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Study on Green Energy Converter for the Purpose of Optimising Teaching and Learning in Energy Science

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ABSTRACT

Knowledge of energy conservation is vital to be understood by students in grasping the topic of energy science. Hence, a study has been piloted to produce energy converter which can be used practically by the students to understand about the conversion of energy from kinetic energy to electricity. In the convertible of kinetic energy to electrical energy, as these energy undergo conversion, the kinetic energy are stored in two forms of storage apparatus. The first type is synchronous flywheels which operate within the allowable range of the synchronous frequency. The second type is asynchronous flywheels whose rotational speed is independent from the system synchronous frequency and varied over a wide range and this features gives the asynchronous flywheel the ability to store and release significant amount of kinetic energy. The outcomes from this study displayed successful performance which is dynamo that act as generator for the converter as energy is being convert from the kinetic energy into the electrical energy and efficaciously can be used to charge electrical gadget.

Keywords: *kinetic energy, electrical energy, green converter*

INTRODUCTION

The science lesson should be fun. However, the trend shows that students become uncompetitive when studying science and many studies show that students are more likely to break away from tasks when considered too difficult (Fong, Zaleski, & Leach, 2015; Moneta & Csikszentmihalyi, 1996). There are many past researches that have investigated the consequences of task difficulties by manipulating the difficulty of a task (Fulmer & Frijters, 2011). More surprisingly, the evidence provided confirms that the retreat was a critical predictor of academic struggles during adolescence surprisingly little about how the daily experience of the students in the classroom was strongly affecting the shift in class resignation (Balfanz, Herzog, & Mac Iver, 2007).

The topic of energy conversion is one of the fundamental topics for students to understand. The basics of this topic are important as it will be expanded to other topics such as thermodynamics, circular movements and many other advanced topics in science (Kreith & Goswami, 2004). The energy conversion concept is applied to many electrical and electronic tools such as chemical energy to electricity in the creation of batteries, potential energy to kinetic energy and then to electric energy used in the concept of hydroelectric dam and many more use of energy conversion concepts in the creation of everyday tools (Xu *et al.*, 2018).

Energy is defined as the ability to cause change in work (Halliday & Resnick, 2015). Energy is divided into five segments. Some forms of energy are identified including kinetic, potential, mechanical, internal and radiant (Young & Freedman, 2007). In the conversion of kinetic energy to electricity, since this energy is undergoing conversion, kinetic energy is stored in two forms of storage devices. The first type is the synchronous mounting wheel that operates within the allowed range of synchronous frequencies. The second type is an asynchronous flywheel whose rotational speed is independent of the frequency of the synchronous system and varies over the range and this feature gives the wheel the ability to store and generate a large amount of kinetic energy.

Green Energy Converter has been created for energy storage applications that undergo inertia-based devices such as blade wheels.

Flywheels are kinetic energy storage devices where kinetic energy is stored in a rotating mass such as a bicycle. Electrical energy is transmitted from bicycles to frequency field variables. Energy exchange controls occur via an alternating current (AC) converter. It makes direct conversion of kinetic energy to electricity with very high efficiency and the amount of energy that can be stored in the device. The kinetic energy produced in bicycles is then converted into electricity with the help of a dynamo that functions as a generator in converting the two energies.

The universal charger is a battery charger that can be used across multiple electronic devices. The old type of charger is large and heavy which makes it difficult for users to carry it. New mobile chargers develop technology in recent years. It's usually the size of the pocket, the light charger that keeps people away from the electric grid facility by providing instant power anywhere to repeat their tools.

Mobile chargers mean they can be easily ported or moved. Gadgets use a large amount of power, it requires connection to an external power source or an electronic device equipped with a power source. Therefore, the charger is a requirement for everyone, especially the mobile charger. Green Energy Converter chargers can be used during exercise (especially cycling) and during emergencies such as electricity (blackouts). One method for harvesting renewable energy is converting excessive kinetic energy into electricity by using kinetic energy conversion system. Conversion is done through the energy flow of a dynamo that functions as a generator for energy conversion to the circuit. Whatever moves have kinetic energy (Khaligh, Zeng, & Zheng, 2010), the kinetic energy imposed on this product is the 'Kinetic Energy of the Rotation' whose object moves with a turn like a bicycle tyre. The rotating kinetic energy output device consists of rotation components and magnetic generating components. The spin component includes the spin body and the rotating body has axis. The axis is separated by pivot on the housing component, the rotating body has at least one magnetic element. Electricity is the energy provided by the electric charge flow through the conductor.

