road = 0.002
- on Asphalt Road = 0.004

To Calculate Rolling Resistance Force (Fr):

Fr = Cr × m × g

Fr = 0.004 × 100 × 9.81

Fr = 3.924 N

➢ **Air (Drag) Resistance Force (Fd):**

Fd = Cd × ½ × d × V2 × A

Where,

Cd = coefficient of Drag = 1.1

d = Air Density = 1.2 kg/m3

V = Velocity of Vehicle

A = Frontage Area of Vehicle = 5.5 ft2 = 0.510967 m2

Coefficient of Drag is depends on:

- Density of Air
- Frontage Area of Vehicle
- Velocity of Vehicle

Speed of Cycle 10mph (16 km/h) air resistance is the dominant force

Drag force can be calculated by:

Fd = Cd × ½ × d × V2 × A

Fd = 1.1 × ½ × 1.2 × 102 × 0.510967

Fd = 41.62 N

➢ **Gradient Resistance Force (Fr):**

Fg = m × g × (sin 10)

Fg = 100 × 9.81 × Sin 10

Fg = 170.35 N

Rolling Resistance:

Power:

P = Fr × V

= 3.924 × 11.11

P = 43.595 W

Drag Force:

Pd = Fd × V

Pd = 41.62 × 11.11

Pd = 462.398 W

Gradient Force:

Pg = Fg × V

Pg = 170.35 × 11.11

Pg = 1892.58 W

Total power = (Pd + Pr + Pg)

= (462.398 watt + 43.512watt + 170.17watt)

Total power = 676.08 watt

P= $\frac{(2\times\pi\times N\times T)}{60}$

N = 200 rpm

676.08 watt = $\frac{(2\times\pi\times T)}{60}$

Torque = 32.28 Nm

Selecting BLDC Hub motor of 250 watt according to torque we found.

➢ **Selection of motor**

Power = 250 Watt

Voltage = 36 V

Torque = 40 N

5.4 Electronic Controlling Unit:

An electronic controlling unit (ECU) is an essential component of an electric cycle that helps in the smooth functioning of the cycle. It is an electronic device that controls the motor, battery, and other electronic components of the cycle. The ECU receives inputs from various sensors placed on the cycle and processes the data to ensure that the cycle operates optimally.

Figure 5.5 Electronic Controlling Unit

The ECU controls the power output of the motor by adjusting the current and voltage supplied to it. It also manages the battery by monitoring its voltage and current levels and preventing overcharging or over-discharging. Additionally, it controls the speed of the cycle and regulates the braking system

The ECU communicates with other electronic components of the cycle, such as the display panel and the throttle, to ensure that the rider receives real-time information about the cycle's status. The ECU also plays a crucial role in ensuring the safety of the rider by preventing the cycle from operating beyond its capabilities and limits.

Overall, the ECU is a critical component of an electric cycle that helps in the efficient and safe operation of the bike. It ensures that the cycle's motor, battery, and other electronic components work together seamlessly, providing an optimal riding experience for the rider.

5.5 Display Unit:

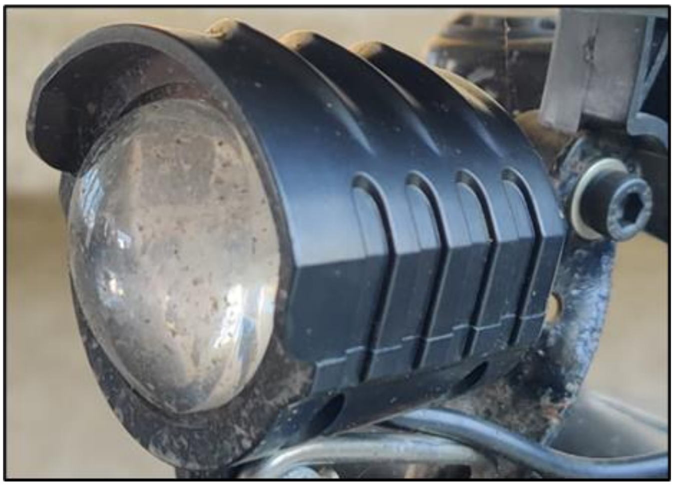
A display unit, also known as an indicator, is an electronic component in an electric cycle that provides the rider with real-time information about the bike's status. It is typically located on the handlebars and can be in the form of an LCD screen or LED lights.

The display unit shows various parameters such as speed, battery level, distance traveled, and other important information that the rider needs to know while riding the bike. Some advanced display units also provide information about the power output of the motor, the assistance level, and the remaining range of the battery.

Figure 5.6 Display Unit

The display unit receives information from sensors placed on the bike and communicates with the electronic controlling unit (ECU) to display the relevant information. The rider can also interact with the display unit through buttons or a touch screen to adjust the settings or view different parameters.

Overall, the display unit is an important component of an electric cycle as it provides the rider with crucial information about the bike's status and enables them to ride the bike more efficiently and safely. It also enhances the overall user experience of riding an electric cycle by providing real-time feedback and control over the bike's performance.



5.6 Speed Throttle (Accelerator):

A speed throttle is an electronic component of an electric cycle that enables the rider to control the speed of the bike. It is typically located on the handlebars and is operated by twisting it like a motorcycle throttle.

When the rider twists the speed throttle, it sends a signal to the electronic controlling unit (ECU), which adjusts the current and voltage supplied to the motor to increase or decrease the bike's speed. The speed throttle is usually connected to a display unit

that shows the speed of the bike in real-time.

