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Battery Powered Electric Vehicle With Self Sustainable Power Source

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ABSTRACT: The frequent news about the extinction of fossil fuels has increased the importance of usage of electricity in the future. There is growing demand for Electric Bikes in India as there will be less air pollution, lower maintenance cost and reduced noise using Electric-Bikes. Electric bikes will be utilized to a greater extent. The people who travel moderate distances will be benefitted from the electric bike.The electric bike contains motor to help the vehicle move forward and various power sources are being used.The batteries provide power to the motor and the motor drives the vehicle. When the battery is fully discharged the battery is recharged again by using a battery charger. The generator is used to recharge the battery itself when the vehicle is in running condition.

KEYWORDS: Electric Bike, Dc Motor, Battery, Alternator

I.INTRODUCTION

An electric vehicle (EV) is a vehicle that uses one or more electric motors or traction motors for propulsion. An electric vehicle may be powered through a collector system by electricity from off-vehicle sources, or may be self-contained with a battery, solar panels, fuel cells or an electric generator to convert fuel to electricity. EVs include, but are not limited to, road and rail vehicles, surface and underwater vessels, electric aircraft and electric spacecraft. The first mass-produced electric vehicles appeared in America in the early 1900s. In 1902, "Studebaker Automobile Company" entered the automotive business with electric vehicles, though it also entered the gasoline vehicles market in 1904. However, with the advent of cheap assembly line cars by Ford, electric cars fell to the wayside most electric vehicles use lithium-ion batteries (Li-Ions or LIBs). Lithium ion batteries have higher energy density, longer life span and higher power density than most other practical batteries. Complicating factors include safety, durability, thermal breakdown and cost. Li-ion batteries should be used within safe temperature and voltage ranges in order to operate safely and efficiently. The power of a vehicle's electric motor, as in other vehicles, is measured in kilowatts (kW). 100 kW is roughly equal to 134 horsepower, but electric motors can deliver their maximum torque over a wide RPM range. Most large electric transport systems are powered by stationary sources of electricity that are directly connected to the vehicles through wires. Electric traction allows the use of regenerative braking, in which the motors are used as brakes and become generators that transform the motion of, usually, a train into electrical power that is then fed back into the lines. This system is particularly 2 advantageous in mountainous operations, as descending vehicles can produce a large portion of the power required for those ascending. This regenerative system is only viable if the system is large enough to utilise the power generated by descending vehicles. Electric vehicle are quiet, comfortable, economic and exciting. The electric motor is smaller than an internal combustion engine translating into an interiors and a peaceful drive. Torque, or pulling power, is instantly available, top speeds exceed legal limits and there are no gears to grind.

II. ELECTRIC VEHICLE WITH SELF SUSTAINABLE

1. COMPONENTS IN ELECTRIC BIKE

1.1 DC MOTOR

DC Motor is an electrical device which converts electrical energy into mechanical energy. A simple DC motor has a stationary set of magnets in the stator and an armature with one or more windings of insulated wire wrapped around a soft iron core that concentrates the magnetic field. The windings usually have multiple turns around the core, and in large motors there can be several parallel current paths. The ends of the wire winding are connected to a commutator. The commutator allows each armature coil to be energized in turn and connects the rotating coils with the external power supply through brushes. (Brushless DC motors have electronics that switch the DC current to each coil on and off and have no brushes. DC motors can operate directly from rechargeable batteries, providing the motive power for the first electric vehicles and today's hybrid cars and electric cars as well as driving a host of cordless tools. Today DC motors are still found in applications as small as toys and disk drives, or in large sizes to operate steel rolling mills and paper machines. Large DC motors with separately excited fields were generally used with winder drives for mine

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hoists, for high torque as well as smooth speed control using thyristor drives. These are now replaced with large AC motors with variable frequency drives.

