Lux Argenti

Final Report

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Abstract

In order to save energy in our community ESG, we propose to design and conceive a circuit to promote the efficiency of electricity under $200 per unit. The global energy crisis is of great concern to us and we believe that such a circuit may be a possible immediate part of the solution. The design parameters require that the device must be portable, under the cost of ≤$200 per unit, conserve, reuse, or generate readily available energy, and be relatively revolutionary while still being reasonably manufacturable. Design concepts such as the average circuit and practical life applications were drawn upon in order to come up with our unique design. Implementing such a device would reduce the energy needed to light a multiple closets or small rooms in each household, reducing the amount of electricity used; while simultaneously increasing the utility of each household.

Introduction

A more efficient circuit device that would decrease the amount of electricity used by the average household is of significant importance because it provides a cheap, yet effective way to help more houses go "green". It is not uncommon for households to waste electricity by lighting entire rooms just to access their closets for storage and clothing purposes. Even though all of the energy used to do so per household per year is not very significant, the energy saved by this device is, proportionally so. To increase the amount of energy saved, this 21W.732 project is to conceive, design, prototype, and evaluate a more efficient circuit device that will decrease the amount of electricity used by each household, while following these guidelines:

- The product must make a common action more energy efficient
- The product must be easily manufacturable
- The product must be portable and user-friendly

These requirements are weighted with the ultimate requirement that some amount of energy is saved and that some utility is achieved according to the rubric in Table 1. For reasons of practicality, this device will primarily be made of the usual components in a circuit i.e. wire, resistors, batteries, and LEDs.

Table 1 - "Cost" of Subsidiary Requirements

requirement	cost incurred
Efficiency	The product must be able to operate while utilizing less than 100Wh to light a present day closet, which is what the average household uses in a standard room.
Manufacturability	The device must be reasonable to reproduce. If the device can not be manufactured easily, this really only gets a tally mark for impressing friends and family.
Portability and User-Friendliness	The device must be easily movable from closet to closet, the process of changing the batteries must be relatively painless, and the product must not be too complicated to operate for the average person.

Background

We wanted to make a device using a fairly simple circuit as described below:
Ohm's law - Voltage = Current x Resistence
Source (in Volts) – 9 Volts
Formula for Total Resistance in Parallel Circuit –

$$R_{total} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots}$$

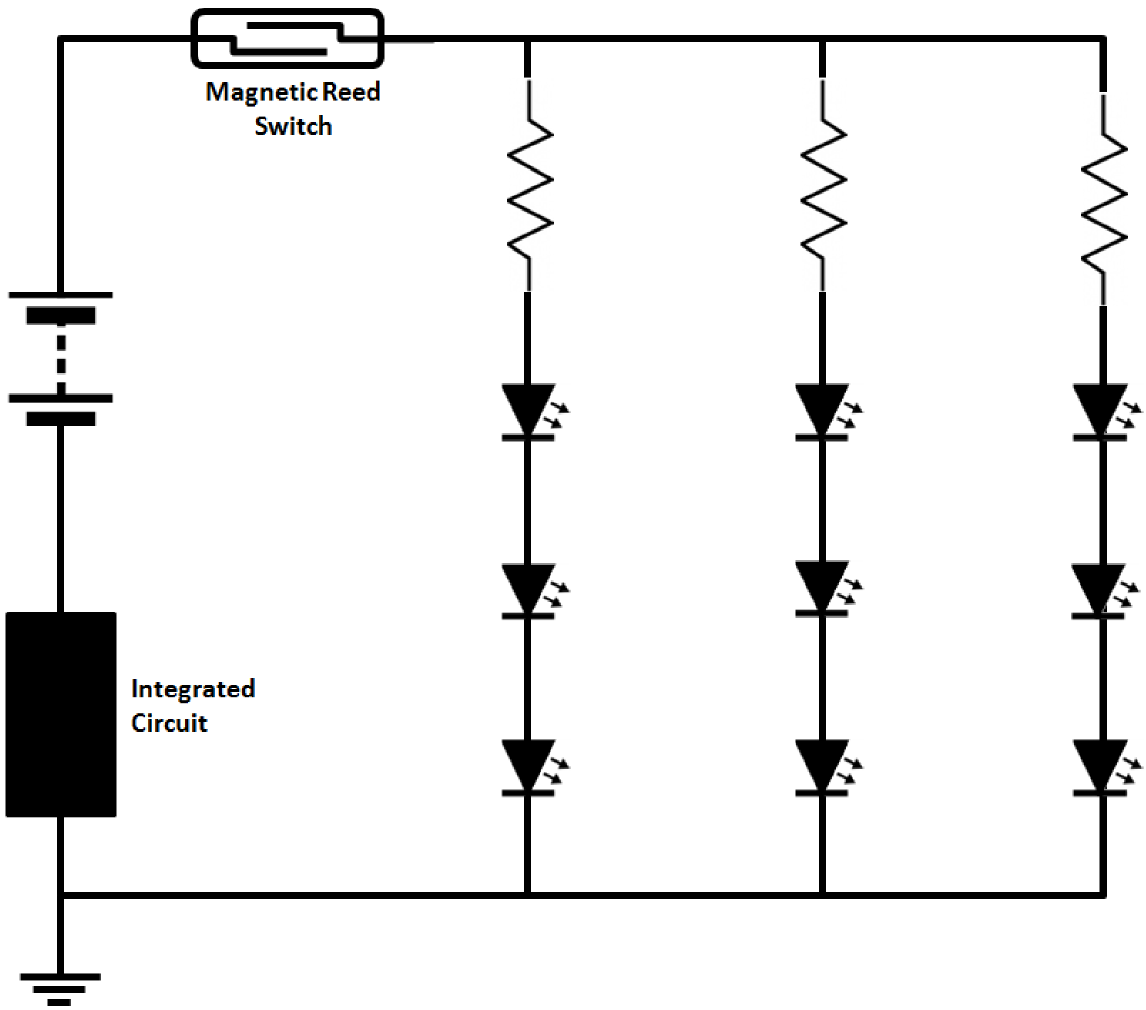
Formula for Total Resistance in Series Circuit -

