Real-Time Portable Device Charging Using Wind Energy

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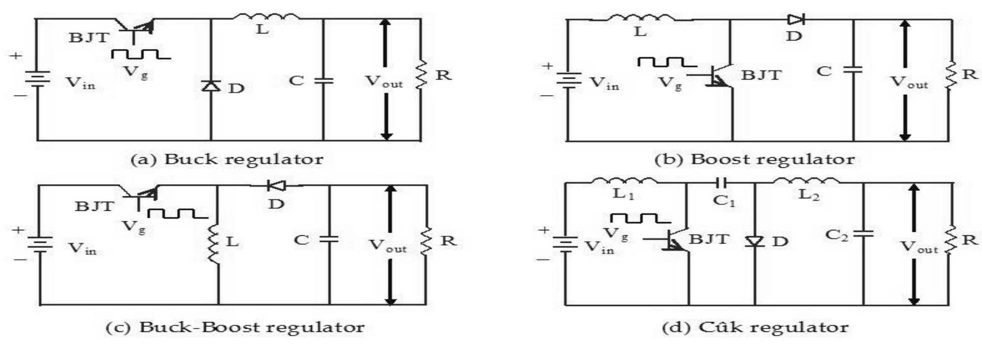
Abstract: In this proposed system, a new method of mobile charging in vehicles, using wind energy has being discussed. In the current trend, the mobile phones are charged by using the internal battery points in automobiles. On usage of this energy, diesel consumption is increased and also it spoils the life of the battery. This issue is overcome by using a small wind turbine, which is used to charge up our mobile phone batteries. The tape recorder DC motor based wind mill is used to generate the electrical energy by a small wind turbine. This DC motor is a permanent magnet type motor which will act as a generator when a mechanical input is provided by an external rotating source. According to the variations of the vehicle speed; the generation of induced EMF of the DC motor is also varied. This variable output is regulated and is used to charge up our mobile phone batteries. Thus, the prototype is implemented for verification and performance analysis.

Keywords: DC motor, Induced EMF, Voltage Regulator IC, Turbine, Permanent magnet,

1. INTRODUCTION

Our aim is charge up our mobile phone battery without using the battery points. So, automatically the diesel consumption is reduced and also the battery life will be saved. According to the variation of the vehicle speed, the induced EMF in the DC motor is also varied. So, we have to provide a constant voltage and the smoothed current also. The proposed circuit diagram is shown in the Figure.1. The simulations works are performed by using MATLAB [4] software.

Proposed Circuit Diagram



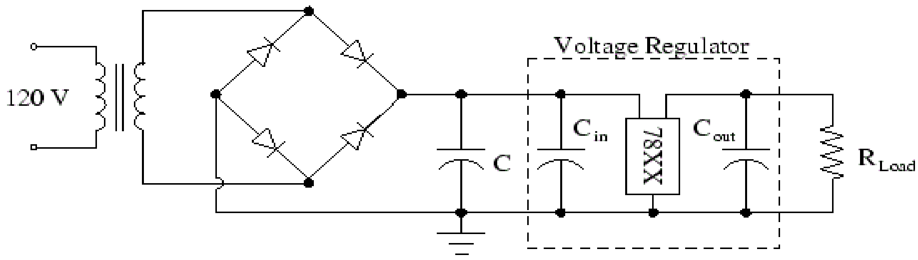


Fig.1. Circuit diagram of the proposed method (Buck- Boost Converter & IC 7805)

Working Principle

The wind turbine is used to converts wind energy into mechanical energy. This wind turbine is mechanically coupled with the shaft of the small permanent magnet DC motor [3]. This motor is used to converts the mechanical energy into electrical energy. The speed of the vehicle is not constant. So, the velocity of the wind energy is also not a constant one. Due to this function, the induced EMF in the machine is always variable.

The small DC machine gives 6.5 volts to 16 volts according to the wind speed velocity as the datasheet says in [1]. This variable DC output supply will regulated by IC7805 [5]. According to the wind speed variation, the output current also varied. This will smoothed by an inductor. Then Zener diode gives constant 4.7Volts output supply. This voltage is used to charge our mobile phones. The rating of mobile phone battery is 3.6 Volts, 800mA or 1400mA. So by my idea, 1hrs 45mins time requires to full charge the battery. So, this idea is capable to reach even common people also.

