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Automatic Harging of Battery for EV Applications using Dynamo

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***Abstract*—This research and project work describes the design and fabrication of a VEHICLE WITH REVERSE CHARGING TECHNOLOGY for short and medium distance transportation. The main components of this innovative model are DC Gear motors and its controller, motor drivers, Li-ion batteries, generator, bluetooth for transmission and Arduino as main controller. This whole system is working based on the supply from battery. The controller plays vital role in controlling the battery power in an efficient manner by the motor driver. This vehicle prototype after implementation can also be used in applications like commuting and fulfills the purpose of energy conservation, Electrical Bike with reverse charging and as a multipurpose hybrid eco friendly way of transporting medium.**

***Index Terms*— E-Vehicle, 18650 Li-ion battery, DC gear motor, generator.**

I. INTRODUCTION

Choosing to drive an Electric Vehicle (EV) is helping to reduce harmful air pollution from exhaust emissions. An EV has zero exhaust emissions and non-polluting nature. Renewable energy, if renewable energy is used to recharge EV, it reduces the greenhouse gas emissions even further Research has shown that electric vehicles are better for the environment. They emit less greenhouse gases and air pollutants over their life than a petrol or diesel vehicle. The main advantage of EVs is no fuel, no emissions, running costs, Low maintenance and Popularity. The major benefit of electric vehicles is the contribution that they can make towards improving air quality in towns and cities. With no tailpipe, pure electric vehicles produce no carbon dioxide emissions when driving. This reduces air pollution considerably. Over a year, just one electric vehicle on the roads can save an average of 1.5 million grams of co2.Presently, the EVs are the most challenging, interesting and fascinating domain around the world. Scientists are trying to analyse the fast charging method, long battery pack, capital cost for an EV. Financial resources are always a constraint in a growing economy like India and hence the capital investment should be such that it provides a minimum life of 5 years with very nominal maintenance cost. For all the above mentioned problems the solution is to provide an external battery pack with a good control and automatic charging by using dynamo.

II. LITERATURE SURVEY

1. Geoffrey J. May et al., (2017) analyzed and concluded that lead batteries cover a range of different types of battery which may be flooded and require maintenance watering or valve regulated batteries. For many energy storage applications with intermittent charging input and output requirements, especially with solar PV input, the battery is required to absorb power as well as deliver power to the network.

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2. Economic Times (2017) reports that the Indian Government should take steps to bring down the country's reliance on fossil fuels below the levels of other countries and continue to be a global citizen on climate change.
3. Umut AKSU et al., (2018) conducted researches and concluded that the energy losses that occur during the driving of vehicles and consequently for the reduction of these losses had also been researched. A huge variety of sources of energy harvesting are from solar power, thermoelectricity, physical motions and piezoelectricity.
4. Song Joo Lee et al., (2007) compared electric vehicle and over ground walking and concluded that there lies difference between normal walking and that of electric vehicle walking due to variation in the force plates. Comparisons between walking conditions were made for temporal gait parameters such as step length and cadence, leg kinematics, joint moments and powers, and muscle activity.

III. Block Diagram Explanation

Fig 3.1.shows the proposed block diagram of the project. The Output of Primary Battery is connected to the power convertor, sensor and BMS. The Dynamo and the motor get coupled then the output of the Dynamo is connected to the secondary battery. The controller connected to the power convertor and connected to the BMS. The power convertor is connected to the Dynamo and the dynamo is connected to the Secondary Battery. In the proposed block diagram of automatic charging systems the primary battery is connected and supplies the power to the motor. Then, the motor starts running through primary battery. While the motor is running the motion of the motor helps the dynamo to generate power. The generated power will store in the secondary battery. The percentage of the batteries will be displayed in the display. When the battery charge downs it indicates through percentage.

