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HYBRID POWERED E-CYCLE CHARGING STATION

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Abstract— This paper describes the solar and wind energy-based charging mechanism(SWCM) to generate the power for charging the battery packs of electric cycles. Due to the number of E-cycles are increased on the road, charging vehicles with conventional fossil fuel-based grids are not efficient and economical. The renewable energy-based charging station finds control for electric cycle charging. This project describes the solar and wind energy-based charging mechanism (SWCM) to generate the power for charging the battery packs of E-cycles. The renewable charging station consists of both the wind generator and PV (solar photovoltaic) modules. The wind energy-based charging mechanism immensely reduces the requirement of fossil fuels to generate electricity, resulting in reduced CO2 and CO-related emissions. An E-cycle charging station integrating solar power, wind power and a BESS (Battery Energy Storage System) is designed for the current scenario. The results show that the renewable charging mechanism is suitable for E-cycle charging and it creates a pollution-free environment.

I. INTRODUCTION

Humanity is facing the major global issues such as the fossil fuel resources depletion and the environmental pollution, requiring us to replace the internal combustion engines-based transport mode by an eco-friendly transport solution such as electric cars and electric bikes (e-cycles). Thanks to its significant ambient and economic benefits, e-cycles with pedal assistance is a promising eco-friendly transport candidate in any area. Recently, more and more people have owned their e-cycles as an essential asset to daily commute in metropolitan areas in China, Taiwan, and the European countries like Austria, Belgium, Norway, and Netherlands. Since the e-cycles need to charge its batteries frequently, there is a high demand on the public charging station for e- cycles. In other words, to promote the use of e-cycles as a prominent transport mode, a significant number of charging stations dedicated to e-cycles must be installed in public areas so that the cyclists can easily park and charge their own e-cycles. These charging stations are required to provide a service with high secure, good price, and smart features. To make the e-cycle being a truly zero well-to-wheel emission transport mode, the e-cycle should be charged by a charging station where its power supply totally comes from the renewable energysources such as solar and wind. In other words, an off-grid charging station is preferable for the eco-friendly e-cycle system.

Compared with the on-grid charging where the power is mainly supplied by an electrical grid, the off-grid charging station is standalone and doesnot require any connection to the electrical grid. Sustainable feature, ease of move and installation, and independence from the electrical grid are the most advantageous features of the off-grid charging station. However, since the power supplied from the renewable sources is naturally intermittent, a battery energy storage system is an essential component in this type of system, which increases the system investment cost.

The solar powered standalone e-bike charging stations available on the market pose some

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drawbacks including a high cost due to large BESS capacity requirement. Therefore, determination of the optimal system configuration is a critical and essential task to minimize the system cost. So far, there have been different determination methods presented in previous research works to determine the optimal configuration of the standalone renewable system. The simplest method is the intuitive one, where the size of the system is formulated based on experience-driven data. However, the impact of fluctuating nature of weather on the energy sources is not taken into account in this method, which may result in an over or under sizing of the system. Another popular method is the analytical approach where the system is characterized based on the fundamental models of each system`s component. The main advantage of this method is its simplicity whereas the parameters in the system model are difficult to estimate with an acceptable level of precision.

Recently, numerical methods were introduced by using the hourly or daily historical weather data and load demand data to determine the minimum requirement of BESS and power supply capacity. Compared to intuitive and analytical approaches, numerical methods are more accurate, but require long- term historical data of load, wind and PV power. In addition, following criteria are usually used to assess the reliability of the designed system: loss ofpower supply probability (LPSP), loss of load expected (LOLE), equivalent loss factor (ELF), total energy loss (TEL), level of autonomy (LA), and loss ofload probability (LLP).

This paper presents and develops a cost-optimized standalone e-cycle charging station that was designed. It shows two novel features comparing with existing conventional standalone e-cycle charging stations. The first one is that the charging station is powered by a hybrid energy system including wind and solar sources, which results in a reduction of the BESS capacity due to the less stochastic intermittent power supply fluctuations. The results show thatthe hybrid solar and wind power source requires smaller BESS capacity. The second novelty of this paper lies in the use of second-life battery (SLB) packs as a BESS. Batteries in electric vehicles (EVs) are usually retired when their capacity rating drop below 80% of their original energy storage capacity which is expressed as their state of health (SOH).

In addition, the rapid development of electric vehicles yields a large number of used batteries. Therefore, reusing the retired EV‘s batteries as second- life battery devices for an energy storage system application is expected to reduce the cost and to mitigate the environmental concerns of EV‘s batteries. To minimize the investment expenditure of the charging station, a cost function considering the photovoltaic (PV) sub-system, small wind turbines (WTs) sub- system, and BESS costs is defined.