1.2 MOTOR CONTROLLER

A motor controller is a device or group of device that can coordinate in a predetermined manner the performance of an electric motor. There are four basic motor controller and drive type: AC, DC, servo, and stepper.A motor controller is a device or group of devices that serves to govern in some predetermined manner the 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, regulating or limiting the torque, and protecting against overloads and faults.A Motor Controller is a device that acts as intermediary between your robot's microcontroller, batteries and motors. A motor controller is necessary because a microcontroller can usually only provide roughly 0.1 Amps of current whereas most actuators (DC motors, DC gear motors, servo motors etc.) require several Amps.

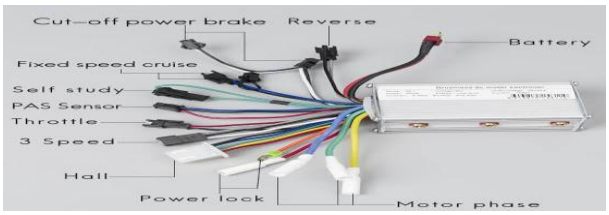

Fig.No. 1.2.1 Motor Controller

1.3 ALTERNATOR

An alternator is an electrical generator that converts mechanical energy to electrical energy in the form of alternating current. For reasons of cost and simplicity, most alternators use a rotating magnetic field with a stationary armature. Occasionally, a linear alternator or a rotating armature with a stationary magnetic field is used. In principle, any AC electrical generator can be called an alternator, but usually the term refers to small rotating machines driven by automotive and other internal combustion engines. An alternator that uses a permanent magnet for its magnetic field is called a magneto.

Alternators in power stations driven by steam turbines are called turbo-alternators. Large 50 or 60 Hz three-phase alternators in power plants generate most of the world's electric power, which is distributed by electric power grids. An alternator is an electrical generator that converts mechanical energy to electrical energy in the form of alternating current. For reasons of cost and simplicity, most alternators use a rotating magnetic field with a stationary armature. Occasionally, a linear alternator or a rotating armature with a stationary magnetic field is used.An automatic voltage control device controls the field current to keep output voltage constant. If the output voltage from the stationary armature coils drops due to an increase in demand, more current is fed into the rotating field coils through the voltage regulator (VR). This increases the magnetic field around the field coils which induces a greater voltage in the armature coils. Thus, the output voltage is brought back up to its original value.

Fig.No.1.3.1 Alternator

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1.4 SPEED CONTROLLER

Throttle is the mechanism by which fluid flow is managed by constriction or obstruction. An engine's power can be increased or decreased by the restriction of battery power (by the use of a throttle), but usually decreased. The term throttle has come to refer, informally and incorrectly, to any mechanism by which the power or speed of an engine is regulated, such as a car's accelerator pedal. What is often termed a throttle (in an aviation context) is more correctly called a thrust lever, particularly for jet engine powered aircraft. For a steam engine, the steam valve that sets the engine speed/power is often known as a regulator. Electronic throttle control (ETC) is an automobile technology which electronically "connects" the accelerator pedal to the throttle, replacing mechanical linkage. The electric motor is then used to open the throttle value to the desired angle via closed-loop control algorithm within the ECM.

Fig.No.1.4.1 Speed controller

1.5 BATTERY

Most electric vehicles use lithium-ion batteries (Li-Ions or LIBs). Lithium ion batteries have higher energy density, longer life span and higher power density than most other practical batteries. Complicating factors include safety, durability, thermal breakdown and cost. Li-ion batteries should be used within safe temperature and voltage ranges in order to operate safely and efficiently or even more for the latest Lithium Iron Phosphate lifepo4 batteries.

Fig. No. 1.5.1 LiFePO4 battery

LiFePO4 batteries are a huge improvement over lead acid in weight, capacity and shelf life. The LiFePO4 batteries are the safest type of lithium batteries as they will not overheat, and even if punctured they will not catch on fire.