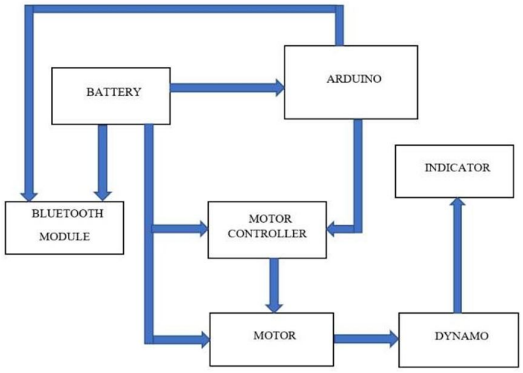


Fig 3.1 Block Diagram

IV. List of Components

A. Battery
B. Arduino Board
C. Bluetooth Module
D. Battery Charging Module
E. Transmission Gears
F. Motor Controller
G. DC Generator

A. Battery

A battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices such as flashlights, mobile phones, and electric cars. When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode. The terminal marked negative is the source of electrons that will flow through an external electric circuit to the positive terminal. When a battery

is connected to an external electric load, a redox reaction converts high-energy reactants to lower-energy products, and the free-energy difference is delivered to the external circuit as electrical energy. Historically the term "battery" specifically referred to a device composed of multiple cells, however the usage has evolved to include devices composed of a single cell.

B. Arduino Board

Arduino is an open source computer hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical and digital world. Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards or Breadboards (shields) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. In addition to using traditional compiler tool chains, the arduino project provides an integrated development environment (IDE) based on the Processing language project. The Arduino project started in 2005 as a program for students at the Interaction Design Institute Ivrea in Ivrea, Italy, aiming to provide a low-cost and easy way for novices and professionals to create devices that interact with their environment using sensors and actuators. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats and motion detectors. Most Arduino boards consist of an Atmel 8-bit AVR microcontroller with varying amounts of flash memory, pins, and features. The 32-bit Arduino Due, based on the Atmel SAM3X8E was introduced in 2012.The boards use single or double-row pins or female headers that facilitate connections for programming and incorporation into other circuits. Most Arduino boards consist of an Atmel 8-bit AVR microcontroller with varying amounts of flash memory, pins, and features. The 32-bit Arduino Due, based on the Atmel SAM3X8E was introduced in 2012.

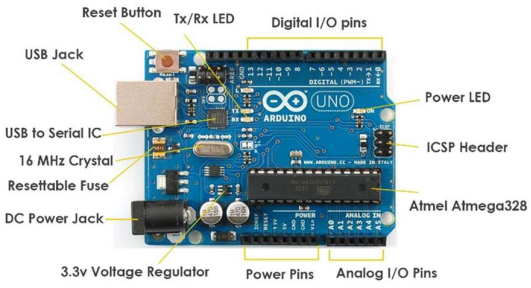


Fig 4.1 Arduino Board

C. Bluetooth Module

A Bluetooth module is usually a hardware component that provides a wireless product to work with the computer; or in some cases, the. Bluetooth may be an accessory or peripheral, or a wireless headphone or other product (such as cell phones can use.)The Bluetooth technology manages the communication channel of the wireless part. The Bluetooth modules can transmit and receives the data wirelessly by using two devices. The Bluetooth module can receive and transmits the data from a host system with the help of the host controller interface (HCI).

D. Battery Charging Module

The battery used in the project has the rating of 48V / 7 AH, so in order to energize it, approximately 24V to 48V DC supply, therefore a rectifier circuit is needed. The 230V AC from the supply main is given to the primary side of the step down transformer which reduces 230V AC supply to 30V AC. Then this 30V AC is given to the bridge rectifier circuit the bridge rectifier circuit consists of 4 diodes which converts 24V AC to 24V DC then it is given to the voltage regulator IC which is IC 7824. In order to prevent heat during operation suitable heat sink is attached with IC 7824. During entire operation a constant steady 24V DC supply which is needed to energize the relay is obtained. Now the positive supply pin of IC 7824 is connected to the transistor's collector terminal and the emitter terminal to the ground. So when 5V pulse signal from controller goes to the transistor, it immediately switches the collector and emitter terminal making a short circuit path and thereby operating the

relay, since microcontroller is not capable to produce 24V DC directly. Similarly for the MOSFET to operate, in order to minimize the heat of it a heat sink is attached with it.

