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Backpack solar-powered grass cutter

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Abstract: Grass cutter machines are very essential in maintaining the surrounding, however, they are gasoline-powered and not environmentally and health-friendly due to the use of a high cost non-sustainable green energy source and emitting carbon dioxide. Thus, a developmental method of research was employed by innovating a solar power grass cutter utilizing a recycled auxiliary fan with power-saving features, and low wattage both for discharging and charging capacity. The uniqueness of its design with a solar panel placed in a backpack and a storage battery inside, its composition and operating performance makes this grass cutter "very acceptable" to the end users. In the fabrication and construction of the machine, the innovation was based on the design criteria. The machine was tested and measured through experimentation using three trials. The system's design, composition, and operating performance were evaluated using the adopted evaluation sheet by thirty (30) evaluators as experts and end users. The charging rate of the equipment was 700 mA at 29°C to 30°C average heat temperature and it took 10 hours to fully charge the battery when not in use. While the discharging rate was 1,525 mAH and it took 4.59 hours of continued usage to fully drain without the support of the solar panel. On the other hand, the discharging rate of the battery when connected to the solar panel was only 560 mAH and it took 12.5 hours to fully drained the battery for cutting the grass field area of 1,000 sq. meters.

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INTRODUCTION

Thousands of people around the globe always look for a way on how to make their work faster and easier, but sometimes they almost forgot the negative effect that it can bring to the environment and even into human health just to satisfy their needs. The researchers of the modern society, want to contribute an innovative product that came from unused parts of an automobile that sometimes consider as junks in our surroundings. As a useful citizen in society they want to innovate or create some devices that can help us in our needs without harming our environment or human health.

According to Energy Management Based on Frequency Approach for Hybrid Electric Vehicle Applications (2012), from ancient time, the sun has been the major source of energy in life on earth. The solar power was being used directly in drying clothes, curing agricultural product, preserving food, etc. Even today, the energy from fuel-wood, petroleum, paraffin, hydroelectricity, and even their food originate indirectly from the sun. Solar energy is almost unbounded. The total energy we obtain from the sun far exceeds our energy demands. Ever since the industrial revolutions, human have been dependent on fuels, electricity and wind energy.

For human enlargement in many countries, there is study and trials are going on the solar power, (Energy Management Based on Frequency Approach for Hybrid Electric Vehicle Applications 2012). This developmental research motivated the researcher to make a new concept by backpack solar-powered grass cutter from an auxiliary fan. In this concept, Users cut grasses that strew on their surroundings and in terms of agricultural industries it can help the local farmers to cut their own small plantations in lawns and gardens.

Statement of the problem

The primary purpose of this study was to develop and investigate the performance of backpack solar-powered grass cutter.

Specifically aims to:

1) determine the charging rate of the Backpack Solar Powered Grass Cutter in terms of milliamp hours (mAH);

2) determine the discharging rate in terms of wattage used and the milliamp hour (mAH) of battery of the solar power grass cutter without solar and with solar charging when used in cutting grass within the area of 1,000 square meters;

3) determine the level of acceptability of the Backpack Solar Power Grass cutter as to its design, composition, and operating performance

METHODOLOGY

Research design

This study is developmental research. Developmental research is particularly important in the field of instructional technology, and has been defined as the systematic study of designing, developing, and evaluating instructional programs, processes, and products that must meet criteria of internal consistency and effectiveness (Institution of Education Sciences, 2012).

Locale of the study and respondents

The 30 evaluators were composed of 10 industrial technology academe from electrical and electronics technology, 3 registered electrical engineers, 7 casual workers from Department of Public Works and Highways DPWH, and 10 local farmers. However, the scores were the basis for the level of acceptability through scaling of means with verbal interpretation and description.

Research instruments

A standardized evaluation sheet using a five-point Likert scale was utilized for the study. Each item in the questionnaire provided five choices, categorized as follows: Very Acceptable (5) with a score interval of 4.21 – 5.00, Acceptable (4) with a score interval of 3.41 – 4.20, Moderately Acceptable (3) with a score interval of 2.61 – 3.40, Slightly Acceptable (2) with a score interval of 1.81 – 2.60, and Not Acceptable (1) with a score interval of 1.00 – 1.80. The scores served as the basis for determining the level of acceptability through scaling means, accompanied by verbal interpretation and description.

Data analyses procedure

The collected data were analyzed using descriptive statistics to determine mean scores for each evaluation parameter, interpreted using the Likert scale to categorize the acceptability level. The overall mean acceptability score was "Very Acceptable" (4.74), with individual components also rated as "Very Acceptable." The development process included multiple iterations with trial and error methods to refine the equipment, incorporating evaluator feedback to enhance the design and functionality. This structured approach provided valuable

insights into the design, composition, and performance of the backpack solar-powered grass cutter.

FINDINGS AND DISCUSSION

Charging rate of the backpack solar power grass cutter in terms of milliamp hour (mAH)

The data shows the charging rate of the developed backpack solar powerer grass cutter in terms of milliamp hour. The standard battery capacity charging rate is 10% of the total battery capacity and found out that it has a 700mA charging rate and it takes 10 hours to fully charge the battery from solar panel. However, the experiment only done during sunny days and sun hits its maximum heat capacity during 9:AM to 4:00PM.