METHODOLOGY

The process of all the methods have been summarised in Figure 1 while Figure 2 shows the schematic diagram of the circuits involved. All electronic components are mounted on the straight board based on the Printed Circuit Board (PCB) diagram as shown in Figure 3. The inner legs of the pointed out electronic components at the other side of the board were soldered systematically starting with the smaller electronic components to larger ones. The melted soldered copper fixing the position of the electronic components were made sure to not exceeding the given soldering area so the outcome will not be affected. Dynamo is placed on the bicycle seat with the rotating spin button touching the rear tire. The small cable suspended on the connector is connected to the generator or dynamo that has been fully mounted to the rear wheels and all meter readings are recorded.

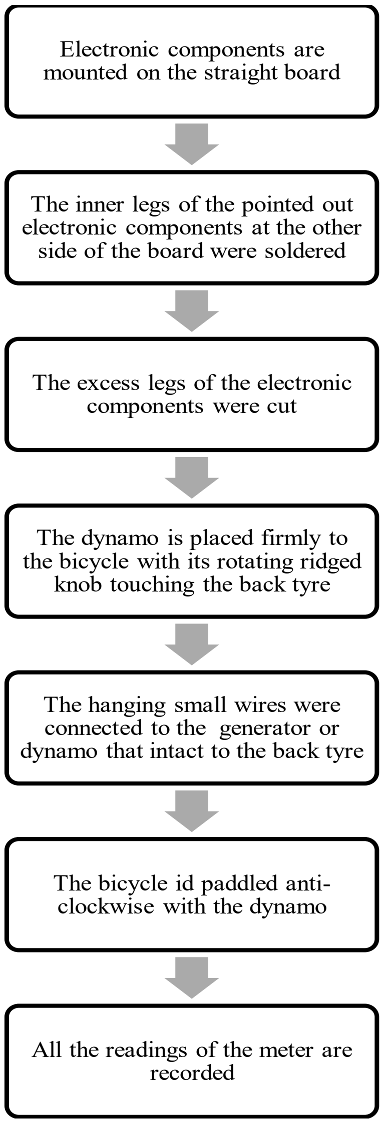

Figure 1: The Flowchart of the Process Being Done to Convert Mechanical Energy to Electrical Energy