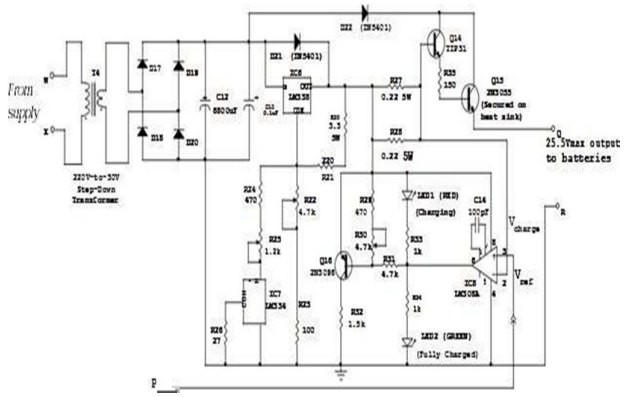


Fig 4.2 Battery Charging Module

E. Transmission Gears

A motorcycle engine can create an enormous amount of power, which must be delivered to the wheels of the vehicle in a controllable way. The motorcycle transmission delivers power to the rear wheel through a series of structures that include the gear set, the clutch and the drive system. A gear set is a set of gears that enable a rider to move from a complete stop to a cruising speed. Transmissions on motorcycles typically have four to six gears, although small bikes may have as few as two. The gears are engaged by shifting a lever, which moves shifting forks inside the transmission.

F. Motor Controller

A motor controller is a device or group of devices that serves to govern in a predetermined manner the performance of an electric motor. A motor controller 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 electrical faults. An electric motor controller can be classified by the type of motor it is to drive, such as permanent magnet, servo, separately excited and alternating current. A motor controller is connected to a power source, such as a battery pack or power supply and control circuitry in the form of analog and digital input signals. The motor controller used in this project has the rated voltage of 48V and rated current of 6A. This controller replaces with fewer connectors because most of the connectors are optional to use. It is connected to the battery, motor and also to the accelerator so that the speed of the vehicle can be easily controlled. It automatically selects under voltage protection of 31.5V with 36V battery packs and 42V with 48V battery packs. Current limiting feature helps prevent controller and motor damage due to over-current conditions. Under voltage protection feature helps prevent over discharge and extends the life of battery pack. It is also compatible with standard 3-wire variable speed hall-effect throttles. The dimension of the motor controller is as follows 5-1/8"
L x 2-3/4" W x 1-1/4" T.