In an alternate way, to this system, the output of the wind turbine can be given to full wave rectifier. The DC output of the rectifier is fed to a BUCK-BOOST converter to increase or decrease the pulsating DC output for the required load. The BUCK-BOOST converter increases the voltage, when the power generation is low and it performs the operation vice-versa. It is clearly explained in [6], [7].

Comparison between Normal Mobile Chargers with proposed Idea

Table.1. Comparison on Normal Mobile Chargers with proposed idea

Data	Normal mobile charge	My idea
Output voltage	4.7V, 150mA	4.7V, 120mA
Charging time	1Hrs, 30Mins	1Hrs, 50Mins
Supply source	Need a AC supply source to work	No need any source
Life time	5 to 6 years	More than normal mobile charger

Design Details for Cooler Fan Blade

Input Data

- PM-generator type generator
- 12V at 2400 rpm (revolutions per minute)
- 7 bladed rotors

Tip Speed Ratio

We start by selecting a value for the Tip Speed Ratio (TSR) which is defined and disused in [8] as

TIP SPEED RATIO (TSR) = (tip speed of blade)/ (wind speed)

The tip speed ratio is a very important factor in the different formulas of blade design. This rotor type usually runs very fast and also the number of blades is more, so let's choose a tip speed ratio of 1.

Power

Power (W) = 0.6 x Cp x N x A x V

Cp = Rotor efficiency = 0.4

N = Efficiency of driven machinery = 0.7

A = Swept rotor area (m2) = 0.35

V = Wind speed (m/s) = 7.55

Revolutions Per Minute

RPM = V x TSR x 60 / (6.28 x R)

TSR = Tip Speed Ratio

R = Radius of rotor

Therefore, RPM = (7.55*1*60)/(6.28*0.03)

RPM = 2400

Rotor efficiency can go as high as Cp = 0.48, but Cp = 0.4 is often used in this type of calculations. This concept works without transmission. If a transmission with efficiency of 0.95 was to be included this means that

N = 0.95 x 0.7

*Power = 0.6 * 0.4 * 0.7 * 0.35 * 7.55*

Power = 44mW

Design Details for Stainless Steel Blade

POWER

Power (W) = 0.6 x Cp x N x A x V

Cp = Rotor efficiency = 0.4
N = Efficiency of driven machinery = 0.7
A = Swept rotor area (m2) = 0.55
V = Wind speed (m/s) = 7.55

Rotor efficiency can go as high as Cp = 0.48, but Cp = 0.4 is often used in this type of calculations.This concept works without transmission. If a transmission with efficiency of 0.95 was to be included this means that

N = 0.95 x 0.7

Therefore,
*Power = 0.6 * 0.4 * 0.7 * 0.55 * 7.55*
Power = 69.76mW
REVOLUTIONS PER MINUTE

RPM = V x TSR x 60 / (6.28 x R)

TSR = Tip Speed Ratio
R = Radius of rotor
Therefore, RPM = (7.55*3*60)/(6.28*0.09)
RPM = 2426.78
From this solved data's, I have taken the cooler fan blade and stainless steel blade. Also the cooler fan and stainless steel blades are shown in figure 2 and figure 3. The speed rate of different types of wind blades are clearly described in [8]

Type of Wind Blades Used
Stainless Steel Blade

Fig 2. Steel blade

Cooler Fan Blade

Fig 3. Cooler fan blade

Output Voltage with Various Speed of the Vehicle

Table.2.Practical Outputs Using Cooler Fan Blade

Vehicle speed (km/hr)	Induced output Voltage (volts)	Speed of the machine (rpm)	Wind velocity (m/s)
20	1.9	382	7.55
30	3.4	685	10.31
40	4.5	906	13.08
50	6.4	1286	14.47

Table.3.Practical Outputs Using Stainless Steel Blade

Vehicle speed (km/hr)	Induced output voltage (volts)	Speed of the machine (rpm)	Wind velocity (m/s)
20	2.7	539	7.55
30	5.3	1065	10.31
40	7.6	1529	13.08
50	9.1	1833	14.47

So from the above table, the cooler fan blade is suitable for high speed application (long travel) and then the stainless steel blade is suitable for low speed application (city travel).