II. SOLAR WORKING PRINCIPLE

Every device we use in our day-to-day life such as mobile phone, computer, induction cookers, washing machines, vacuum cleaners, etc., requires electric power supply. Thus, the advancement in technology is increasing the electrical and electronic appliances usage – which, in turn – is increasing the power demand. Thus, to meet the load demand, different techniques are used for electric power generation. In the recent times, to avoid pollution and to conserve non-renewable energy resources like coal, petroleum, etc., renewable energy sources like solar, wind, etc., are being preferred for power generation. The combination of renewable energy sources can also be used for generating power called as hybrid power system.

As a special case, we will discuss about the working of solar-wind hybrid system in this project. Solar and wind hybrid power systems are designed using solar panels and small wind turbine generators for generating electricity. Generally, these solar wind hybrid systems are capable of small capabilities. The typical power generation capacities of solar wind hybrid systems are in the range from 1 kW to 10 kW. Before discussing in brief aboutthe solar and wind hybrid power system, we should know about solar power generation systems and wind- power generation systems. To better understand the working of solar wind hybridsystem, we must know the working of solar energy system and wind energy system.

Solar power system can be defined as the system that uses solar energyfor power generation with solar panels. Solar energy is one of the major renewable energy resources that can be used for different applications, such as solar power generation, solar water heaters, solar calculators, solar chargers, solarlamps, and so on. There are various advantages of solar energy usage in electric power generation including low pollution, cost-effective power generation (neglecting installation cost), maintenance free power system, etc. Solar power system consists of three major blocks namely

- solar panels
- solar photovoltaic cells
- Batteries for storing energy.

The electrical energy (DC power) generated using solar panels can be stored in batteries or can be used for supplying DC loads or can be used for inverter to feed AC loads. The solar panel output is electric power and is measured in terms of Watts or Kilo watts. These solar panels are designed with different output ratings like 5 watts, 10 watts, 20 watts, 100 watts etc. So,based on the requirement of output power, we can choose appropriate solar panel. But, in fact, the solar panels output is affected by number of factors like climate, panel orientation to the sun, sun light intensity, the presence of sunlight duration, and so on. During normal sunlight a 12 volt 15 watts solar panel produces around 1 Ampere current.

Generally, solar panels maintained properly will work for 25 years. It is essential for designing the solar panel arrangement on the roof top for efficient usage and typically solar panels are arranged such that they face the East at an angle of 45 degree. The solar panel output is electric power and is measured in terms of Watts or Kilo watts. These solar panels are designed with different output ratings like 5 watts, 10 watts, 20 watts, 100 watts etc. So, based on the requirement of output power, we can choose appropriate solar panel. But, in fact, the solar panels output is affected by number of factors like climate, panel orientation to the sun, sun light intensity, the presence of sunlight duration, and so on. During normal sunlight a 12 volt 15 watts solar panel produces around 1Ampere current. Generally, solar panels maintained properly will work for 25 years. It is essential for designing the solar panel arrangement on the roof top for efficient usage and typically solar panels are arranged such that they face the Eastat an angle of 45 degree.

III. SOLAR PHOTOVOLTAIC CELLS WORKING

We must also know the working of the solar cells to understand how the solar panels convert solar energy into electrical energy. Solar cells or solar photovoltaic cells are the devices that are used for converting solar energy into electrical energy by utilizing the photovoltaic effect. These cells are used in many real-time applications such as railway signalling systems, street lighting systems, domestic lighting systems, and remote telecommunication systems.

Solar photovoltaic cell consists of a P-type of silicon layer that is placedin contact with an N-type silicon layer. The electrons diffuse from the N-type material to the P-type material. The holes in the P-type material acceptthe electrons but there are more electrons in the N-type material. So, with the influence of the solar energy, these electrons in the N-type material moves from N-type to P-type. Thus, these electrons and holes combine in the P-N junction. Due, to this combination a charge on either side of the P-N junction is createdand this charge creates an electric field. This formation of electric field results in developing a diode like system that promotes the charge flow. This is called as drift current and the diffusion of electrons and holes is balanced by drift current. This drift current occurs in an area where mobile charge carriers are lacking andis called as the depletion zone or space charge region .

During night time or in the darkness, these solar photovoltaic cellsbehave like reverse bias diodes. Generally solar panel open circuit voltage (voltage when battery is not connected) is higher than solar panel rated voltage. For example,consider a 12-volt solar panel giving an output voltage of around20 volts in bright sun light- but, whenever a battery is connected to the solar panel, then the voltage drops to 14-15 volts. Solar cells are made of most frequently used semiconductor materials such as silicon. Solar photovoltaic (SPV) effect is a process to convert solar energy into DC electricity using anarray of solar panels. This, DC electricity can be stored in batteries shown in the figure or can be used to feed DC loads directly or can be used to feed AC loads using an inverter that turns DC electricity into 120-volt AC electricity.