Discharging rate while in operation without solar panel in terms of voltage

Table 2 shows the discharging rate of the developed backpack solar powered grass cutter without solar panel in cutting grass within 1000m2. The storage battery had a 24.7 initial volts with 7,000mAH, the load consumption was 37.68 watts and it was devided by the initial voltage resulting to have a 1,525mAH.

Since we have a load consumption in milliamp hour it was then devided to the total capacity of the battery which is 7,000mAH resulting to 4.59 hours of continuous operation before the battery discharge. Therefore using low AH (Ampere-Hour) battery only without solar panel mounting is not sufficient to cut the grass for a long time using auxiliary fan motor as an improvised head cutter.

This result was also in consonance with other batteries which are seldom fully discharged and manufacturers often use the 80 percent depth-of-discharge (DoD) formula to rate a battery, meaning that only 80 percent of the available energy is delivered and 20 percent remains in reserve or about 7 volts is still remaining in each battery. Cycling a battery at less than full discharge increases service life and manufacturers argue that this is closer to a field representation because batteries are commonly recharged with some spare capacity left (“Basics About Discharging”, 2015).

Discharging rate while in operation with solar panel connected

The result showed the discharging rate of the backpack solar-powered grass cutter without solar panel support within 1,000m2 initial area to measure the wattage of load consumption with the solar panel connected. Since the solar panel is connected the working device the researcher theorized that the extra power to operate the grass cutter came from solar panel and battery.

The result of the measured parameters shows that the grass cutter consume 13.853 watts only in a rate of 650mAH of battery. Since the battery capacity is 7,000 mAH it takes about 12.5 hours of continuous operation before the battery runs out.

Acceptability of backpack solar powered grass cutter in terms of design, composition, and operating performance

Further examination of the data shown that in all three constituents, the mean ranged from 4.21 to 5.00, all of which had a verbal interpretation as “Very Acceptable”. The highest mean of 4.80 in terms of design followed with 4.79 in terms of composition and lastly 4.62 in terms of operating procedure.

The result involves that the design includes the provision and pre-occupational measures for the safety of detail parts and its fittings that suits for cutting the grass that you can move according to your desire due of the source of power to operate the equipment is design for easy to carry through bag pack. In the same manner how to utilize solar power to generate electricity to operate the equipment. Furthermore, the composition of the equipment was carefully and skillfully planned with the available materials used to construct the equipment, as a result, it implies that the equipment can operate using free energy and renewable without any harm both to the environment and human where it conforms to the suggestion of Bartasevick (2010) entitled “The Cordless Grass Trimmer Having Removable Battery Pack” that having a fixed charging power supply as alternator to the battery while discharging is much appreciated.

In the same manner, the result implies that the equipment can operate continuously within 3-4 hours, however, that the charging rate needs for some improvement because it takes about 2 days if the heat of the sun is the primary source to charge the storage device to become a full charge.

The result further proves that the solar powerer grass cutter from auxiliary fan suit the operating performance since that even pro-grass trimmer from the DPWH as one of the evaluator said that even two strokes engine don’t long last for a certain time because of the engines becomes hotter when it reaches the overheat point that they need to shut down the engine and wait about half hour to cool down the engine and start doing their job again. Moreover, the development of solar power grass cutter was “Very Acceptable” in terms of its design, composition and operating performance as supported by the reviewed literature of this study.

CONCLUSIONS AND RECOMMENDATION

Based on the major findings of the study, several conclusions were drawn. Firstly, it was determined that the 700mAh battery of the backpack solar-powered grass cutter takes 10 hours to fully charge when not in use. Secondly, the discharging rate of the grass cutter without the solar panel was 1,525mAh, allowing for 4.59 hours of continuous use before the battery drains. However, when connected to a solar panel, the discharging rate dropped to 560mAh, extending the battery life to 12.5 hours. The researcher theorized that the solar panel compensates for the excess power needed to run the motor, resulting in more than 60% of the power being supplied by the solar panel and thus prolonging the grass cutter's usage time. Lastly, the innovations in design, material use, integration of different parts, and the device's capacity for its intended purpose received high approval from evaluators. They considered the grass cutter to have significant attributes, deeming it safe and very convenient due to its eco-friendly and humanitarian benefits.

For further improvement of the study, the following recommendations were considered by the researcher, some of which were insights imparted by the evaluators. It is suggested that the solar-powered grass cutter be mass-produced for use by local farmers to save expenses on gasoline and reduce maintenance costs. Additionally, upgrading the storage battery to a higher milliamp-hour (mAh) capacity is recommended to extend its operational time to 6 to 7 hours.

Resort, golf course, and amusement farm owners are encouraged to use the equipment to take advantage of the free energy available in the environment, thereby minimizing

pollution caused by traditional fuel-powered grass cutters. Other researchers are encouraged to conduct further studies on the utilization of solar energy for innovating agricultural equipment, contributing to the improvement and development of new inventions. Lastly, the recommendations suggested can be used to further develop the study in the near future.

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