1.6 BATTERY MANAGEMENT SYSTEM

A battery management system is any electronic system that manages a rechargeable battery, such as by protecting the battery from operating outside its safe operating area, monitoring its state, calculating secondary data, reporting that data, controlling its environment, authenticating it and / or balancing it. A BMS may also feature a recharge system allowing a safe way to connect the battery to different loads and eliminating the excessive inrush currents to load capacitors.The connection to loads is normally controlled through electromagnetic relays called contactors. The recharge circuit can be either power resistors connected in series with the loads until the capacitors are charged. Alternatively, a switched mode power supply connected in parallel to loads can be used to charge the voltage of the load circuit up to a level close enough to battery voltage in order to allow closing the contactors between battery and load circuit.

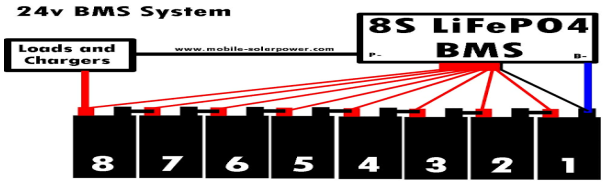

Fig.No. 1.6.1 Battery Management System

1.7 BRIDGE RECTIFIER

A diode bridge is an arrangement of four diodes in a bridge circuit configuration that provides the same polarity of output for either polarity of input. When used in its most common application, for conversion of an alternating-current input into a direct-current output, it is known as a bridge rectifier. When used in its most common application, for conversion of an alternating into a direct-current (DC) output, it is known as a bridge rectifier.

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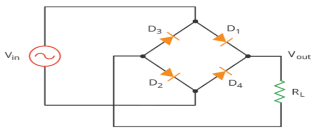

Fig.No. 1.7.1 Bridge rectifier

1.8 MINIATURE CIRCUIT BREAKERS

Miniature circuit breakers perform the duel function of a switch and a fuse. They can open a circuit for safety or maintenance reasons simply by switching their toggle levers to the OFF position. As a substitute for fuses, they provide automatic circuit protection and need not be replaced after a dangerous overcurrent has passed or a short circuit has been corrected.

Fig. No. 1.9.1 Miniature circuit Breaker

Using 5A 2 poles, Miniature circuit breaker it is protect your electrical switches, application and circuits from overload or short circuit. It is made of fine quality sturdy plastic material to offer longevity. Operate at the rate of 220 to 415 voltages.MCB stands for Miniature Circuit Breaker. It automatically switches OFF electrical circuit during any abnormal condition in the electrical network such as overload & short circuitconditions.An MCB is an automatically operated electrical switch, designed to trip and therefore prevent damage to an electrical circuit as a result of excess current.

1.9 BATTERY CHARGER

Charging works the same way as when you charging your mobile phone or laptop. Each bike is supplied with a charger and a flat battery is fully charged in 3 to 4 hour. In addition, the electric bike battery does not have to be completely discharged before it is recharged.Lithium battery has no “memory” and therefore can be charged at any time. It is perfectly acceptable to recharge the battery after a short ride so that the battery is fully charged before the next ride.

Fig.No. 1.10.1 Battery Charger

IV. DESIGN A BATTERY

2.1 BATTERY PACK

A pack is made of a number of smaller battery cells all stacked in a specific way to deliver the required power that your ebike system needs to function.

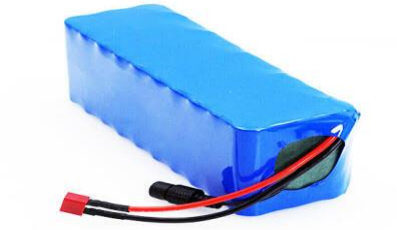

Fig.No. 2.1.1 Battery Pack

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2.1.1 VOLTS AND AMPS

Without going into too much confusing detail, Voltage is what pushes (speed) the flow of electric energy, while Amps is a measure of Force. Typically, higher Voltage electric bikes go faster, while higher Amps require thicker gauge wires and/or more powerful and larger battery packs. Combination of Volts and Amps equal watt.All batteries and battery packs will have fine print, listing various things of high importance, put on the bifocals and squint, expect to find things.

