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## Tool Demonstration Lamp Gravity (Gravity Lights)

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### ABSTRACT

Petromax lamps have many disadvantages such as kerosene which is increasingly expensive and limited. Petromax lamps also produce pollution in the form of smoke produced which can cause disease. The danger of the petromax lamp is that it can cause a fire if there is negligence. But it is undeniable, people really need lighting from lights, especially at night. Therefore, an alternative plan is needed that can replace the petromax lamp by using other available energy sources. A lamp design using renewable energy that can be used throughout the day without the slightest cost in its use. One of the renewable energies available on earth that can be used to replace petromax lamps is energy that comes from the gravitational force of the earth. Due to the lack of knowledge about the use of gravity as renewable energy, a learning tool is needed that can be used especially by electrical engineering students to better understand the concept of gravity which is applied to a visual aid in the form of a gravity lamp.

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## 1. INTRODUCTION

Electricity is a source of energy that is needed anywhere and anytime to support and improve the quality of human life. In Indonesia alone, people use as much electricity as 200 TWh in 2015. With this very large amount of electrical energy consumption, it is also needed lots of resources. However, electricity resources are limited and will eventually run out. then needed something alternative *renewable energy* for Fulfill needs life man.

Renewable *energy* is alternative energy that comes from nature, such as sunlight sun, wind, water, gravity, and so on. Gravity is a renewable energy which is eternal, unlike oil and coal which can run out. So gravity should be could our take advantage as alternative energy without must worrying cost nor its availability. The lamp is a mandatory lighting tool that is needed by the community. Without a light so life Public will disturbed. There is various type lamp which moment this already there is like Lamp *neon* , Lamp Bulb, and until *LED* light economical energy which everything use energy electricity. However, because electricity has not yet spread to all remote areas, there are still many remote people which forced use lamp *Petromax* which made from burn oil soil.

### A. Earth's Gravity

Gravity or gravitas is a natural phenomenon in which everything that has mass or energy in the universe including planets, stars, galaxies, and even light mutually attract each other. On earth, gravity causes

physical objects to have weight, the moon's gravity causes ocean tides, and the sun's gravity causes the planets and various other objects to be in their respective orbits in the solar system [1].

**B. Potential energy and kinetic energy**

Potential energy is energy that affects objects because of the position ( height ) of the object where the tendency is towards infinity with the direction of the force generated from the potential energy. Potential energy can also be possessed by objects in a depressed state such as an arrow that will be released from its bow.

The equation for potential energy is:

$$E_p = m \cdot g \cdot h \dots\dots\dots (2)$$

Where :

- $E_p$  = Potential Energy
- $m$  = Mass of object
- $g$  = acceleration due to gravity
- $h$  = height of object

Kinetic energy is the energy possessed by an object due to its motion . kinetic energy of an object is defined as the work required to move an object with a certain mass from rest to a certain speed . The kinetic energy of an object is equal to the amount of work required to express its speed and rotation , starting from rest [2].

The equation for kinetic energy is:

$$E_k = \frac{1}{2} m \cdot v^2 \dots\dots\dots (1)$$

Where :

- $E_k$  = Kinetic Energy of Object
- $m$  = Mass of object
- $v$  = Speed

**2. RESEARCH METHOD**

**A. .. Line diagram gravity light**

Tools designed as shown below can work with a given load on the tool. The bicycle wheel will move from gear C with the lowest rotation, followed by the movement of gear B and gear A which are connected to the belt through a pulley system . Gear A that meets the motor will get the fastest rotation so that it produces a large output . After that the output voltage will make the LED light up for a certain time according to how long the load can reach the maximum limit (the load can't go down anymore) from the initial height. If the light is off (the load reaches the maximum limit) then the load only needs to be returned to its initial position so that the system will return to work. An illustration of a light-producing device using the force of gravity can be seen in the image below.

