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Design and Fabrication of Bio-Hybrid Vehicle

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Abstract: ***The present work intends to study and create a solution to be used as a means of transportation adapted to the metropolis environment. With the zero-emission, agile and space-saving Bio-Hybrid combining electric propulsion with human muscle power, we offer an approach to solving urban mobility issues because cities will change. This Paper reviews the design and fabrication of bio-hybrid vehicle. The points of the car I decided to specifically focus on were the chassis, components are used in this car. The most time and effort went into designing and implementing these components of the vehicle . During the entire design process, consumer interest through innovative, inexpensive, and effective methods was always the primary goal.***
Keywords: Bio-hybrid, zero-emission, ev etc.,

I. INTRODUCTION

With conventional fossil fuel consuming rides posing a threat to the existence of life on earth, it is high time to develop alternate and greener modes of transportation for a sustainable future.

As the name suggest it is a Bio-hybrid which can be operated by two ways either by manually i.e., by pedaling or by the means of battery, motor. Generally, in rural areas it is seen that people travel long distances by bicycle which is considered as essential means of transport & the ways in which people get from A to B in metropolitan areas will change. There's a clear trend toward new, compact mobility solutions.

They offer major opportunities for small vehicles that can close the gap between electric cars and bicycles. We are involved in actively shaping this trend and in the process of investigating future requirements, possible fields of application, as well as concepts and solutions for personal mobility today. In such case if we implement biohybrid it will nearly overcome all their problems and will definitely help in travelling long distances. The search and evolution of electrical vehicles is growing more and more as the days go by. New technological breakthroughs allied with growing concerns with the environment and physical health had led to huge developments around this concept.

Electrical vehicles are claiming a place in several industries, especially in the fields of transportation. The application of electrical motors in bicycles and cars opens up new possibilities and a large number of advantages.

Electric motor vehicles are a concept to take into account in the present and even more in the future, as they can open new possibilities or even replace the possibilities given nowadays by the common internal combustion engines. In the current days, fully electrical cars can already directly compete with an internal combustion car or even overcome and make them look obsolete in several aspects. Human powered hybrid vehicle presents the new milestone in the realm of "Green Technology"

A. Objective

1) Due to its four wheels, the concept of the Bio-Hybrid delivers exceptional driving stability.
2) Being electrical, they are not causing any damage to the environment.
3) To provide protection from weather conditions.
4) To maneuver easily through traffic.
5) To requires minimum parking space.
6) To less capital required for purchasing.
7) To develop new form of modern transportation in urban areas
8) Must be given 30-35km average on single charge.
9) Lowest running and maintenance cost.

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II. COMPONENTS

The components used in this project are motor, DC motor controller, Lithium-ion batteries, ignition switch, accelerator, wiring kit.

A. BLDC Motor

Motors are an interesting development which could offer benefits such as compactness, noiseless operation, and high efficiency for electric vehicles.

Here, we select 48V 750W BLDC motor. These motors have stators fixed at the axle, with the permanent magnet rotor embedded in the wheel. The traditional "exterior rotor" design has the hollow cylindrical rotor spinning around a stator axle. There is a "radial air gap" between the stator and rotor. The stator consists of stacked laminated steel plates with wound coils. Pulse width modulated current is used to supply current to the stator. motors must run at relatively low speed – equal to the actual rotation of wheel if there is no final gearing stage. The benefit is about a 10% increase in efficiency due to the lack of transmission. The main reason for choosing a BLDC motor is that it does not require a transmission system which helps in reducing the transmission losses. Since it has no brushes to wear out the life of motor is increased. It has a greater traction control. The back emf created by BLDC motor can easily be stored in the batteries supplied by 48v 23Ah lithium-ion battery through controller for testing purpose. Two independent propelling sources are being employed for obtaining total propulsion of the vehicle.



Figure 1 . BLDC MOTOR

B. Controller

The controller connects the power source to the motor. It controls speed, direction of rotation, and optimizes energy conversion. While batteries produce constant voltages, which decrease as they are used up, some controllers require a DC-to-DC converter to step down this changeable voltage to the motor's expected constant operating voltage, but other controllers incorporate a DC- to-DC converter and can accept a varying voltage. Converter efficiencies are typically greater than 90%. The controller for the motor is being interfaced with the motor speed regulation. The speed controlling throttle is being interfaced through the motor controller circuit. The motor used here is 48V, 750W motor. The controller for the motor is also Ampere made suitable for controlling the specified motor. The throttle is an ampere made throttle for speed regulation of the specified motor. The input to the motor is



Figure 2 . DC CONTROLLER

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C. Lithium Ion Battery

A lithium-ion battery or Li-ion battery is a type of rechargeable battery in which lithium ions move from the negative electrode through an electrolyte to the positive electrode during discharge, and back when charging. Li-ion batteries use an intercalated lithium compound as the material at the positive electrode and typically graphite at the negative electrode.