Most electric cycles have different levels of assistance, and the speed throttle works in conjunction with the assistance level selected by the rider. For example, if the rider selects a high assistance level, twisting the speed throttle will result in a greater increase in speed compared to a lower assistance level.

Figure 5.7 Speed Throttle (Accelerator)

The speed throttle is an important component of an electric cycle as it provides the rider with control over the speed of the bike and enables them to ride the bike more efficiently and

safely. It also enhances the overall user experience of riding an electric cycle by providing real-time control over the bike's performance.

5.7 Head Light and Horn:

An inbuilt headlight and horn are important safety components of an electric cycle. The headlight helps the rider see the road ahead in low light conditions, while the horn alerts pedestrians and other road users of the rider's presence.

The inbuilt headlight is typically located on the front of the bike and is powered by the bike's battery. It can be turned on and off using a switch located on the handlebars or through the display unit. Some advanced electric cycles also have headlights that automatically turn on when the ambient light

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level drops, ensuring that the rider always has adequate visibility.

Figure 5.8 Head Light and Horn

The horn is also typically located on the handlebars and is activated by pressing a button. It emits a loud sound that alerts pedestrians and other road users of the rider's presence. The horn can be especially useful in crowded areas or when the rider needs to make their presence known to other road users.

Overall, an inbuilt headlight and horn are essential safety components of an electric cycle. They help the rider see the road ahead and alert other road users of their presence, enhancing the overall safety of riding an electric cycle.

5.8 Cycle Frame:

A cycle frame made of steel is a popular choice among cyclists due to its strength and durability. Steel frames are typically made of high-quality carbon steel or chromyl steel, which are strong and lightweight.

Steel frames are known for their stiffness, which means they are less likely to flex or bend under stress. This makes them ideal for riders who want a bike that is stable and responsive, especially when going at high speeds or riding on rough terrain.

Another advantage of steel frames is their durability. They can withstand a lot of wear and tear, making them ideal for riders who use their bikes frequently or for long periods. They are also resistant to corrosion and rust, which can be a problem with other frame materials such as aluminum.

However, steel frames are generally heavier than frames made of other materials such as aluminum or carbon fiber. This can make the bike feel sluggish or harder to handle, especially when climbing hills or accelerating.

Figure 5.9 Cycle Frame

Overall, a cycle frame made of steel is a great choice for riders who want a bike that is strong, durable, and offers a stable and responsive ride. It is an excellent option for riders who use their bikes frequently or for long periods and want a bike that can withstand a lot of wear and tear.

6. Experimentation & Data Analysis

Need of experimentation:
Installing a Hill Stop Mechanism in Electric Cycle.

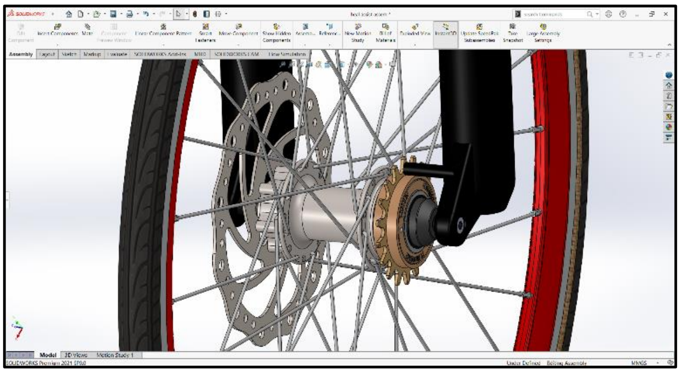
Hill stop assist (HSA) can be useful in electric cycles when riding on steep inclines. HSA is a feature that helps the rider start and stop the bicycle on a hill by holding the brake for a few seconds after the rider releases it. This prevents the bicycle from rolling backward or forward when the rider starts pedaling or stops on an incline.

In electric cycles, HSA can be particularly helpful as they are often heavier than traditional bicycles due to the motor and battery. This extra weight can make it more challenging for riders to start or stop the bicycle on a hill, especially if they are not used to riding on inclines.

Furthermore, many electric cycles have a throttle that can be used to power the bicycle without pedaling, which can be particularly useful when riding up hills. However, if the rider needs to start pedaling after stopping on an incline, HSA can prevent the bicycle from rolling backward and provide a smoother start.

➢ **Construction:**

- The Mechanism consist of the Free wheel and a disc brake assembly.
- The free wheel will be mounted on the hub of the front wheel, in the way such that free wheel will the backward free motion.
- The disc will be mounted on the free wheel and accordingly the calipers will be mounted on the disc to perform braking.



➢ **Working of Hill Stop Assist Mechanism:**

- The Hill Stop mechanism will be mounted on the front wheel of the E-Bike.
- Then Brake of the Hill Stop mechanism will be engaged resulting in the calipers firmly holding the disc.
- As a result of this there will be no Backward motion of the wheel, but because of the rachet bearing of the freewheel there will be no hindrance to the forward motion of the vehicle.

7. CONCLUSIONS

The Electric cycle is built which can achieve the top speed of 28 kmph. The Electric cycle has a range of 40-45 km in single charge. The battery of the cycle takes 2.5 hrs to fully charge. Hence a Electric cycle is built which is very effective in daily commutes at affordable running cost.

8. ACKNOWLEDGEMENT

The heading should be treated as a 3rd level heading and should not be assigned a number.

9. REFERENCES

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