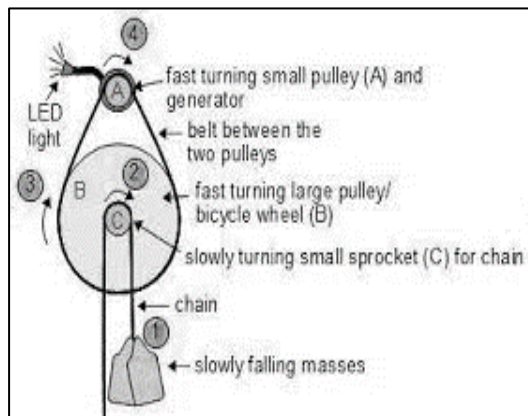


Fig.1 One line diagram of gravity light

### B. Weight of the load used

The weight of the load used in this study uses 3 types of load variations, namely starting with 10 Kg, 15 Kg and 20 Kg. This burden working as tensile load which will be changed into kinetic energy. The description of the load variation is as shown in the image below.

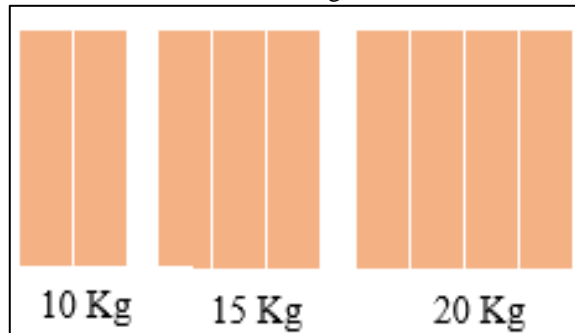


Figure 2. Variation of load

The workings of this research is to first use a load with a certain weight. After that, the bicycle wheel will move from *gear C* with the lowest rotation, followed by the movement of *gear B* and *gear A* which are connected to the *belt* through a *pulley system*. *Gear A* that meets the motor will get the fastest rotation so that it produces a large *output*. After that the *output* voltage will make the *LED* light up for a certain time according to how long the load can reach the maximum limit (the load can't go down anymore) from the initial height. If the light is off (the load reaches the maximum limit) then the load only needs to be returned to its initial position so that the system will return to work.

### C. One-line flowchart

In the picture below there is a one-line flowchart of data collection in this study. Research starts from preparing equipment and materials. Then determine the variation of the load used. After being given a load, the gear / wheel will rotate which is generated from kinetic energy when the load drops. And from the rotation of this wheel will make the generator generate electricity. Electrical energy generated by the generator will be flowed to turn on the led lights.

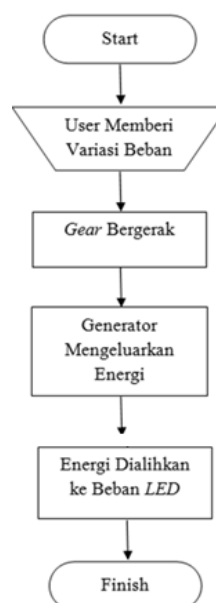


Figure 3. One line flowchart

**D. Wheel and pulley rotation**

In this study the author uses a gearbox consisting of a wheel rotation and a pulley which connected use belts. Tire rotation which is used consists of gear C with a diameter of 7 cm, gear B with a diameter of 65 cm and on the pulley system there are gear A with a diameter of 23 cm. The fall time on the gravity light system can be calculated based on calculation as follows:

$$\begin{aligned} \text{around gear A} &= d \times \pi \dots (3) \\ A &= 23 \times 3,14 \\ &= 72 \text{ mm} \end{aligned}$$

to turn on the LED it takes 1/2 turns per second then it takes 1/2 circumference i.e 36 mm. So, linear speed gear A = distance/time ....(4)

$$\begin{aligned} &= 36\text{mm} / 1 \text{ s} \\ &= 36\text{mm/s.} \end{aligned}$$

because system shaped pulley so speed linear in gear A and speed linear in gear B same, so speed linear gear B that is 36mm/s.

**3. RESULTS AND DISCUSSIONS**

Test which tested could seen that variation burden  $R_L$  take effect on the resulting output. From the experiment used load variation R from 200 K $\Omega$  - 1 M $\Omega$ . From the experimental results, it was found that the voltage generated from each variation of the weight of the load with a variation of resistance  $R_L$ . In the table below there are the results of the voltage on the resistance  $R_L$  and the current on the  $R_L$ . where the current value can be determined from the Ohm's law equation below:

$$I = \frac{V}{R} \dots \dots \dots (5)$$

- Where :
- I: Current
  - V : voltage
  - R: obstacle

In the table below is the result of the value of the voltage and current value generated based on the variation of  $R_L$  given with a load of 10 Kg.