Figure 3 . Li-ion Battery

In this project, 48V 23Ah lithium-ion batteries are used. Lithium-ion batteries are common in consumer electronics.
They are one of the most popular types of rechargeable battery for portable electronics, with one of the best energy- to-weight ratios, high open circuit voltage, low self- discharge rate, no memory effect and a slow loss of charge when not in use. Beyond consumer electronics, lithium-ion batteries are growing in popularity for military, electric vehicle, and aerospace applications due to their high energy density.

D. Ignition Switch

An ignition switch is a switch in the control system of motor vehicle that activates the main electrical systems for the vehicle. It also usually switches on power to many accessories. The ignition switch usually requires a key be inserted that works a lock built into the switch mechanism. It may be bypassed by disconnecting the wiring to the switch and manipulating it directly. This is known as hot wiring.



Figure 4 . Ignition Switch

E. Accelerator

The accelerator mode is similar to how a motorcycle operates. When the accelerator is engaged the motor provides power and propels you and the bike forward. It allows you to kick back and enjoy a free ride. Most accelerators can be fine-tuned like a volume dial between low and full power.



Figure 5 . Accelerator

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F. Wiring Kit

The wiring kit place a major role in an electric bike. The main connecting unit is DC controller.

The Connections to DC controller:

1) Three wire throttle control for speed control
2) Brake control for controlling supply to motor
3) Input supply from battery
4) Output to motor

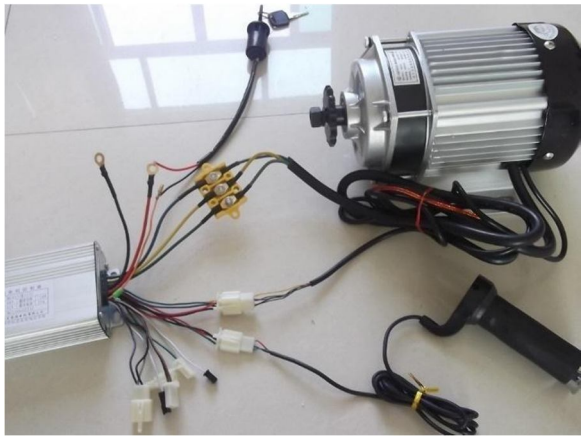


Figure 6 . Wiring Connection

III. BLOCK DIAGRAM

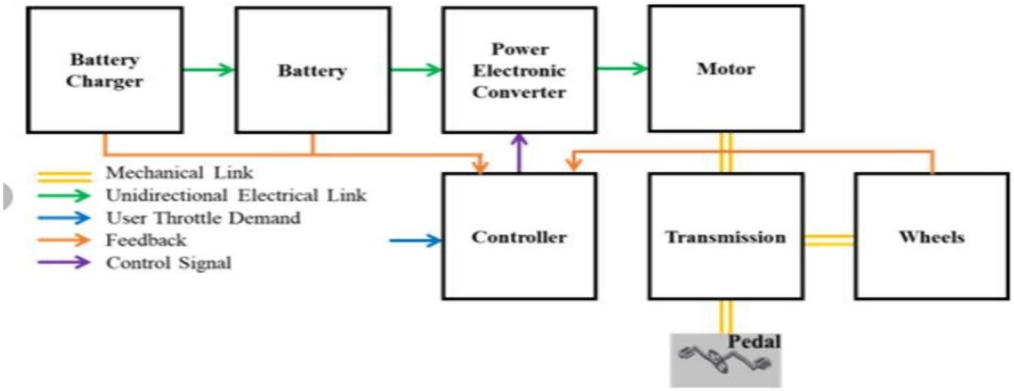


Figure 7 . Block Diagram

A. Methodology

Bio-hybrid name itself suggest that a Bio means healthful to environment and hybrid means vehicle which can be operated by two ways either by manually i.e., by pedaling or by the means of battery, motor.