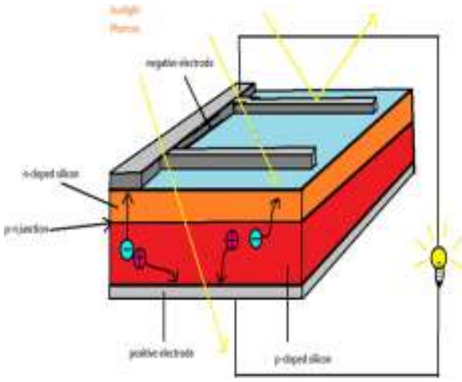

Figure 1: Working principle of PV cells

IV. WORKING OF WIND POWER SYSTEM

Wind energy is also one of the renewable energy resources that can be used for generating electrical energy with wind turbines coupled with generators. There are various advantages of wind energy, such as wind turbines powergeneration, for mechanical power with windmills, for pumping water using wind pumps, and so on. Large wind turbines are made to rotate with the blowing wind and accordingly electricity can be generated. The minimum wind speed required for connecting the generator to the power grid is called as cut in speed and maximum wind speed required for the generator for disconnecting the generator from the power grid is called as cut off speed. Generally, wind turbines work in the range of speed between cut in and cut offspeeds.

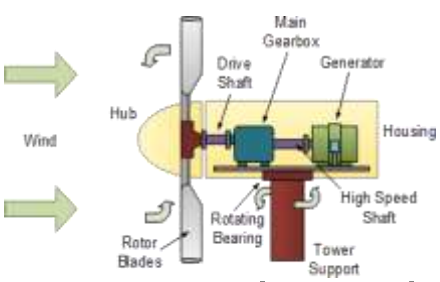

Figure 2: Working mechanism of wind powergeneration

V. WIND TURBINE

A wind turbine is a device that converts the kinetic energy of wind into electrical energy. As of 2020, hundreds of thousands of largeturbines, in installations known as wind farms, were generating over 650 gig watts of power, with 60 GW added each year. Wind turbines are an increasingly important source of intermittent renewable energy, and are used in many countries to lower energy costs and reduce reliance on fossil fuels. One study claimed that, as of 2009, wind had the "lowest relative greenhouse gas emissions, the least water consumption demands and the most favourable social impacts" compared to photovoltaic, hydro, geothermal, coal and gas energy sources. Smaller wind turbines are used for applications such as battery charging for auxiliary power for boats or caravans, and to power traffic warning signs. Larger turbines can contribute to a domestic power supply while selling unused power back to the utility supplier via the electrical grid.

Wind turbines are manufactured in a wide range of sizes, with either horizontal or vertical axes. Wind turbine can be defined as a fan consisting of 3 blades that rotate due to blowing wind such that the axis of rotation must be aligned with the direction of blowing wind. A gear box is used for converting energy from one device to another device using mechanical method; hence, it is termed as a high-precision mechanical system. There are different types of wind turbines, but the frequently used wind turbines are horizontal axis turbines and vertical axis turbines.

VI. WIND TURBINE GENERATOR

An electrical generator is coupled with wind turbine; hence, it is named as wind turbine generator. There are different types of wind turbine generators and these wind turbine generators can be directly connected to the power grid or loads or batteries based on different criteria. In general, there are offour types:

- Squirrel cage induction generator is directly connected to the power gridor to feed AC loads or DC loads using appropriate converters.
- A generator along with an AC to DC to AC converter is connected to power grid.

- A wound rotor induction generator, which is connected to power gridor batteries whose speed can be adjusted using rheostats for maintaining required outputs.
- A double fed induction generator, which is connected to power grid whosespeed can be controlled using back-to-back converters.

Consider DFIG double fed induction generator with 3-phase wound rotor and 3- phase wound stator. An AC current is induced in the rotor windings due to three phase AC signal fed to rotor windings. Due to mechanical force produced from wind energy the rotor starts rotation and produces a magnetic field. The speed of the rotor and frequency of AC signal applied to rotor windings are proportional to each other. This result of constant magnetic flux passing through stator windings produces AC current in the stator winding.

Due to variation of speed in wind speed there is chance of getting AC signal output with varying frequency. But, the AC signal with constant frequency is desired. So, by varying the frequency of input AC signal given to the rotor windings we can obtain AC output signal with constant frequency. Grid side converter can be used for providing regulated DC voltage to charge batteries. Rotor side converter can be used for providing controlled AC voltage to the rotor. Thus, the electric power generated from solar energy system and wind energy system can be used for charging the batteries of e-cycles.

VII. EXISTING SYSTEM

Solar panels can be used to charge electric bikes in many locations, such as while on the road, at home, or at a solar charging station. Solar panels come in various sizes from small portable panels to large fixed ones. The size of the solar panel will determine how much power it can generate.