Volts: Used to describe how fast electrons move, more voltage = more speed.

Amps: How wide the road is, more lanes, more cars can pass at the same time side by side. The combination of Volts and Amps (Volts X Amps = Watts).

2.1.2 AMP HOURS

Should always be listed, typically 10 to 20 Amp Hours (abbreviated "Ah") a measure of how many fixed number of Amps a battery can sustain for 1 hour. (C rate). or, double the amps for half the time. Or half the amps for two hours.

2.1.3 WATT HOURS

Watt Hour more accurate way to know how much usable energy is in a given battery pack when available, this is the number to look for! Also, you can translate it into how many watts, continuous, for 1 hour! A 500wh battery can deliver 500 watts for 1 hour or 1000w for 30 minutes or 250w for 2 hours etc.

Most ebikes do not use power at an exact level, continuously, so this does not directly translate into ride time, but you can quickly see how a larger battery with more energy (capacity) can deliver lower power levels for longer periods of time, and go further on a charge.A Watt Hour is a unit of measurement for power over a period of time (an hour), or in our case, a way of measuring capacity. One Watt hour is equal to one Watt of average power flow over an hour.One Watt over four hours would be four Watt Hours of power.A Watt, the measure of power, is usually calculated using this equation: Watts = Volts x Amps. To explain a little further, we will use a plumbing analogy. If we have a water pipe; Volts would be a measure of the water pressure (force) in the pipe, Amps would be a measure of the current or flow through the pipe.

2.1.4 THE FORMULA TO CALCULATE BATTERY RUN TIME:

The formula: (10 x battery capacity in amp hours) divided by (appliance load in watts). This information appears on the lead acid battery label and in the small print on the appliance.

Battery Efficiency

8Ah,24V Battery

Load = 350 w

Battery= 24v

$P=V\times I$

350W/24V =14.5 Amps

Battery Backup = AH/current (Amp)

Battery Backup=0.55 hours =33 Minutes

V. BATTERY CONNECTION

There are mainly two types of circuits, series and parallel. Cells can be connected both in series, parallel or a combination of both.

3.1 CELLS IN SERIES CONNECTION

In series circuit electrons travel only in one path. Here the current will be the same which passes through each resistor. The voltage across resistors in a series connection will be different. Series circuits do not overheat easily. The design of series circuit is simple compared to parallel circuits.In a parallel combination, all the positive terminal are connected together and all the negative terminal are connected together.

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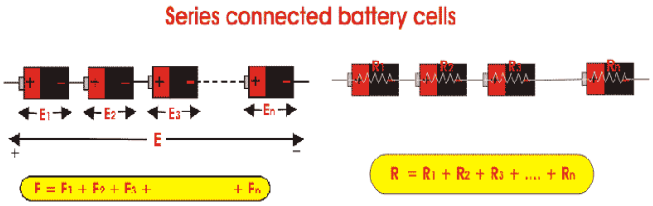

Fig.No. 3.1 Cell in series connection

A Watt would be the measure of of what you can do with that water, like turning a water wheel.

3.2 CELLS IN PARALLEL CONNECTION

Cells are in parallel combination if the current is divided among various cells. In a parallel combination, all the positive terminal are connected together and all the negative terminal are connected together. The external resistor is connected between these two points. If r/m<<R then I=ER. The parallel connection attains higher capacity by adding up the total ampere hour (Ah). A weaker cell would cause an imbalance.

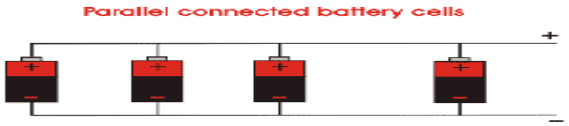

Fig.No. 3.2.1 Cell in parallel connection

3.3 MIXTURE OF SERIES AND PARALLEL CONNECTION

Batteries achieve the desired operating voltage by connecting several cells in series; each cell adds its voltage potential to derive at the total terminal voltage. Parallel connection attains higher capacity by adding up the total ampere-hour (Ah).