By using the cooler fan blade, it’s a made of DC motor when it reverses it acts as a Generator [2]. The mobile phone will charge when the speed of the vehicle is above 50Km/hr, but by using the stainless steel blade, the mobile phone will charge when the speed of the vehicle is only 30Km/Hr.

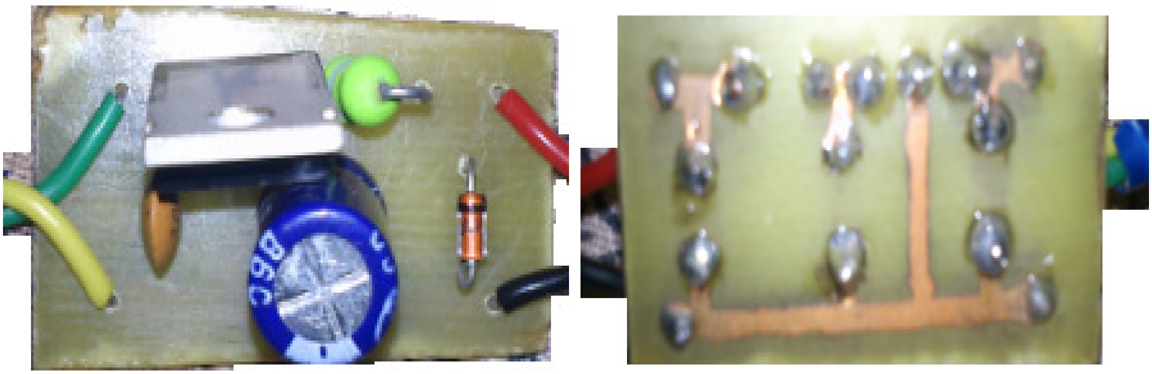
Future Scope

- It is used for electrifying the vehicle.
- It can also be used charging the lap-top.

Applications

- This is very suitable for very long travel.
- In railway system, there is no charging facility. So, this is very much useful to train travelers also.

Circuit Design in PCB



The figure shows the design of the proposed circuit diagram as shown in figure 1. First one is top view and second one is bottom view.