Table 1. Table of results of resistance values, currents and voltages produced at a load of 10 Kg.

$R_L$ (Ohms)	$V_{R_L}$ (Volts)	$I_{R_L}$ (milli Ampere)
200 K $\Omega$	16.4	0.082
270 K $\Omega$	16.8	0.062
510 K $\Omega$	17.1	0.033
830 K $\Omega$	17.9	0.021
1 M	18.4	0.018

The relationship between the value of the voltage and the resistance generated at a load of 10 Kg can be seen in the following figure.

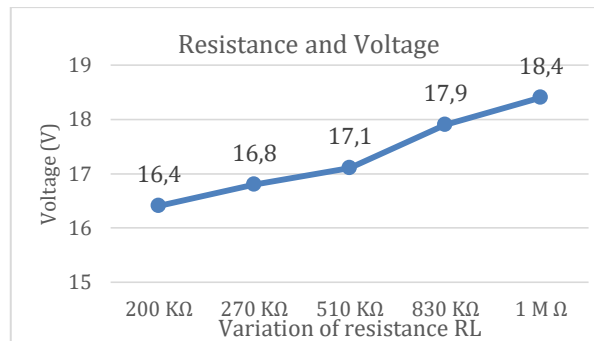


Figure 4. One line flowchart

The relationship between the value of the current and the resistance generated at a load of 10 Kg can be seen in the following figure.

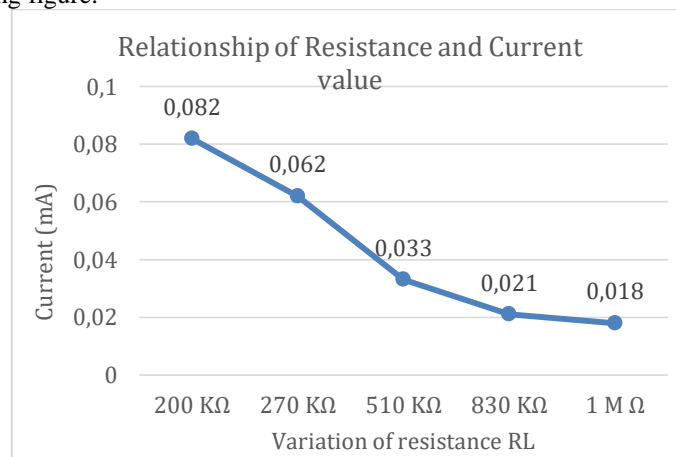


Figure 5. One line flowchart

In the table below is the result of the value of the voltage and current value generated based on the variation of  $R_L$  given with a load of 15 Kg.

Table 2. Table of results of resistance values, currents and voltages generated at a load of 15 Kg.

$R_L$ (Ohms)	$VR_L$ (Volts)	$IR_L$ (milli Ampere)
200 K $\Omega$	18.6	0.093
270 K $\Omega$	19.0	0.070
510 K $\Omega$	19.7	0.038
830 K $\Omega$	20.1	0.024
1 M	20.9	0.020

In the table below is the result of the value of the voltage and current value generated based on the variation of  $R_L$  given with a load of 20 Kg.

Table 3. Table of results of resistance values, currents and voltages generated at a load of 20 Kg.

$R_L$ (Ohms)	$VR_L$ (Volts)	$IR_L$ (milli Ampere)
200 K $\Omega$	21.2	0.106
270 K $\Omega$	21.4	0.079
510 K $\Omega$	22.3	0.043
830 K $\Omega$	22.8	0.272
1 M	23.4	0.023

From the measurement results it can be determined that the value of the voltage and current value depends on the weight of the load used. So the current value is higher if using a heavier load. This is because the kinetic energy produced will be faster if using a heavier load.

#### 4. CONCLUSION

This study discusses the lamp props using the force of gravity. The results of this study can be concluded as follows:

1. Difference size gear and comparison ratio between gear influence speed turngenerator so that voltage and current output influence results efficiency which obtained.
2. The more heavy variation burden input so voltage, current, power which generated will the more big will but time lit up lamp will the more short.

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