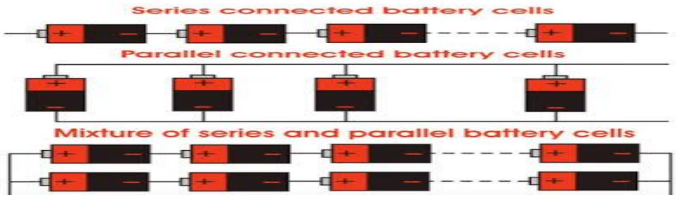

Fig.No. 3.3.1 Mixture of series and parallel connection

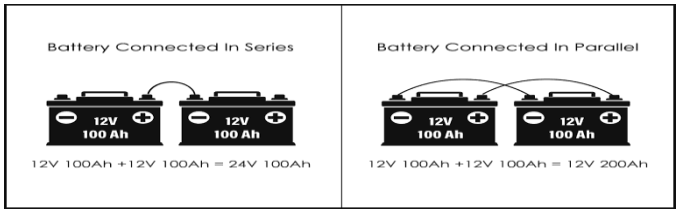

Fig.No. 3.3.2 series and parallel connection

VI. HARDWARE CONNECTION& OPERATION

The main aim of this paper is to present the idea of harnessing the electrical energy and use it in today's day-to-day human life. For human being travelling has become vital. In order to sustain in this fast-forward world, he must travel from one place to another. It is very important that time taking for travelling should be less, also it should be economical and easily available. With the rapid depleting resources of crude oil, there is need to find alternative source of energy. Taking all this into account, switching from conventional based fuels to using a non-conventional source of energy is a must. Electric bike which will be driven by using battery power and thus provide required voltage to the motor. The focus of this report is to system design of this electric bike. Therefore, the manufacturing of such bike is essential.Electric vehicle are quiet, comfortable, economic and exciting. The electric motor is smaller than an internal combustion engine translating into an interiors and a peaceful drive. Torque, or pulling power, is instantly available,

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top speeds exceed legal limits and there are no gears to grind. Today's e-bike systems often require: Integrated solutions with built-in protection features Real-time embedded processing solutionsIntegrated motor control to enable low latency peripherals. The output from the generator can recharge the battery and this vehicle can run up to a speed of 26km/hr.

4.1 BLOCK DIAGRAM

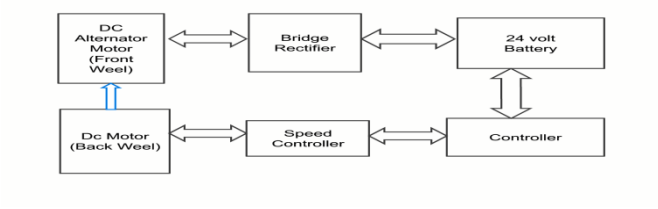

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Fig.No.4.1 Block Diagram

4.1.1 BLOCK EXPLANATION

The controller has 8 connectors, compatible with many 24V bikes with up to 350W motors 1. Battery / 2. Motor / 3. Brake / 4.Generator / 5. Indicator light / 6. Ignition lock / 7. Charger port / 8. Derailleur (throttle) The controllers have 4 groups necessary cables: Battery, Motor, Ignition lock, Derailleur (throttle), when hook up these 4 groups cables, the E-bike can run normally.The electric motor is smaller than an internal combustion engine translating into an interiors and a peaceful drive. The controller have other optional functions, you can hook them up according to your applications. The focus of is to system design of this electric bike. E-bikes recharging battery and typically travel up to 25 to 32 km/h (16 to 20 mph). High-powered varieties can often travel more than 45 km/h (28 mph).