DISADVANTAGES

- Only one source of energy generation
- Limited power supply
- Efficiency comparatively less

Figure 3 : Solar powered E-cycle chargingstation

VIII. PROPOSED SYSTEM

This paper presents the design and implementation of a cost-effective standalone e-cycle charging station where the power is supplied by photovoltaic (PV) panelsand small wind turbines (WTs).

Figure 4 : Hybrid powered E-cycle chargingstation

ADVANTAGES

- Regeneratable.
- Non-polluting.
- Continuous supply of power.
- High returns of investments.
- Reduced investments of the system for same output of two sources.

IX. BLOCK DIAGRAM

The block diagram of the system contains a solar panel, Propeller, DC generator, PWM charging controller, Lead acid battery, booster circuit and output port. The solar panel is used to convert the solar energy to electrical energy. The normal voltage rating of the solar panel used is 12V.The principle used is PHOTOELECTRIC EFFECT for the conversion of solar energy to electrical energy and the PWM charging controller circuit regulates the input from the solar panel to a consistent voltage. In apparently the propeller of the wind turbine generates mechanical energy to implements on DC generator to produce electrical energy. The output driven by the DC Generator is 12V andboth the voltage from solar and wind generator goes to the booster circuit to step-up the voltage into 24V and then the generated energy is stored on the battery for the charging of E-cycles.

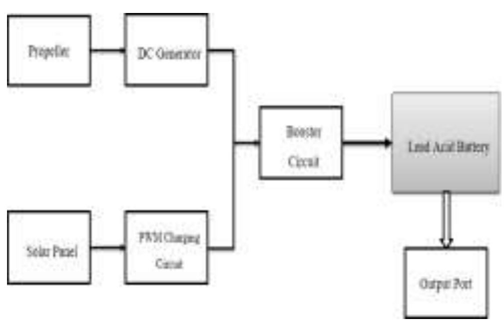

Figure 5 : The Functional block diagram of proposed system

X. HARDWARE DESCRIPTION

- Solar panel
- Dc generator
- Boost converter
- Solar charge controller
- LM317 Regulator
- Battery
- Propeller
- Bearing

1) SOLAR PANEL

A solar panel is a set of solar photovoltaic modules electrically connected and mounted on a supporting structure. A photovoltaic module is a packaged connected assembly of solar cells. The solar panel can be used as a component of a larger photovoltaic system to generate and supply electricity in commercial and residential applications. A photovoltaic system typically includes a panel or an array of solar modules, an inverter, and sometimes a battery and/or solar tracker and interconnection wiring. Photovoltaic cells or panels are only one way of generating electricity from solar energy. They are not the most efficient, but they are the most convents to use on a small to medium scale. PV cells are made of silicon, similar to that used in computer "chips". While silicon itself is a very abundant mineral, the manufacture of solar cells (as with computer chips) has to be in a very clean environment. This causes production costs to be high. A PV cell is constructed from two types of silicon, which when hit by solar energy, produce a voltage difference across them, and, if connected to an electrical circuit, a current will flow. A number of photovoltaic cells will be connected together in a "Module", and usually encapsulated in glass held a frame which can then be mounted as required.

The cells in a module will be wired in series or parallel to produce a specified voltage. What may be referred to as a 12-volt panel may produce around 16 volts in full sun to charge to 12-volt battery. Here we use OSWAL company solar panel. The mechanical characteristics made from high efficiency crystalline silicon solar cells. Cells encapsulated in low iron, high transmission, toughened glass using UV stable ethylene vinyl acetate (EVA) sheets. Premium quality back sheet protects the module from environmental conditions. Laminate framed with strong anodized aluminium profile with fitted junction box.

Specification of the solar panel:

- Material: Silicon
- Rated peak power (P_{max}): 15W
- Type: Polycrystalline
- No of Cells: 32
- Rated Voltage (V_{pm}): 18V
- Rated Current (I_{pm}): 0.85A
- voltage at maximum power: 17.5 V
- Current at max. Power: 0.58 A
- Tolerance: 3%

Figure 6 : The solar panel

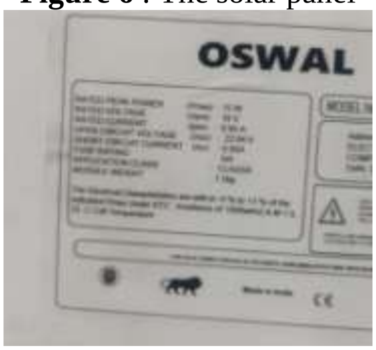

Figure 7 : The configuration of the solar panel

2) DC GENERATOR

A direct-current (DC) generator is a rotating machine that supplies an electrical output with unidirectional voltage and current. The basic principles of operation are the same as those for synchronous generators. Voltage is induced incoils by the rate of change of the magnetic field through the coils as the machine rotates. This induced voltage is inherently alternating in form since the coil flux increases and then decreases, with a zero average value.

