A MODERN DESIGN OF WIND OPERATED BATTERY CHARGER

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***Abstract*: Now a days, the charging of mobile phone battery is very toughest thing in travelling or in remote areas. Another conventional energy sources and charging sockets are not available while travelling. But wind energy is available at the time of travelling. So this paper gives idea about charging the mobile battery at the time of travelling. The voltage level of wind operated dynamo is fluctuates due to variation in wind energy. To overcome this problem the maximum power point tracking (MPPT) boost converter is used as the voltage control circuit. This system is used as an emergency source for charging mobile phone while travelling by vehicle or train.**

***Keywords*:** propeller, Maximum power point tracking (MPPT) boost converter, Dynamo, mobile battery, USB connector.

I. INTRODUCTION

In this modern era, mobile phone plays a vital role in human life. But battery backup of mobile phone is poor. The charging sockets are not available in remote areas and when we travelled by train, bus, bike, car. But this problem is tackled by using renewable energy sources technologies like solar charger, charging pins powered by automobile battery and hand operated dynamo. But problem arise when there is no sunlight or insufficient amount of light is available, the automobile battery fails to charge mobile battery and hand operated dynamo is laborious work and also not effective for long time. For to overcome this problem this modern charger can be used. This concept utilizes the wind generated electrical energy to charge the mobile phones battery through USB connected multi-charger.

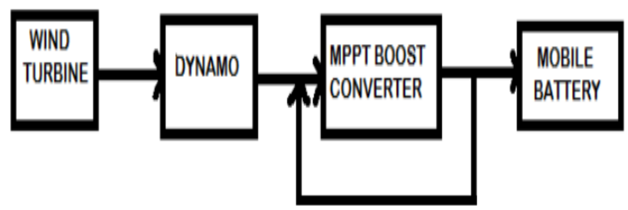

Figure1: Block diagram of wind energy conversion system

The proposed model consists of wind turbine, dynamo maximum point tracking (MPPT) boost converter, PCB, USB connector and suitable mobile charging pin.

II. MATERIAL AND METHOD

A) Propeller

The propeller works the opposite of a fan. Instead of using electricity to make wind, like a fan, propeller use wind to make electricity. The wind turns the blades, which spin a shaft, which connects to a dynamo and make electricity. The energy in the wind turns two or four propeller like blades around a rotor. The rotor is connected to the main shaft, which spins a dynamo to create electricity. When the wind blows, a pocket of low pressure air forms on the downwind side of the blade. The low pressure air pocket then pulls the blade toward it, causing the rotor to turn. This is called as lift. The force of the lift is actually much stronger than the wind’s force against the front side of the blade, which is called drag. The combination of lift and drag causes the rotor to spin like a propeller, and turning shaft spins a dynamo to make electricity.

The output mechanical power of the propeller is given by usual cube law equation,

$$Pm = \frac{1}{2}\rho CpAU_w^3 \qquad (1)$$

The tip speed ratio λ is expressed as:

$$\lambda = \frac{R\omega_m}{U_w} \qquad (2)$$

Where Cp= power coefficient function of tip speed ratio λ and blade angle β, A= wind turbine rotor swept area $[m^2]$, U_w= wind speed [m/s], ρ= air density [kg/m^3], R= radius of the rotor[m], ω_m= mechanical angular velocity of the dynamo[r/sec].

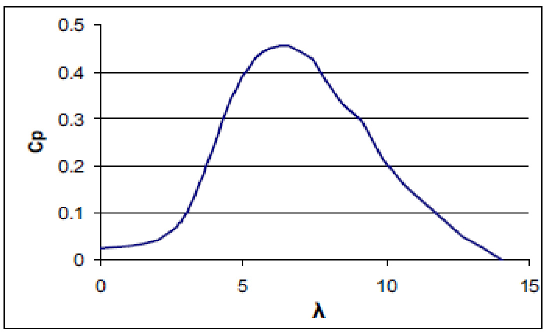

Fig.2 Power coefficient versus tip speed ratio

Above fig. shows the ratio of power coefficient versus tip speed ratio. When Cp increases then λ is also increases but at particular value of λ, Cp starts decreasing.

The propeller used in this device is high RPM because the propeller consists of three blades in horizontal axis arrangement.

Fig.3 Propeller

B) DC Generator

A dc generator is used instead of the AC generator for avoiding rectifier circuitry so as to making the system cheaper and compact. In modern day's dynamo or generator have only two structural designs. Vertical axis generator and horizontal axis generator. In such a generator, the propeller is connected to the shaft of generator to rotate the magnet in between copper wire coil to produce the electrical energy. Here we can use a 24V output generator for power generation, because it is sustainable at high speed of vehicle rather than 12V generator.

Fig.4 DC generator

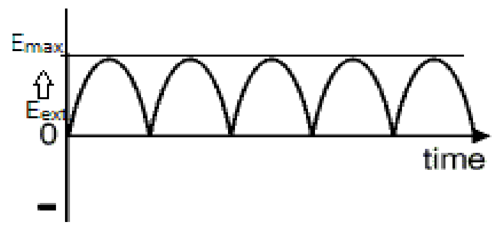

Fig.5 Sinusoidal waveform of DC generator

Above waveform shows the generator voltage versus time. In this waveform the EMF E_{ext} is the EMF of external circuit of generator and E_{max} is the maximum EMF of the generator.

C) MPPT Boost converter

Maximum power point tracking (MPPT) boost converter is used to control output voltage of dc generator which is used in wind energy conversion system.

There are many methods used for maximum power point tracking a few are listed below:

1) Perturb and Observe method

2) Incremental Conductance method

3) Parasitic Capacitance method

4) Constant Current method

5) Constant Voltage method

In this system we can use the constant voltage method, because we require 5v constant power supply for charge the mobile battery.