4.2 CIRCUIT DIAGRAM

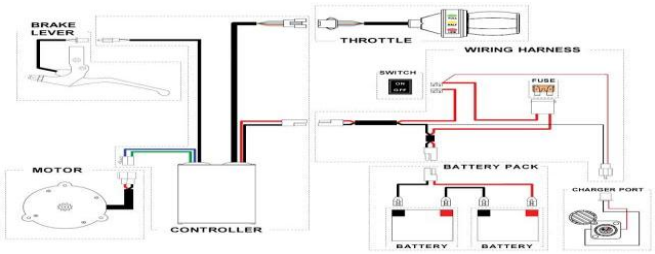

Fig.No. 4.2.1 Circuit Diagram

4.2.1 CIRCUIT EXPLANATION

In E-bike. In e-bike it don't mean that motor and battery that's all. There is third party involved in this to manage them and they work correctly. This is only possible by somehow programming and hardware skill with the help of controller. Now we are designed controller for this to control the motor of bike. The main or we can say the core feature of this controller is to manage the DC Motor that the run smoothly. Many motor are controlled by hall sensors that are responsible for the power consumed.

Now a day we need motor running smooth beside this, we need throttle, motor, and battery. If you want this things run perfectly then make sure you are using controller. Now we are designing such type of controller that will responsible of all. This controller senses the setting of throttle and adjusting the power supply to the motor. For does all this things we are using Pulse-width Modulation technique. Cut-off switch which is responsible for the voltage supply from the battery. Cut-off switch cut the connection if voltage drops to the motor. This help to protect the battery from over discharge. This cut-off switch is manage the current supply to motor and the field effect power transistor. In case of the over current is supply to the motor and field effect power transistor, it will cut the power supply for the protection of motor and field effect transistor.The cutoff switch is help to manage motor and no waste of current. It cut the supply to the motor when you applying brakes. This is only for safety purpose.

4.3 WORKING PRINCIPLE OF OUR PROJECT

The electric bike contains motor to help the vehicle move forward and various power sources are being used.The batteries provide power to the motor and the motor drives the vehicle. When the battery is fully discharged the battery

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is recharged again by using a battery charger. In this project, we have used a DC motor/generator attached in bike.Two sets of batteries are connected to the setup such as A and B. When one of he batteries gets discharged another battery will provide the power required. During that time, the rotation of the wheel rotates the shaft of the dc motor/generator which produces an output of voltage. The voltage helps in the charging of the battery thus by increasing the mileage of the electric bike voltage or load conditions. There are two types of voltage regulators: linear and switching.

VII. HARDWARE DEVELOPMENT

5.1 THE BLDC MOTOR KIT

Includes: 1pcs x MY1016Z3 DC 24V 350W motor. 1pcs x Motor controller. 1pcs x Chain. 1pcs x Freewheel. 1pcs x Freewheel adapter. 1pcs x mounting plate with bolts. 1pcs x Throttle handle & Brake lever. 1pcs x Headlight. 1pcs x Switch & key. 1pcs x 18cm axis + charger. Please note - This kit does not include batteries. Specifications of Motor - This popular reduction motor is simply the most commonly used motor for Scooters, Bikes and quads available in the market! It is normally found in the better quality quads and scooters on the market and is classed as a mid-range combination. They are quite powerful for their small size and extremely reliable.

Fig.No. 5.1.1 Motor kit

Table.No. 1 Properties of Motor

MOTOR DESCRIPTION	
Voltage	**24Volts**
Power	**350 Watt**
Speed	**324 RPM**
Torque	**11 Nm**
Weight	**2.98 Kg**
Current	**19.2 amp**
Type	**BLDC Motor**

5.2 BATTERY PACK

A **battery pack** is a set of any number of (preferably) identical batteries *or individual* battery *cells.* They may be configured in a series, parallel or a mixture of both to deliver the desired voltage, capacity, or power density.