The field is produced by direct current in field coils or by permanent magnets on the stator. The output, or armature, windings are placed in slots in the cylindrical iron rotor. A simplified machine with only one rotor coil is shown in Figure 6. The rotor is fitted with a mechanical rotating switch, or commutator, that connects the rotor coil to the stationary output terminals through carbon brushes. This commutator reverses the connections at the two instants in each rotation when the rate of change of flux in the coil is zero— i.e., when the enclosed flux is maximum (positive) or minimum (negative). The output voltage is then unidirectional but is pulsating for the simple case of one rotor coil. In practical 2-pole machines, the rotor contains many coils symmetrically arranged in slots around the periphery and all connected in series. Each coil is connected to a segment on a multi-bar commutator. In this way, the output voltage consists ofthe sum of the induced voltages in a number of individual coils displaced around half the periphery. The magnitude of the output voltage is then approximately constant, containing only a small ripple. The voltage magnitudeis proportional to the rotor speed and the magnetic flux. Control of output voltage is normally provided by control of the direct current in the field.

For convenience in design, direct-current generators are usually constructed with four to eight field poles, partly to shorten the end connections on therotor coils and partly to reduce the amount of magnetic iron needed in the stator. The number of stationary brushes bearing on the rotating commutator isusually equalto the number of poles but may be only two in some designs.

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A dynamo uses commutators to produce direct current. It is self-excited, i.e. its field electromagnets are powered by the machine's own output. Other types ofDC generators use a separate source of direct current to energize their field magnets.

A. Homopolar generator

A Homopolar generator is a DC electrical generator comprising an electricallyconductive disc or cylinder rotating in a plane perpendicular to a uniform static magnetic field. A potential difference is created between the centre of the discand the rim (or ends of the cylinder), the electrical polarity depending on the direction of rotation and the orientation of the field. It is also known as a unipolar generator, acyclic generator, disk dynamo, or Faraday disc. The voltage is typically low, on the order of a few volts in the case of small demonstration

models, but large research generators can produce hundreds of volts, and some systems have multiple generators in series to produce an even larger voltage. They are unusual in that they can produce tremendous electric current, some more than a million amperes, because the Homopolar generator can be made to have very low internal resistance.

B. Magneto hydrodynamic (MHD) generator

A magneto hydrodynamic generator directly extracts electric power from moving hot gases through a magnetic field, without the use of rotating electromagnetic machinery. MHD generators were originally developed because the output of a plasma MHD generator is a flame, well able to heat the boilers ofa steam power plant. The first practical design was the AVCO Mk. 25, developed in 1965. The U.S. government funded substantial development, culminating in a 25 MW demonstration plant in 1987. In the Soviet Union from 1972 until the late 1980s, the MHD plant U 25 was in regular utility operation on the Moscow power system with a rating of 25 MW, the largest MHD plant rating in the world at that time. MHD generators operated as a topping cycle are currently (2007)less efficient than combined cycle gas turbines.

Figure 8 : The DC generator

3) BOOST CONVERTER

A boost converter (step-up converter) is a DC-to-DC power converter that steps up voltage (while stepping down current) from its input (supply) to its output (load). It is a class of switched-mode power supply (SMPS) containing at least two semiconductors (a diode and a transistor) and at least one energy storage element: a capacitor, inductor, or the two in combination. To reduce voltage ripple, filters made of capacitors (sometimes in combination with inductors) are normally added to such a converter's output (load-side filter) and input (supply-side filter). Battery power systems often stack cells in series to achieve higher voltage. However, sufficient stacking of cells is not possible in many high voltage applications due to lack of space. Boost converters can increase the voltage and reduce the number of cells. Two battery-powered applications that use boost converters are used in hybrid electric vehicles (HEV) and lighting systems. The NHW20 model Toyota Prius HEV uses a 500 V motor. Without a boost converter, the Prius would need nearly 417 cells to power the motor. However, a Prius actually uses only 168 cells [*citation needed*] and boosts the battery voltage from 202 V to 500

V. Boost converters also power devices at smaller scale applications, such as portable lighting systems. A white LED typically requires 3.3 V to emit light, and a boost converter can step up the voltage from a single 1.5 V alkaline cell to power the lamp.