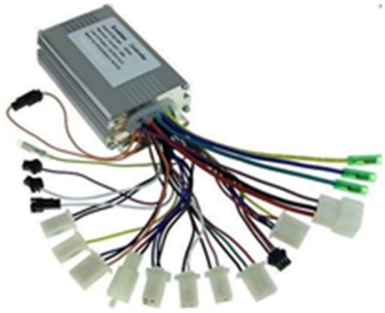


Fig 4.3 Motor Controller

G. DC Generator

In electricity generation, a generator is a device that converts motive power (mechanical energy) into electrical power for use in an external circuit. The reverse conversion of electrical energy into mechanical energy is done by an electric motor, and motors and generators have many similarities. Many motor can be mechanically driven to generate electricity and frequently make acceptable manual generators. The dynamo was the first electrical generator capable of delivering power for industry. The "dynamo-electric machine" employed self-powering electromagnetic field coils rather than permanent magnets to create the stator field. The use of electromagnets rather than permanent magnets greatly increased the power output of a dynamo and enabled high power generation for the first time. The dynamo machine that was developed consisted of a stationary structure, which provides the magnetic field, and a set of rotating windings which turn within that field. Bicycles require energy to power running lights and other equipment. There are two common kinds of generator in use on bicycles, bottle dynamos which engage the bicycle's tire on an as-needed basis, and hub dynamos which are directly attached to the bicycle's drive train. Some electric bicycles are capable of regenerative braking, where the drive motor is used as a generator to recover some energy during braking. Human powered direct current generators are commercially available. Typically operated by means of pedal power, or a foot pump, such generators can be practically used to charge batteries. An average "healthy human" can produce a steady 75 Watts (0.1 horsepower) for a full eight hour period, while a "first class athlete" can produce approximately 298 Watts (0.4 horsepower) for a similar period. At the end of which an undetermined period of rest and recovery will be required. At 298 Watts the average "healthy human" becomes exhausted within10Minutes. The net electrical power that can be produced will be less, due to the efficiency of the generator. In this project, a hand cranked dynamo or DC generator is used. It has the capacity of 12V producing 40W power. The generator is used in order to convert the linear motion of the treadmill produced by the user by walking on the treadmill setup to electrical energy. The electrical energy thus produced is stored in the battery. The generator is fixed along with spur gear and shaft.

V. HARDWARE MODEL

There are basically four sections in implementation of treadmill vehicle model:

A. Battery charging unit
B. Motor section
C. Motor controller section
D. Generator section

A. Battery charging unit

This section explains about the battery management system. It is the circuit module to protect the inrush current from the DC charger. It also protects the surge current and transients from the input power supply. To charge the battery, two charging modules are connected in series which equally charges the individual batteries.

B. Motor section

We used the 48V 350W motor fixed in the cycle wheel. The motor is excited by the supply provided from the battery through motor controller. The motor makes the cycle to move thereby the treadmill belt also rotates through transmission gears. As soon as the motor is energized, it runs and so the treadmill. The speed of the motor is controlled by application of throttle by the user.

C. Motor controller section

The motor controller rated voltage is 48V and rated current is 6A. This controller replaces with fewer connectors because most of the connectors are optional to use. It is connected to the battery, motor and also to the accelerator so that the speed of the vehicle can be easily controlled. It automatically selects under voltage protection of 42V with 48V battery packs. Current limiting feature helps prevent controller and motor damage due to over- current conditions. Under voltage protection feature helps prevent over discharge and extends the life of battery pack. It is also compatible with standard 3- wirevariable speed hall-effect throttles. The dimension of the motor controller is as follows 5-1/8" L x 2-3/4" W x 1-1/4" T.

D. Generator section

The linear motion of the treadmill produced by the user by walking on the treadmill setup is converted into electrical energy by 12V 40W DC generator. The generator used is a hand cranked generator. The electrical

energy thus produced is stored in the battery. The generator is fixed along with spur gear and shaft.