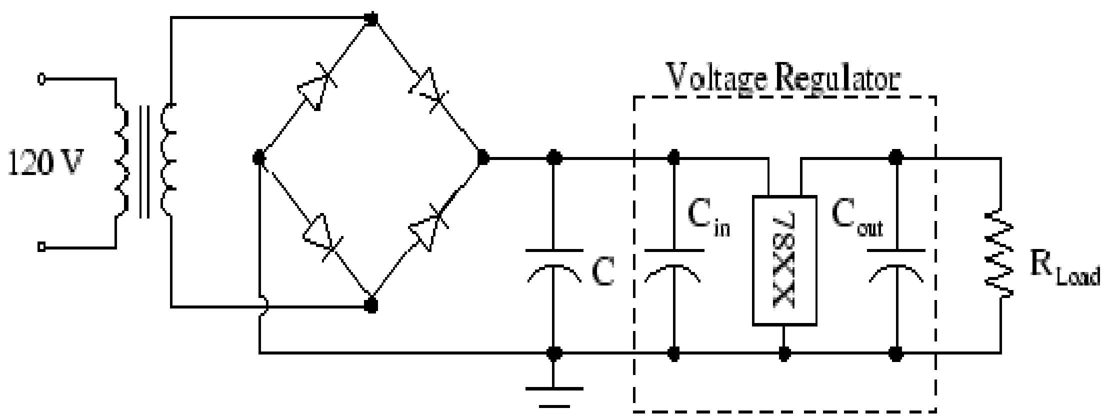


Photo Graph of the Proposed Idea

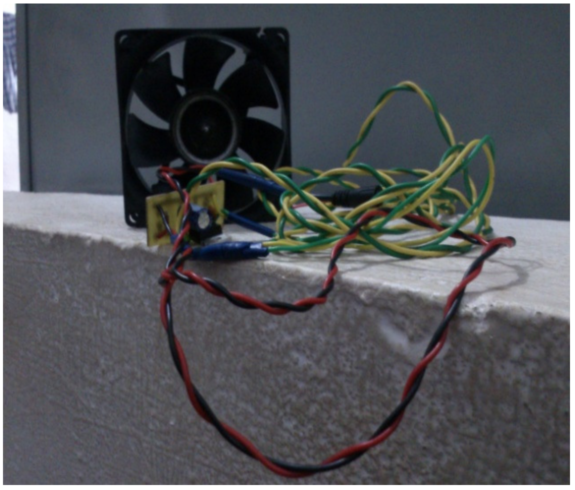


Fig.4. Proposed idea with cooler fan blade

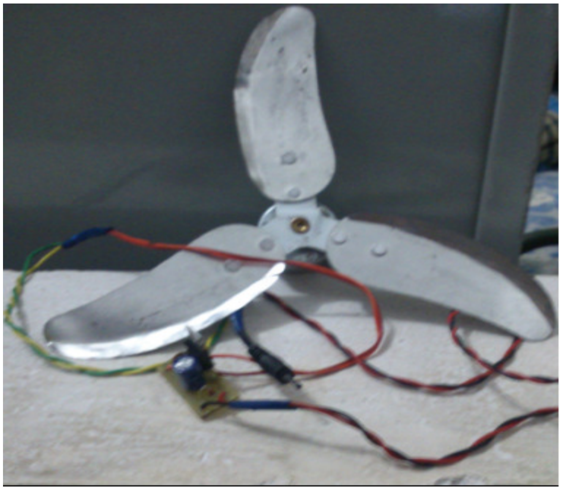


Fig.5. Proposed idea with stainless steel blade

Output Voltage vs. Speed Curve Using MATLAB

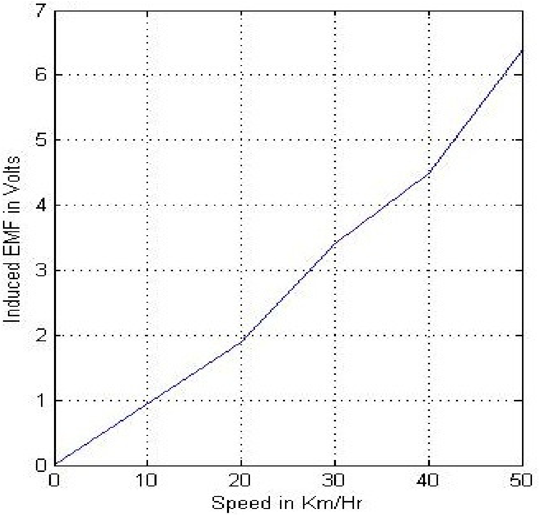


Fig.6.Speed vs Induced EMF curve for cooler fan blade

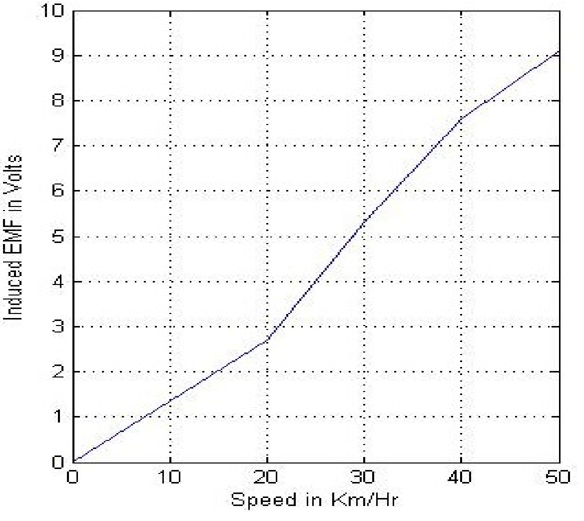


Fig.7.Speed vs Induced EMF curve for stainless steel blade

2. CONCLUSION AND FUTURE WORK:

In this paper, we had proposed an alternate way of charging portable device on travel. The prototype has been implemented and their corresponding result has been tabulated to estimate the performance of the proposed system. This model can be taken to a step ahead that this method can be used to charge laptop, audio surround systems in luxury cars, for its lighting technology and so on. The system can also be implemented in trains also, so that the high speed motion of the train can be made use to generate useful electric energy.

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