An unregulated boost converter is used as the voltage increase mechanism in the circuit known as the 'Joule thief'. This circuit topology is used with low power battery applications, and is aimed at the ability of a boost converter to 'steal' the remaining energy in a battery. This energy would otherwise be wasted since the low voltage of a nearly depleted battery makes it unusable for a normal load. This energy would otherwise remain untapped because many applications do not allow enough current to flow through a load when voltage decreases. This voltage decrease occurs as batteries become depleted, and is a characteristic of the ubiquitous alkaline battery. Since the equation for power is R tends to be stable, power available to the load goes downsignificantly as voltage decreases. `It is a dc to dc step-up converter. The simplestway to increase the voltage of a DC supply is to use a linear regulator (such as a 7805), but linear regulators waste energy as they operate by dissipating excess power as heat. Boost converters, on the other hand, can be remarkably efficient (95% or higher for integrated circuits). It utilizes a MOSFET switch (IRFP250N), a diode, inductor and a capacitor. Few resistors also are used in the circuit for the protection of the main components. When the MOSFET switch is ‗ON' current rises Through inductor, capacitor and load. Inductor stores energy. When switch is ‗OFF' the energy in the inductor circulates current through inductor, capacitor freewheeling diode and load. The output voltage will begreater than or equal to the input voltage. Here we use an LM2596 DC- DC buck converter step-down power module with high-precision potentiometer for adjusting output voltage, capable of driving a load up to 3A with high efficiency.

The specification of the DC-DC boost converter are-

1) Module properties: non-isolated constant voltage module
2) Rectification: non-synchronous rectification
3) Input Voltage: 0V-35V
4) Output Current: 3A maximum
5) Output Voltage: 1.3V-30V
6) Conversion efficiency: 92% (maximum)
7) Switching frequency: 150KHz
8) Output ripple: 50mV (maximum) 20M-bandwidth
9) Load regulation: ± 0.5 %
10) Voltage regulation: ± 2.5%
11) Operating temperature: -40 °C t

Figure 9 : Booster converter circuit

4) SOLAR CHARGE CONTROLLER

A charge controller or charge regulator is basically a voltage and or current regulator to keep batteries from overcharging. It regulates the voltage and current coming from the solar panels going to the battery. Most"12 volt" panels put out about 16 to 20 volts, so if there is no regulation the batteries will be damaged from overcharging. Most batteries need around 14 to 14.5 volts to get fully charged. Not always, but usually. Generally, there is no need for a charge controller with the small maintenance, or trickle charge panels, such as the 1 to 5-watt panels. A rough rule is that if the panel puts out about 2 watts or less foreach 50-battery amp-hours, then you don't need one. Charge controls come in all shapes, sizes, features, and price ranges. They range from the small 4.5-amp (SunGard) control, up to the 60-to-80-amp MPPT programmable controllers with computer interface. Often, if currents over 60 amps are required, two or more 40-to-80-amp units are wired in parallel. The most common controls used for all battery-based systems

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are in the 4-to-60-amp range, but some of the new MPPT controls such as the Outback Power Flex Max go up to 80 amps. Charge controls come in 3 general types (with some overlap):

Simple 1 or 2 stage controls which rely on relays or shunt transistors to control the voltage in one or two steps. These essentially just short or disconnect thesolar panel when a certain voltage is reached. For all practical purposes these are dinosaurs, but you still see a few on old systems - and someof the super cheap ones for sale on the internet. Their only real claim to fameis their reliability -theyhave so few components, there is not much to break.

3-stage and/or PWM such Morningstar, Xantrex, Blue Sky, Steca, and many others. These are pretty much the industry standard now, but you will occasionally still see some of the older shunt/relay types around, such as in the very cheap systems offered by discounters and mass marketers.

Maximum power point tracking (MPPT), such as those made by Midnite Solar, Xantrex, Outback Power, Morningstar and others. These are the ultimatein controllers, with prices to match - but with efficiencies in the 94% to 98% range, they can save considerable money on larger systems since they provide 10 to 30% more power to the battery. For more information, see our article on MPPT.

Pulse-width modulation (PWM), or pulse-duration modulation (PDM), is a method of controlling the average power delivered by an electrical signal.The average value of voltage (and current) fed to the load is controlled by switching the supply between 0 and 100% at a rate faster than it takes the load to change significantly. The longer the switch is on, the higher the total power supplied to the load. Along with maximum power point tracking (MPPT), it isone of the primary methods of reducing the output of solar panels to that which can be utilized by a battery. PWM is particularly suited for running inertial loads such as motors, which are not as easilyaffected by this discrete switching. The goal of PWM is to control a load; however, the PWM switching frequency must be selected carefully in order to smoothly do so.

The PWM switching frequency can vary greatly depending on load and application. For example, switching only has to be done several times a minute inan electric stove; 100 or 120 Hz (double of the utility frequency) in a lamp dimmer; between a few kilohertz (kHz) and tens of kHz for a motor drive; and well into the tens or hundreds of kHz in audio amplifiers and computer power supplies. Choosing a switching frequency that is too high for the application results in smooth control of the load, but may cause premature failure of the mechanical control components. Selecting a switching frequency that is too low for the application causes oscillations in the load. The main advantage of PWM isthat power loss in the switching devices is very low. When a switch is off there is practically no current, and when it is on and power is being transferred to the load, there is almost no voltage drop across the switch. Power loss, being the product of voltage and current, is thus in both cases close to zero. PWM also works well with digital controls, which, because of their on/off nature, can easily set the needed duty cycle. PWM has also been used in certain communication systems where its duty cycle has been used to convey information over a communications channel.