Above Block diagram provide brief information about working of our propulsion system. In this system ,battery is main component it send electric current to power electronic converter .This power electronic converter is to process and control the flow of electric energy by supplying voltage and currents in a form that is optimally suited for different load condition and then it provide to motor . Controller is electronic device that operate between batteries and the motor to control the electric vehicle speed and acceleration .and it will be connected other electrical system (lighting system, horn etc.,). Then motor rotates as per driver gives acceleration. motor is connected to differential with the help of chain drive system and vehicle moves in desired direction. Driver can reduce consumption of battery with the help of pedaling. that will reduce load on motor. Also, if battery get fully discharged then driver can drive the vehicle with the help of pedals, the force used by pedaling enables the gears of a vehicle to spin the back wheel. As the back wheel rotates, the tire uses friction to grip the area and move the bike in the desired direction.

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IV. DESIGN

A. Chassis

The chassis is the component in charge of supporting all other vehicle's subsystems with the plus of taking care of the driver safety at all time. The chassis design need to be prepared for impacts created in any certain crash or rollover. It must be strong and durable taking always in account the weight distribution for a better performance

We use IS 4923 (Commonly Known As GI) Pipe, Carbon Steel IS 4923 YST 240 Seamless Pipes has a unique composition and mechanical properties depending upon the ISO standards bearing 0.12% max. Carbon, 0.50% max. Manganese, 0.03% to 0.08% Silicon, 0.05% Phosphorous and silicon each.

1) Chassis Design Consideration

Consideration	Priority	Reason
Light Weight	Essential	A light car moves faster
Durable	Essential	Must not deform during rugged driving and loading condition
Cost	Essential	Car needs to be within budget

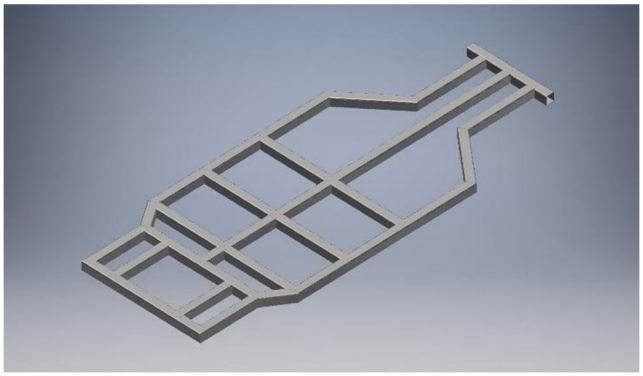


Figure 8 CAD Model Of Chassis

2) Finite Element Analysis (FEA): Finite element is a method for the approximate solution of partial differential equations that model physical problems such as: Solution of elasticity problems , Determine displacement, stress and strain fields. Static, transient dynamic, steady state dynamic, i.e. subject to sinusoidal loading, modes and frequencies of vibration, modes and loads of buckling.

3) FEA of Chassis: A geometric model of the Chassis was constructed in Autodesk Inventor and analysis also done in Autodesk Inventor 2019 professional.