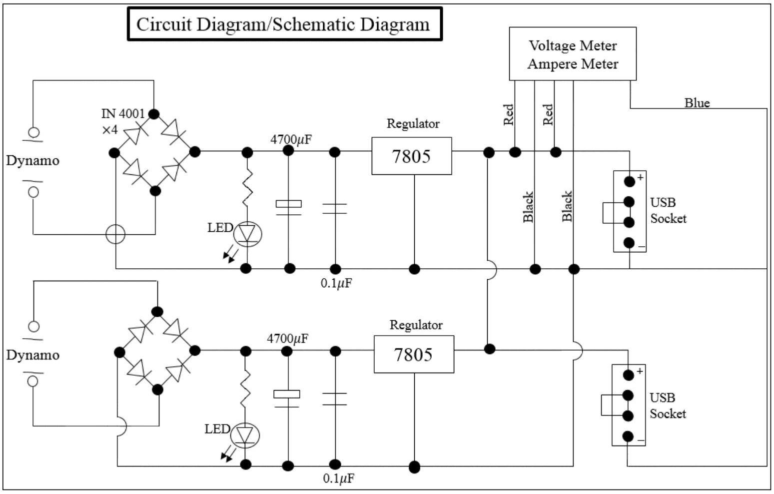

Figure 2: Schematic Diagram

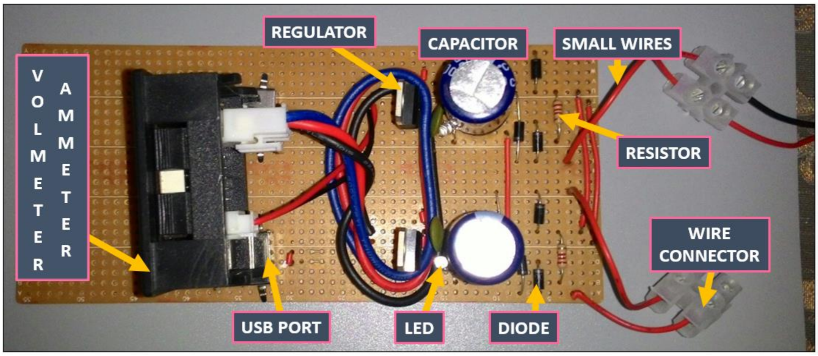

Figure 3: Diagram of the Circuit

DATA ANALYSIS

For an object rotating about an axis, every point on the object has the same angular velocity. The tangential velocity of any point is proportional to its distance from the axis of rotation. Angular velocity has the unit rad/s. Angular velocity is the rate of change of angular displacement and can be described by the relationship.

$$\omega = 2\pi f \qquad (1)$$

$$\omega_{average} = \frac{\Delta\theta}{\Delta t} \qquad (2)$$

Table 1: Average Cycle for Minimum Voltage (4.2V) and Maximum Voltage (5.3V)

Trial	Cycles for V_{min}	Cycles for V_{max}
1	27	32
2	26	36
3	28	34
Average	27	35

Table 1 shows the minimum and maximum voltages obtained from the trials. It can be stated that the minimum average voltage output was 27 V and the maximum average voltage obtained was 35 V. In general, the kinetic energy of the rotating object is the same as the linear kinetic energy and can be expressed in terms of moment of inertia and angular velocity. The overall kinetic energy of the extended object can be expressed as the kinetic energy of the hub centre translation and the kinetic energy of the rotation of the mass centre. For a fixed rotation axis given, rotational kinetic energy can be expressed in the form of:

$$K_E(linear) = \frac{1}{2}mv^2 \text{.............................(1)}$$
$$K_E(rotational) = \frac{1}{2}I\omega^2 \text{........................(2)}$$
$$K_E(rotational) = \frac{1}{2}(mr^2)\omega^2 \text{.................(3)}$$

The expressions for rotational and linear kinetic energy can be developed in a parallel manner from the work-energy principle. Consider the following parallel between a constant torque exerted on a flywheel with moment of inertia I and a constant force exerted on a mass m, both starting from rest. As the data related to this experiment collected below are achieved, calculations regarding rotational motion and the rotational kinetic energy can be performed.

Table 2: Time Taken for the Battery Voltage to Increase to 1% (s) from 0%

Types of Smartphone	Time Taken for the Battery Voltage to Increase to 1% (s)
ASUS (ZENFONE 5)	138
ACER (Z410)	127
SAMSUNG (S4)	165
Average	143

Table 2 exhibits the time taken for the battery voltages to increase to 1% from zero. Three types of smartphones have been utilised in this studies namely Asus (Zenfone 5), Acer (Z410) and Samsung (S4). The results showed that the average time taken for the battery to increase to 1% was 143 seconds (~2 min 23 s).

The green energy converter attached to the bike can be used in most areas but as soon as the device fully charged by this product is affected by many variables, especially cyclical speed. The higher the cycle speed, the higher the power supply to the green mobile charger. However, regulators are included in the circuit to maintain the amount of electricity supply to the USB port so that it does not exceed 5V. Regulators play an important role in preventing from overheating and explosion.

However, if a bicycle is too slow, an unexpected charge may occur because based on our observations on our attempts, to make the green energy converter functionality, it requires at least 4.2V electricity at 4km / h. The green mobile charger gives the same voltage as a 5V (normal) charger for small gadgets like cell phones, mp3s and iPods. In terms of charging periods, when we compare between universal chargers (with USB ports and cables) and green mobile chargers, both have the same period of battery fully charged batteries (small-time battery charging time from 0% to 100% battery usually ranging from 3 to 4 hours as both provide the same amount of electricity if the bicycle operator maintains the cycle speed to produce 5V.

The green energy converter not only being a good model in teaching and learning process by increasing the understanding about energy conversion but it also provide wide range of usefulness as it give many benefits such as conserving of energy, easy to use and can be made at a low cost budget and also easy to carry around. Green energy converter also can be used during exercising (specifically cycling) and during emergency circumstances such as blackout. As user cycling a bicycle, the unused kinetic energy are converted into electrical energy. The conversion was done through the flow of energy from the dynamo which act as the generator for the conversion of energy to the circuit. A brief survey questionnaire shown in Figure 4 has been conducted to the students and the resounding responds (100%) stated that they understand better the conversion of energy by using the green energy converter.