In electronics, many modern microcontrollers (MCUs) integrate PWM controllers exposed to external pins as peripheral devices under firmware control by means of internal programming interfaces. These are commonly usedfor direct current (DC) motor control in robotics, switched-mode power supply regulation, and other applications.

Figure 10 : PWM charging controller

5) LM317 REGULATOR

The LM317T is an adjustable 3-terminal positive voltage regulator capable of supplying different DC voltage outputs other than the fixed voltage power supply of +5 or +12 volts, or as a variable output voltage from a few volts up to some maximum value all with currents of about 1.5 amperes. With the aid of a small bit of additional circuitry added to the output of the PSU we can have abench power supply capable of a range of fixed or variable voltageseitherpositive or negative in nature. In fact, this is simpler than you may think as the transformer, rectification and smoothing has already been done by the PSUbeforehand all we need to do is connect our additional circuit to the +12- volt yellow wire output.

But firstly, let‗s consider a fixed voltage output. There are a wide variety of 3terminal voltage regulators available in a standard TO-220 package with the most popular fixed voltage regulator being the 78xx series positive regulators which range from the very common 7805, +5V fixed voltage regulatorto the 7824, +24V fixed voltage regulator. There is also a 79xx seriesof fixed negative voltage regulators which produce a complementary negative voltage from -5 to -24 volts but in this tutorial, we will only use the positive 78xx types. The fixed 3-terminal regulator is useful in applications where an adjustableoutput is not required making the output power supply simple, but very flexible as the voltage it outputs is dependant only upon the chosen regulator. They are called 3- terminal voltage regulators because they only have three terminals to connect to and these are the Input, Common and Output respectively.

The input voltage to the regulator will be the +12v yellow wire from thePSU (or separate transformer supply), and is connected between the inputand common terminals. The stabilised +9 volts is taken across the output and common as shown. So suppose we want an output voltage of +9 volts fromour PSU bench power supply, then all we have to do is connect a +9v voltage regulator to the +12V yellow wire. As the PSU has already done the rectification and smoothing to the +12v output, the only additional components required are a capacitor across the input and another across the output. These additional capacitors aid in the stability of the regulator and can be anywhere between 100nF and 330nF. The additional 100uF output capacitor helps smooth out the inherent ripple content giving it a good transient response. This large value capacitor placed across the output of a power supply circuit is commonly called a ―Smoothing Capacitor‖.

These 78xx series regulators give a maximum output current of about amps at fixed stabilised voltages of 5, 6, 8, 9, 12, 15, 18 and 24V respectively. But what if we wanted an output voltage of +9V but only had a 7805, +5V regulator. The +5V output of the 7805 is referenced to the ―ground, Gnd‖ or ―0v‖ terminal.

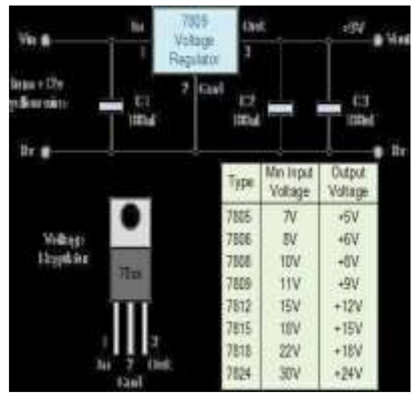

Figure 11 : The pin configuration of Lm317 voltage regulator

6) LEAD ACID BATTERY

The electrical energy produced by the system is needed to be either utilized completely or stored. Complete utilization of all the energy produced by the system for all the time is not possible. So, it should be store rather than useless wasting it. Electrical batteries are the most relevant, low cost, maximum efficient storage of electrical energy in the form of chemical reaction. Hence, batteries are preferred. As they are inexpensive compared to newer technologies, lead–acid batteries are widely used even when surge current is not important and other designs could provide higher energy densities. In 1999, lead–acid battery sales accounted for 40–50% of the value from batteries sold worldwide (excluding China and Russia), equivalent to a manufacturing market value of about US$15 billion. Large-format lead–acid designs are widely used forstorage in backup power supplies in cell phone towers, high- availability emergency power systems like hospitals, and stand-alone power systems. For these roles, modified versions of the standard cell may be used to improve storage times and reduce maintenance requirements. *Gel-cells* and *absorbed glass-mat* batteries are common in these roles, collectively known as VRLA (valve-regulated lead– acid) batteries. In the charged state, the chemical energy of the battery is stored in the potential difference between metallic lead at the negative side and PbO_2 on the positive side. Lead is highly toxic to humans, and recycling itcan result in pollution and contamination of people resulting in numerous and lasting health problems. One ranking identifies lead–acid battery recycling as the world's most deadly industrial process, in terms of Disability-adjusted life years lost—resulting in 2,000,000 to 4,800,000 estimated years of individual human life lost, globally.