Fig. No. 5.2.1 LiFePO4Battery Pack

Product Description

- Safety and economical: Each battery has built in PCM protection board from Over-discharge, Over-charge, Short Circuit etc.,LiFePO4 battery is environmentally friendly, which will not destroy the ecological environment, also have no memory effects.
- Excellent discharge characteristics:Have low internal resistance and high flat voltage characteristics during strong current discharge, which ensures a wider application field.
- Long cycle life: Provide long storage life with few limiting conditions. It offers problem-free charge after long storage, permitting to use in a wide range of applications.

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Table.No. 2 Properties of Battery

Part Number	LiFePO4 12v 6Ah Battery
MAIN PARAMETR	
Rated Capacity	6 Ah
Nominal Capacity	12.8V
Max Charge Voltage	14.6V
Discharge cutoff Voltage	10 V
Charging current	3A
Cycle Life	≤ 3

5.3 ALTERNATOR DESIGN

An alternatoris an electrical generator that converts mechanical energy to electrical energy in the form of alternating current. For reasons of cost and simplicity, mos*t* alternators use a rotating magnetic field with a stationary armature.

Table.No. 3 Properties of Alternator

ALTERNATOR DESCRIPTION	
Speed	4900 RPM
Power	1.5 Kw
Voltage	90-120
Rated Torque (Nm)	4.5
Weight	4kg

The alternator has three main components and a voltage regulator: The Stator, Rotor, and Diode. When the alternator belt or V-belt spins the pulley on the alternator, the rotor inside the alternator spins fast.Alternators produce AC power through electromagnetism formed through the stator and rotor relationship that we'll touch on later in the article. The electricity is channeled into the battery, providing voltage to run the various electrical systems.A voltage regulator is an important component of your car's charging system Most new alternators have internal voltage regulators, meaning wiring is not necessary, but if you have an external regulator then you need to hook it up to the alternator and ignition system.

5.4 FINAL OUTCOME OF THE PROJECT

Fig.No. 5.4.1 Electric Bike

The project is successfully completed. The output from the generator can recharge the battery. And this vehicle can run up to a speed of 26km/hr.

VIII. CONCLUSION

It can be seen that all the vehicle companies are changing to electric engines from existing IC engines. But the real problem of the electric motors lies in the field of charging the batteries. Our project may provide a solution for this existing problem since charging of the battery is done as the Vehicle runs. It is very much suitable for young, aged people and caters the need of economically poor class of society. The most important feature of this bicycle is that it

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does not consume valuable fossil fuels thereby saving the money. It is eco-friendly & pollution free, as it does not have any emissions.

IX. FUTURE SCOPE

With battery prices reportedly falling 73% since 2010, electric cars are expected to be as cheap as fuel-powered cars in the foreseeable future. The International Energy Agency cites that by 2020 up to 20 million electric vehicles will ply the road, a number that is expected to go up to 70 million by 2025.The automobile industry of India has been buzzing with new advancements, innovation and trends lately. The mention of electric vehicles, which only used to make a few heads turn till about a few years back, is gradually catching the attention of a growing number of population. Yes, it is true that electric vehicles are on their way to soon become a bright reality in India, paving way for a positive change. The manufacturing landscape of EVs, which solely used to be dominated by the global automakers earlier, is also now seeing a rejig, as numerous Indian automakers now take a deep dive into the electric vehicle space, tapping the growing potential that the country has in store. What is even more interesting is that the mind-set of the Indian population is also slowly evolving, with many now willing to make a switch to EVs soon. A recent study has highlighted that by 2022, most consumers in India would consider buying an electric vehicle. This in itself is a key trend which is likely to trigger the growth of the EV segment in the country.Definitely, government intervention and policy have a key role to play in promoting electric mobility in the country. Indian policymakers have been actively pushing EV adoption over the recent years, and multiple initiatives have also been introduced to develop domestic capabilities across the entire EV value chain.

