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Power Generation through Pedaling

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***Abstract*—It is known that the supply of fossil fuels are inadequate and their usage as energy source cause environmental degradation, besides as the world population increases the energy demand is also increasing day by day, this leads to search for new renewable energy sources. Clean and ecological friendly power is requested far and wide today. The main objective of this paper is to utilizing the human energy that is lost in pedaling, and transforms it into a useful form that is electricity. In this work a low cost pedal power generator is fabricated for pedal power generation. For this a single phase induction motor is converted to single phase 4-pole alternator by changing its parameter. The output of alternator which is AC is converted DC using the Bridge rectifier. In order to reject the harmonic components a capacitor filter is used. As an application the rectified output is used for battery charging. The paper explains in detail the method using car alternator to generate power. A detailed analysis of using pedal power is also presented.**

***Index Terms*— Exercise Bike, Pedaling, Alternator, Converter, Batteries.**

I. INTRODUCTION

It is well known that energy can neither be created nor destroyed but can be altered from one form to another. We are not utilizing the resources that can produce energy as if they are limitless. If we can renew the energy we don't utilize, it would contribute in some way to the problem of scarcity of energy, which is the dominant threat of the present world. Human muscles are able to generate approximately 150W of power while riding bicycle. Nevertheless, this is going wasted. If we can make use of this energy, we can empower many electronic devices. A dynamo or an alternator can be used for harvesting the energy generated by an exercise bike during riding. We can charge mobile phones or a small lighting device with this power. In addition, in cities, where most people use exercise bikes, the energy can be productively used to power electronic gadgets, which require less power. In India, many of the villages are still without electricity by basic transformation to an exercise bike in such places, our system will be of great help. Charging of the battery can be made by a rider by just connecting the circuit to the output of the alternator connected through a converter circuit which is connected to exercise bike and would charge the batteries. M. P. Mohurle et. al [1] reported that minor improvements at the mechanical block should increase the generator's speed and, consequently, the output current. Pawan et.al [2] reported that ANN modeling has been used to version the experimental findings for human powered flywheel motor. It has been found that neuron length, switch function, plays vital role in performance of the network. The most efficient choice of parametric values of

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each ANN parameter is carried via observation of overall performance, regression plots. Authors illustrate a unique method of choosing finest ANN configuration for fitting function approximation problem. Authors found that reliability of the derived ANN model is 97%. Tiwari [3] found that an uninterrupted output of 60 W pedaling at 50 rpm for a long period is reasonable. Such an output is idyllic for many tasks such as threshing, water pumping, grain grinding and maize shelling. It is reported that [4], in India villages are more than cities, and development of India is only possible by the development of those villages. Out of 593732 villages in India, only 488439 villages are electrified, i.e. 105293 villages are un-electrified. To accumulate the power and to accomplish our daily needs we are going for fuel less generation of power through bicycle. As previous methods [5] for generation of power using bicycle through dynamo have some disadvantages such as friction which reduces speed it leads to more efforts to piddle the bicycle. It can be overcome in this technology which is based on the principle of electromagnetic induction. Generated energy can be stored in the battery and it can be re used to charge mobile phones etc. during driving the bicycle. It requires only human efforts. This type of generation is very useful during large power cuts. Here human is acting as prime mover to provide rotation to the alternator, alternator is fixed at the front wheel of the exercise bike using angle rods which are welded and attached to the frame, the output of alternator is given to bridge rectifier and subsequently stored using battery.

II. Hardware Component Selection and Description

TABLE I. LIST OF EQUIPMENT AND SPECIFICATION

Sl.NO	Component name	Specification/rating	Quantity
1	Exercise bike	Steel alloy	1
2	Alternator	4-pole permanent magnet	1
3	Belt and pulley	Iron/ v-shaped pulley of bore diameter of 12.4mm	1
4	Battery 12v	Lead-acid	1
5	Transformer	230/24 v	1
6	Rectifier	Bridge rectifier	1
7	Filter	Capacitive filter	1
11	Flywheel		1

III. Design of Alternator Rotor

For the efficient the rotor pole pitch should be 30&40% of rotor periphery
The diameter of rotor =70.4mm, circumference of rotor $A = \pi D$.
$A = \pi * 70.4 = 211.2$
This circumference is divided into four parts in order to get 4 pole cylindrical rotor=211.2\4 =52.8. The pole pitch=52.8*0.24 =12mm. The dimensions of permanent magnet are
Length=30 mm, width=12mm, height=12mm.