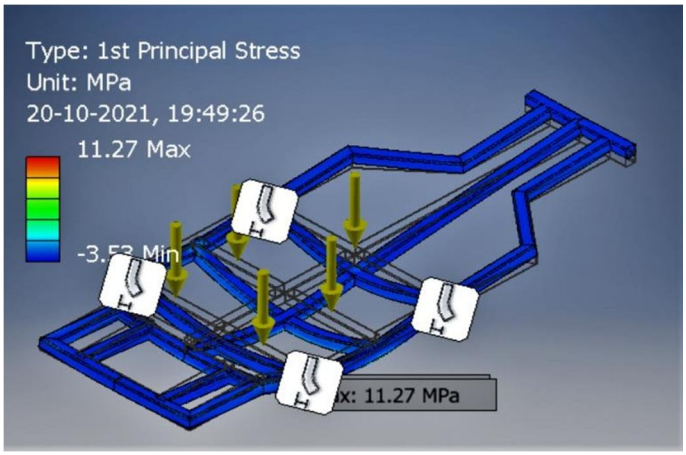


Figure 9 . 1St Principal Stress

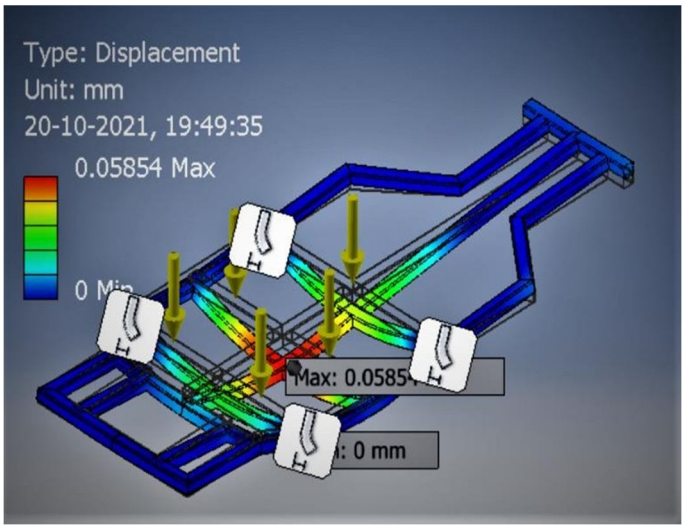


Figure 10 . Deformation

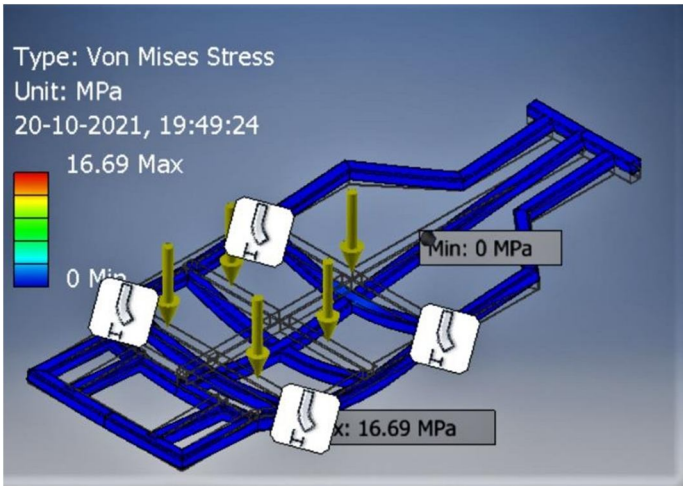


Figure 11 . Von Mises Stress

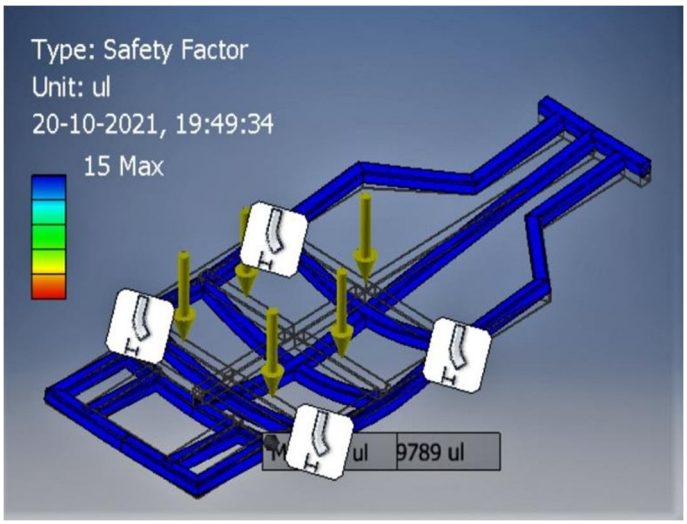


Figure 12 . Safety Factor

B. Complete CAD Model



Figure 13 CAD Model of BIO-HYBRID

C. Fabrication

The frame is fabricated successfully according to the design specifications. Fabrication techniques included arc welding, bending, cutting, grinding, drilling and assembly of various parts required.

Fabrication was carried out in two phases, namely phase-I which included initial spot welding of all the joints for assuring proper shape of the frame and phase-II included complete welding of all the joints in the frame, along with custom paint job and finally the assembly of all the parts.



Figure 14 . Final Actual Model

V. TESTING OF MODEL

After the complete design was fabricated, it was necessary that the controls be tested extensively & in various conditions.

The team decided to perform the first test on the vehicle in the local village road. The purpose of using this particular road as a test track is the fact that it contains gradients, up and down hill, turns as well as straight roads. Hence, nearly all types of road conditions can be simulated without the need for going elsewhere.

The team performed following simulations successfully on the vehicle:

1) Starting the vehicle from rest on level road surface
2) Making sharp turns while driving at 10-15 km/hr.
3) Braking the vehicle on downward slope & starting again
4) Checking Top Speed

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VI. CONCLUSION

With the increasing consumption of natural resources of petrol, diesel it is necessary to shift our way towards alternate resources like the Bio-Hybrid Vehicle and others because it is necessary to identify new way of transport.

The final goal of our project was to design and fabricate BIO-HYBRID Vehicle which will allow modification of the existing cycle by using electric energy and it would sum up to increase in energy production. Since it is energy efficient, and light weight which is cheaper and affordable to anyone. It can be used for shorter distances by people of any age (12- 60 yrs.). It can be contrived throughout the year. The most vital feature of the Bio-Hybrid is that it does not consume fossil fuels thereby saving currencies. The second most important feature is it is pollution free, eco – friendly and noiseless in operation. Our project is inspired by those people who have lot of interest in vehicles; especially in electric vehicle.