Name:

Age:

Gender:

QUESTION:

***Tick (/) in the box**	YES	NO
1) Do you enjoy cycling?	☐	☐
2) Does your gadget (phone, tab, etc) out of battery frequently?	☐	☐
3) Would you like to conserve energy instead of being waste?	☐	☐
4) Do you think that green energy converter is a necessity?	☐	☐
5) Do you understand better the energy conversion by using the green energy converter?	☐	☐

Figure 4: The Survey Questionnaire That Has Being Conducted to the Students

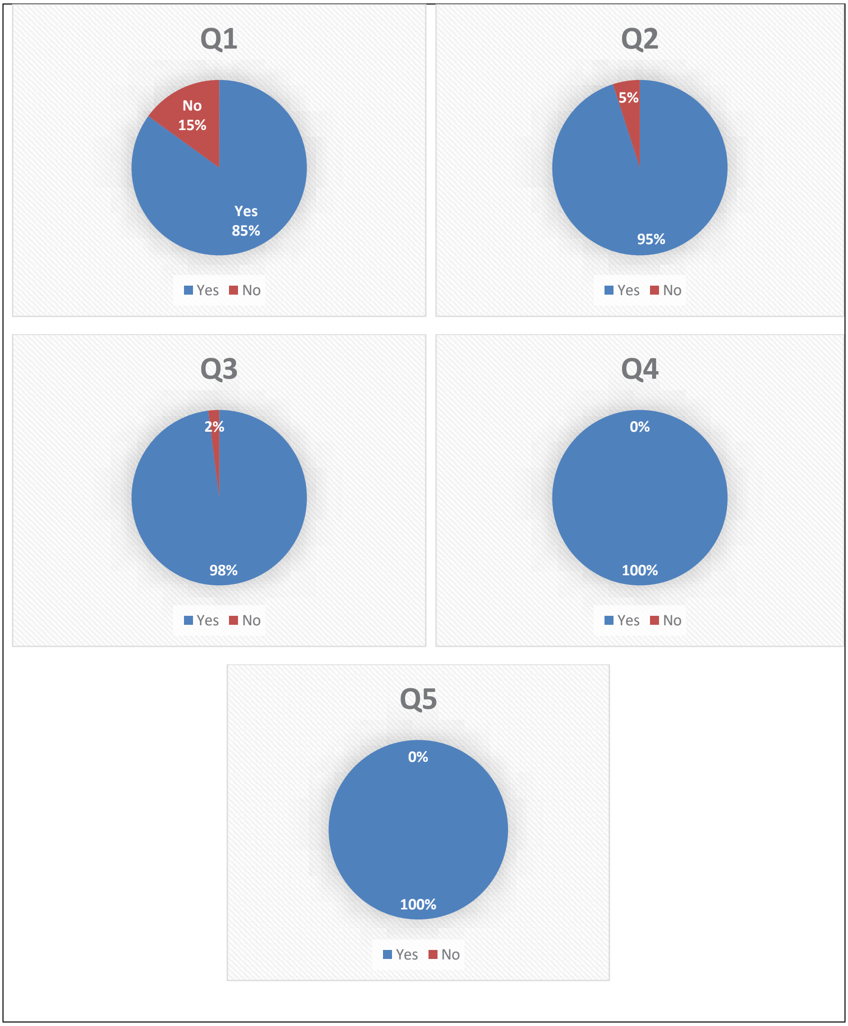

Figure 5: The Outcomes from the Survey Questionnaire, Question 1 (Q1) Till Question 5 (Q5)

CONCLUSION

Topics in science studies on energy conversion can be clearly demonstrated to students through the use of Green Energy Converter. The kinetic energy generated from bicycle pedal will generate electric potential (voltage) that can be seen and measured when charging the gadgets such as smartphones, tablets and other electronic devices. Additionally, this energy conversion tool can also be optimised for the benefit of users. For further research, this Green Energy Converter can also be further expanded so that it can be widely used for optimising teaching and learning in energy-related fields.

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