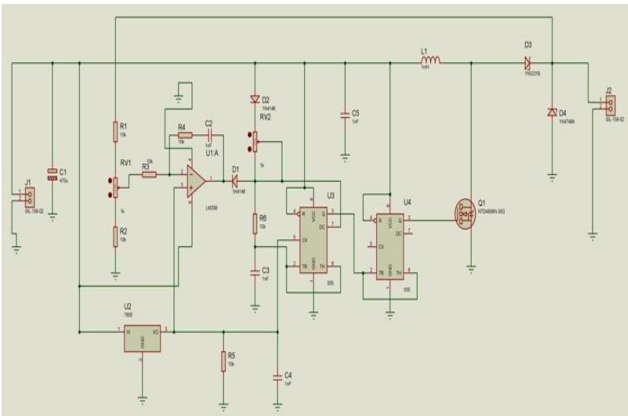

Fig.6 Circuit diagram of MPPT boost converter

The above fig. shows the circuit of MPPT boost converter used for the given system. By the boost converter topology circuit, inductor (L1) charge when Q1 turns on. When Q1 gets turn off L1 discharges into the battery via diode D1. Completing this action thousand times per second outcomes in appreciable output current. It is also called as inductive discharge. For this work, the input voltage must be lower than the output voltage. The schematic consist of essentially three sections including 555 MOSFET driver, 555 PWM generator and operational amplifier voltage limiter. The 555 with its totem pole output can source as well as sink roughly 200mA and makes a great low power gate driver. To govern the c_3 discharge time, pin 5 is held at regulated 5V. Op amp U1 unite the battery voltage signal when the divided set point voltage is compared with the 5V reference. When the voltage be greater than the setting, the output integrates in the negative direction, thus reducing the repetition rate of the PWM generator and limiting any subsequent charging. This effectively prevents overcharging.

As the wind generator voltage or current increases the PWM generator increases its replication rate thus resulting increased output current. At the same time, surplus voltage is applied to the inductor thus raising its charge current. As outcome, the boost regulator really digs in as the voltage rises, or lets up as the voltage deducts. To attain maximum transfer of power with full aero-access, potentiometer R8 is adjusted so that the battery charging current is maximized-this is the maximum power point. If the circuitry working properly, there will be a very shoal peak as R5 is turned. Diode D3 makes the automatic MPPT adjustment function more severely by deducting a fixed voltage from the voltage difference between the battery and the average voltage across C3. Under low aero-access conditions, it is observed that R3 is not exactly at best, but will not be significantly off. Observed that MPPT controller can do a better work across the full range, but such a progress is very marginal.

D) Mobile battery

Mobile battery generally made up of Lithium (Li) ion. When battery starts charging then negative ions move towards the cathode terminal present in battery and when the battery starts discharging then negative ions move towards the anode terminal of battery. For demonstration we can use a 1500 mAh battery.

E) USB cable

Universal Serial Bus (USB) cable is used to charge the mobile battery and transfer the data from computer to mobile or vice-versa. Here we can use 2.0 port USB cable for charging purpose.

III. RESULT AND DISCUSSION

The wind generator pitched with propeller is held in the direction of running vehicles. The positive polarity of the generator is identified by using DMM. It is observed that whenever the generator is held in the similar direction of running vehicle, it will revolve exactly in wind direction which is polarity of output terminal will stay fixed and never changed until the generator direction is changed. The capacity reached around 4.2 volt per cell. The following graphs show the relation between voltage and vehicle speed in km/hr.

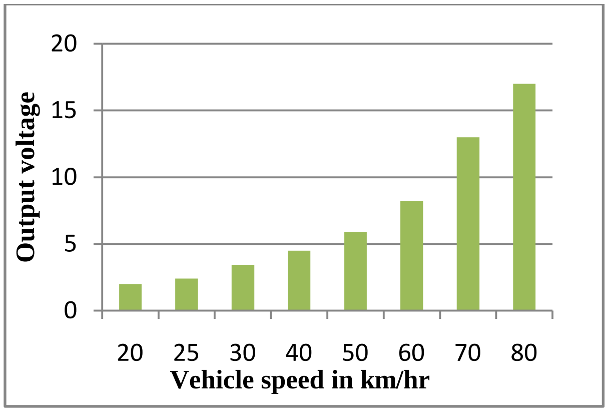

Fig.9 Output voltage without using MPPT boost converter

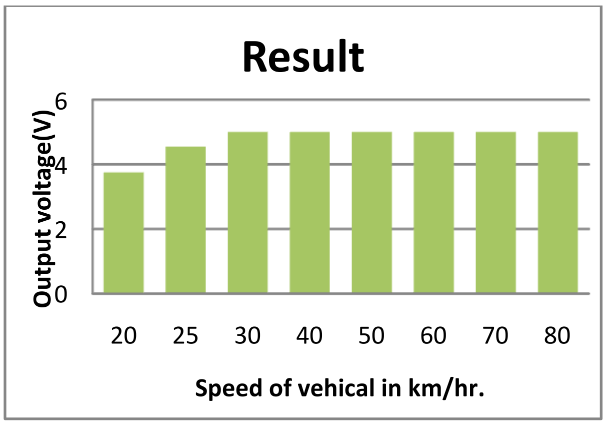

Fig.10 Output voltage with using MPPT boost converter

IV.CONCLUSION

Application in this work a wind battery has been calibrated to charge the mobile phone as or battery while travelling and hilly areas. This technology can help to meet the emergency power requirement when conventional energy source is not available. The wind powered charger is also portable, cost-effective any energy efficient.

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