Lead–acid battery-recycling sites, themselves, have become a sourceof lead pollution, and by 1992, the EPA had selected 29 such sites for its Superfund clean-up, with 22 on its National Priority List. An effective pollution control system is a necessity to prevent lead emission. Continuous improvement in battery recycling plants and furnace designs is required to keep pace with emission standards for lead smelters.

The energy generated from the proposed project is needed to be store.So, one battery is needed. One is attached to wind turbine for which a 7 AmpH battery will be required, which will be fair enough full fill the storage capacity for targeted value.

Figure 12 : Lead Acid Battery

7) *PROPELLER*

Propeller or a wind turbine comprises essentially a hub and blades. The blade of the propeller or the wind turbine blade can be considered asa rotating wing. The blade shape is defined by profiles, chosen for their aerodynamic performance. Profiles are distributed along the blade of the wind turbine or the propeller, in order to achieve the best compromise between resistance and production of lift.

The rotation of the propeller generates a speed and an apparent angle, which vary depending on the position of the observed point on the radius of the blade. To keep an optimum angle of incidence, the profiles of the blade of the wind turbine or the propeller, will have a pitch adjusted to apparent velocities along the blade. Pitch profiles varies and causes a twist of the blade. Twisting of the blade of the propeller or turbine blade, is the angle measured between the chord of the profile at the blade root, and the profile chord at the blade tip.

Varying the rotational speed or velocity of the fluid relative to the operating point of construction, degrades the performance of the propeller or turbine. The variation of the pitch is to rotate the blade of the wind turbine or the propeller on its axis so as to correct the loss of performance. The pitch variation also helps regulate the speed of the wind turbines. The number of blade of the wind turbine or the propeller varies according to the torque and velocityat operating point .A wind pump will not have same number of blade, than wind turbine of electricity generation. A sailing boat propeller has a blade shapedifferent from a speedboat propeller.

Figure 13 : The structure of wind turbine (a)

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Figure 14 : The structure of wind turbine(b)

For one blade

- Length of the blade: 300mm
- Minimum width: 75mm
- Maximum width: 100mm
- Total diameter of the wings: 700mm

8)BEARING

A bearing is a machine element that constrains relative motion to only the desired motion, and reduces friction between moving parts. The design of the bearing may, for example, provide for free linear movement of the moving part or for free rotation around a fixed axis; or, it may *prevent* a motion by controlling the vectors of normal forces that bear on the moving parts. Most bearings facilitate the desired motion by minimizing friction. Bearings are classified broadly according to the type of operation, the motions allowed, or to the directions of the loads (forces) applied to the parts.

Rotary bearings hold rotating components such as shafts or axles within mechanical systems, and transfer axial and radial loads from the source of the load to the structure supporting it. The simplest form of bearing, the *plain bearing*, consists of a shaft rotating in a hole. Lubrication is used to reduce friction. Lubricants come in different forms, including liquids, solids, and gases. The choice of lubricant depends on the specific application, and factors such as temperature, load, and speed. In the *ball bearing* and *roller bearing*, to reduce sliding friction, rolling elements such as rollers or balls with a circular cross- section are located between the races or journals of the bearing assembly. A widevariety of bearing designs exists to allow the demands of the application to be correctly met for maximum efficiency, reliability, durability and performance.

Figure 15 : The rolling element Bearing

XI. RESULT AND DISCUSSION

Figure 16 : The hardeware kit of proposedsystem

Figure 17 : The ouput of the proposed system

XII. CONCLUSION

In this paper, a new recharging mechanism for electric cycles is proposed using solar and wind energy. The usage of E-cycles is directly affected by the present charging technique. Recharging stations are necessary for longer drive vehicles and it is commonly used in few countries. The traveling distance depends on the capacity of energy storage present in the vehicle. The recharging stations are needed for long distance travel.

So, we have introduced a new hybrid renewable charging mechanism for E- cycles. A performance of solar and wind energy has been studied. Various parameters of the solar module have been verified under different irradiation level. The SG has been studied under different loading condition. Finally, the hourly load of E-cycles versus generated electricity has been analysed. From the output generated by the hybrid system, we strongly say that the proposed SWCMprovides enough power for recharging the electric vehicle and the timetaken for charging can be avoided by battery swapping method. At last, we areconcludingthat this approach reduces the pollution and increase the usage of EVs as a result creating pollution free environment.

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