VI. Methods and Materials

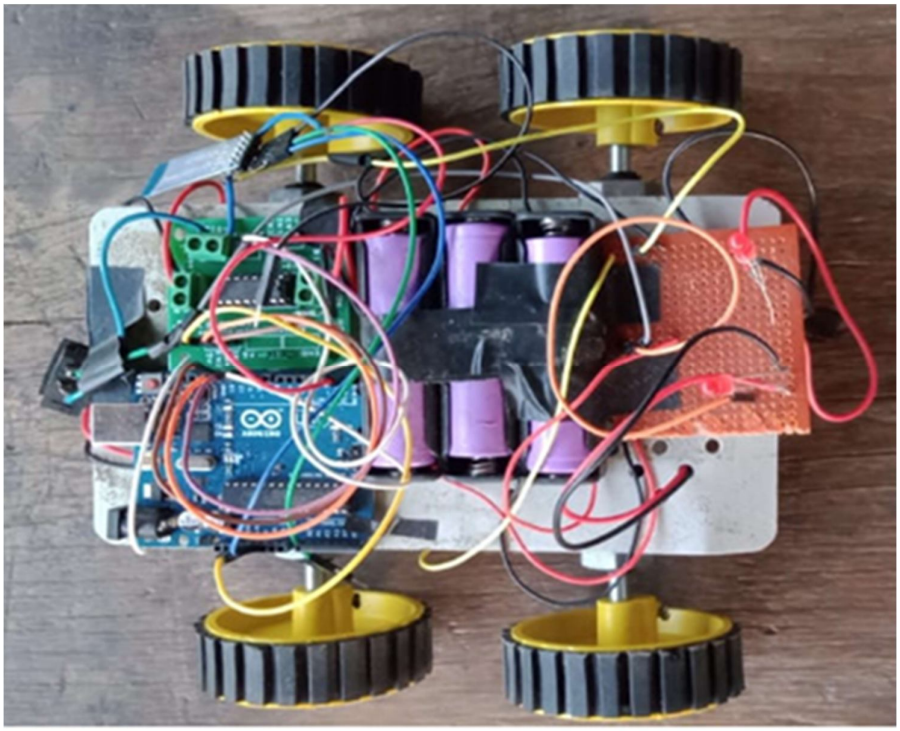
A. Design Procedure

AutoCAD is used to design the proposed vehicle model prior to prototype manufacturing. In this project by using this software the actual image and standard size of the vehicle as per the consumer electronics and ideal conditions for developing a vehicle is employed. AutoCAD is computer-aided design (CAD) software that architects, engineers and construction professionals rely on to create precise 2D and 3D drawings. Draft and edit 2D geometry and 3D models with solids, surfaces and mesh objects. Annotate drawings with text, dimensions, leaders and tables. So we have initially kept the design ideas and implemented it in this tool for the accurate geometry and standard limits of the same which is considered as origin of the project. To create 3 dimensional process of the image, in a transparent background for the proper viewing and imaging of the vehicle. The image is converted into the required size parameters and after getting necessary approval based on the actual standards and the formulated into manufacturing process.

B. Mechanical Design

In mechanical design, the design parts, detailed design is done practically and dimensions are obtained as per the ideal standards and regulations components are categorized into two parts, self design parts and parts to be purchased.For design parts, detailed design is done in AutoCAD and dimensions are obtained as per the ideal standards and regulations, the parts to be purchased directly are specified and selected from standard catalogue.

Final Model



VII. Applications

1. *Transportation*

The proposed electric powered vehicle can also be used in short and medium distance commuting so as to remove the unwanted usage of fossil fuels and other raw materials to get the power for the transportations.

2. Outdoor usage with limited speed requirements
3. Ecofriendly and uses electrical energy only.
4. It is a relatively easy piece of commutation means to use.
5. It has a predictable surface that is much easier to negotiate than sidewalks, curbs or trails and the risk of accident is reduced.
6. Multiple users can use the same equipment without adjusting the structure.
7. It helps in energy conservation and plays vital role in free energy application

VIII. CONCLUSION

The implementation of this project is primarily helpful to curtail the consumption of natural resources for medium and long distance transportation. The batteries are used in this vehicle to enhance the charging capacity as it takes long time to discharge the energy stored. This helps to run the vehicle for long time. Initially the battery is charged via battery charging module which is designed for 48V 7AH battery by connecting two 24V batteries. In addition to this, generator is used to regenerate the rotational motion of the motor while travelling. This regenerated energy is further stored in the battery as electrical charge. Thus the motor moves as the vehicle starts to move. The speed of the vehicle can also be controlled by the motor controller which controls the motor speed according to the application of throttle. This project is immensely obliging for generating the power from dynamo and for transportation and also to introduce free energy concept in the field of eco-friendly transportation. In these days where the world is challenged to be more responsible in its sourcing of electrical power, the method of human power generation by free energy with eco-friendly nature could be a solution that also helps to mitigate the issue.

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