For the final design of our project, we decided to use waste material for roof, seat stand etc., The reason behind the use of waste material is that it would be cost efficient.

A. Scope for Future Works

1) Higher voltage, high Ah batteries and suitable motors of higher power but lesser weight can be used for running the vehicle with greater performance.

2) More comfortable wider seating arrangements can be provided for comfort of the rider. Also extra seat arrangement possible.

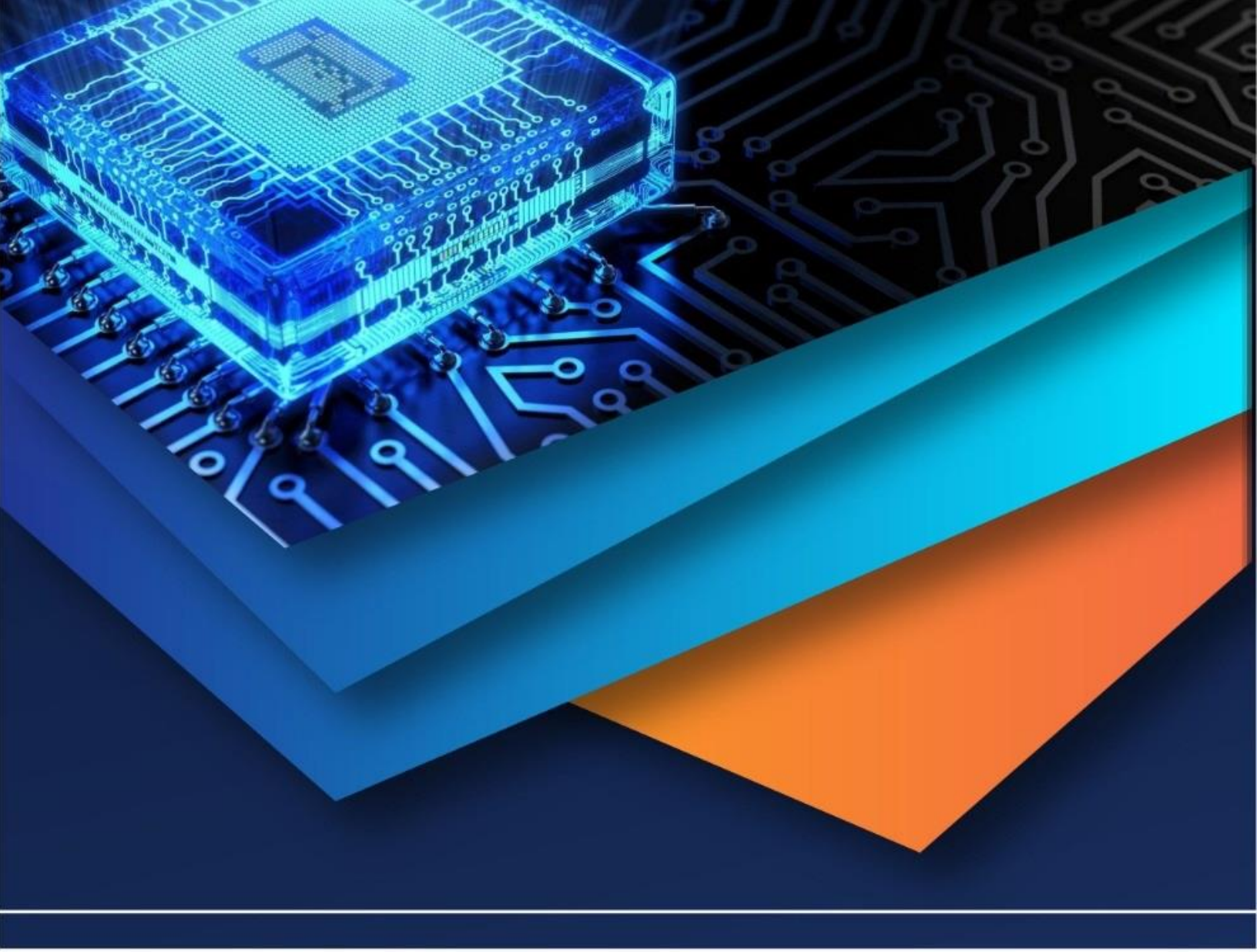
3) We can use solar panel to charge the battery and also provide auto-charging feature to charge battery while pedaling.

4) Smart features via a dedicated app that will make life easier for the operator.

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