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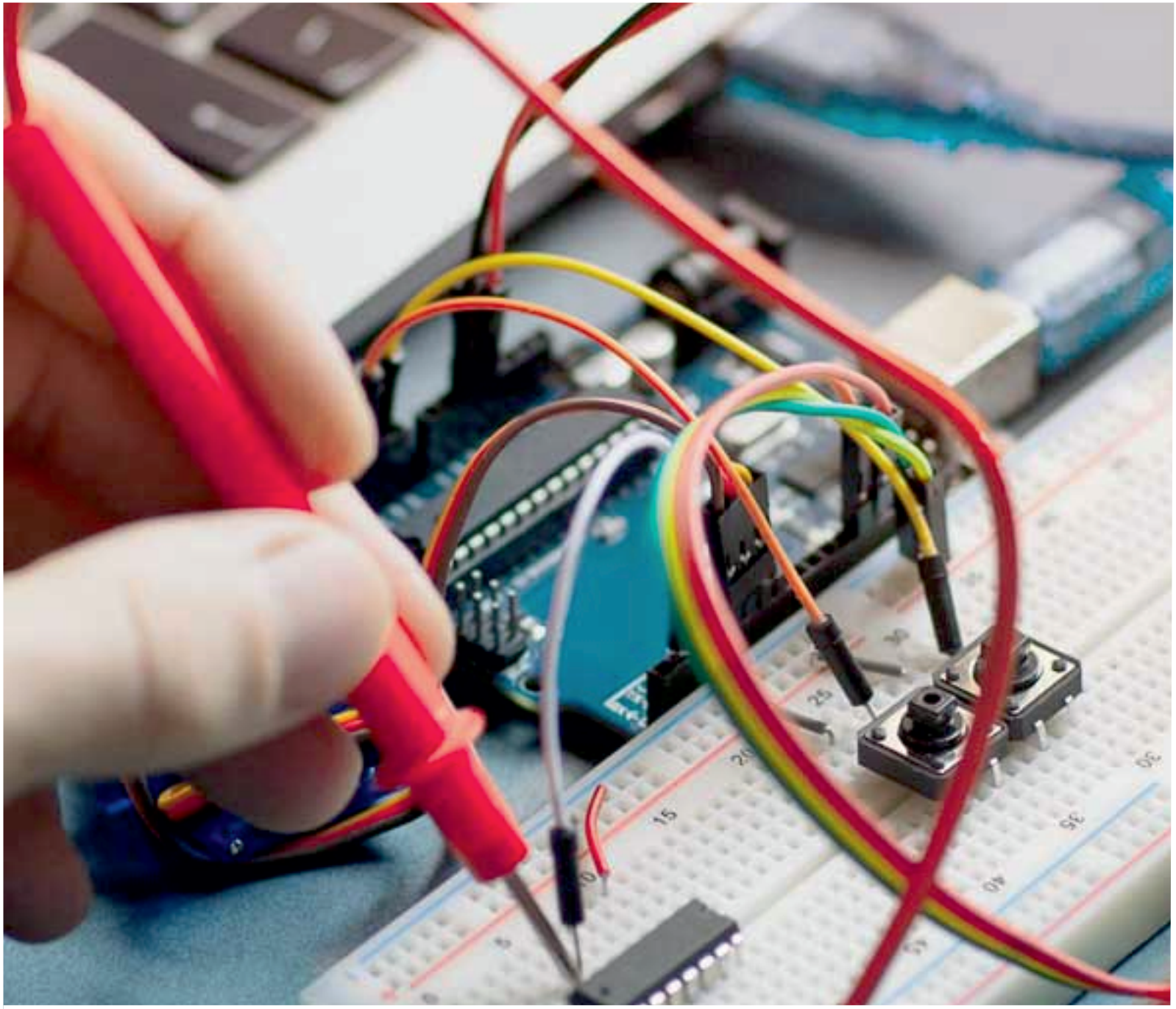

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