IV. Design of Convertor

In reference to paper [6] an alternator is an electromechanical device that converts mechanical energy to AC (alternating current) electrical energy, and we can convert the AC to DC by rectifying it, regulates the DC voltage output to 12 Volts, and supplies this 12V DC power to charge the battery and power the electrical components. A belt spins a magnet (called the rotor) inside a coil of wires (called the stator), which, by the laws of electromagnetism, induces an AC electrical current in the wires. The AC current is then rectified by a series of "electrical one-way valves" called diodes and is output as DC current to the vehicle's electrical system. The output of bridge rectifier is = $2Vm\backslash\pi \quad 2\sqrt{2} * Vm\backslash\pi$ =21.62v. This harmonic content voltage is filter out through a capacitor filter.

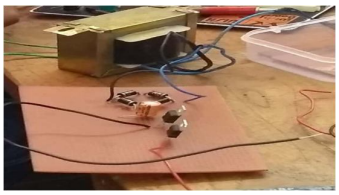

Fig. 1 Diode bridge rectifier

V. Experimental Result

In this process, we basically use human energy, i.e. a person can put his effort to rotate the pedals, which is referred as pedaling. This Pedaling gives the rotational energy or mechanical energy. This mechanical energy is converted into electrical energy by means of the components used in the system. Fig. 2 shows the system setup. In this system, an alternator is attached to the follower for power generation. When the person gives the motion to the pedals, that pedal motion transferred to the driver, and this driver is directly connected to the pedals, and this driver is also in contact with the driver/follower and this follower is directly connected to the alternator, with this alternator results in the rotational motion of the follower (of the alternator). This motion causes the alternator to produce electrical energy. Output from the alternator is alternating which passes through a bridge rectifier as mentioned above in construction part, after rectification, it passes through an electronic voltage regulator and the output voltage of the alternator is around 50 V to 230 V. This voltage can be directly utilized to charge a 12V battery, run the 1000 rpm Motor. Fig.2 shows the complete experimental bike setup.

Fig. 2 Exercise bike setup

Table II. Generation of voltage at different speed

Sl. No	Speed(rpm)	Voltage(volts)
1	950	50
2.	1680	100
3.	2668	150
4.	3386	200
5.	4182	220
6.	4436	240

The results obtained from experiment are tabulated in table 2. Fig. 3 shows the maximum voltage is obtained at 4436 rpm of alternator.

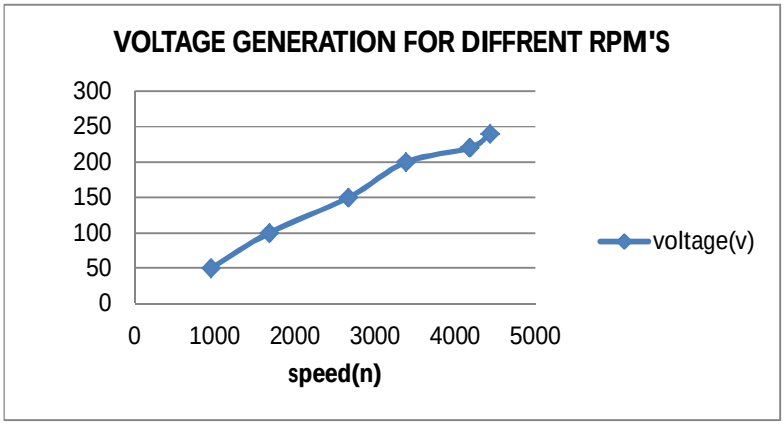

Fig.3 Generation of voltage at different speed

VI. Conclusions

In this paper a model is designed to meet explicit need in our locality. The system can also used as an alternative power source even in urban centers. In view of the fact that the system is manually operated, it can also be used in places where there is no power supply. The system is environmentally friendly as it is less noise and produces no waste in the process of its operation. The results show that the system efficient because even with a minimum pedaling speed, the system produced enough voltage which is required to charge the battery. The amount of harvested energy is more than sufficient to motivate us not to let it be wasted into heat or other forms of un-useful energy. The results obtained so far show that the prototype having less efficiency due to various losses in the system, which needs to be addressed in its future generations. In the next steps of this research, we plan to enhance and refine the design and test new solutions (e.g., use other types of batteries, such as lithium–ion, or a different type of generator such as an alternator with permanent magnets) and we are going to create a new strategy for the problems discussed so far.

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