$$R_{total} = R_1 + R_2 + R_3 + \cdots$$

Total Resistance (in Ohms) ≈ 80.85 Ω

LEDs minimum ON current (in Amps) – 10 mA

Figure 1 – The Circuit



Methods

Functional Requirements	**Design Parameters**	**Analysis**	**Research**	**Risks**	**Counter-measures**
Efficiency	Bright LEDS	LEDs, when researched in online stores, operate anywhere from 1-3W for sufficient lighting.	Amazon.com ebay.com google.com	Short circuiting	No one gets blown up
Manufactura-bility	Simple Circuitry	Simple device recipe leads the consumer to build a sufficient device. Especially since there are few components.		Misinterpretation of instructions seems to be the only reasonable cause for a faulty product.	The instructions included are very explicit, and were made as simple as possible.
Portability and User-Friendliness	Packaging and Simplicity	Proof of Concept	Practical	N/A	N/A

The circuit is made to drive enough current to light all of the bulbs in the circuit. The circuit is constructed in three series running in parallel to each other. This is to lower the amount of power running through and create a longer lasting circuit.

Device recipe

The device is a simple device to construct. All that is required is a battery or another source of power, breadboard, wiring, and ten high-powered LEDs. When using a breadboard it is important to know that the electrical current runs up and down the vertical column of connectors and from left to right along the connectors in the middle.

1. First, take the solderless breadboard and wire the power and ground connections by placing them on opposite sides of the breadboard along the vertical column of connectors. Use red wire for power and black for ground and other colors for the connections between components.
2. Then, carefully run a wire from the vertical column where the power is coming from to the horizontal row.
3. Place the cathode of an LED (shorter side) along the same row as the wire and the anode (longer side) in another row.
4. To add more LEDs, place its anode and cathode in the same fashion as stated in step 3. Put two more LEDs to for the first series.
5. Then run a wire in the same row as the last anode in the series of LED to the column where ground is to complete the circuit.
6. To make the next series of LEDs, repeat the same procedures as steps 2-5. In the second series add four LEDs total and in the third series add 3 LEDs total.
7. Now take a 9V battery and attach the positive end (+) to the power and the negative end (-) to ground.
8. Enjoy the lights!

Testing

The ability of our device to conserve energy will be tested by its feasibility through ease of construction, and the fact that it will function using only two 9V batteries when tested (proof of concept). Ease of manufacture will be evaluated by the ability of our team with little background in electronics and circuitry to gather the required materials and construct a working prototype. The prototype will then be evaluated by first being tested using power from an outlet that has been converted to Direct Current (DC), and then it will be tested using two 9-Volt batteries. Should the design prove successful, all LED's will light up and then a pressure switch will be connected to the circuit and it will be tested again with outlet power and battery power. If the pressure switch causes the LEDs to deactivate when the switch is compressed, we will have proof of concept and assurance that our device will actively be able to conserve energy by eliminating the need to turn on a larger room light to access ones closet. Finally the success of our device will also be measured by the fact that it will cost less than 200 U.S. dollars to manufacture.

Results

The Device was able to function properly using both outlet power converted to DC current even though it was constructed by inexperienced designers. It was also able to be governed by a pressure switch meaning that it can be mounted on a closet and governed by the opening and closing of the door.

Analysis

Through use of a readily available breadboard (used for quick assembly of circuit components) and other readily available circuit components, we were able to construct a fully functional prototype at a minimal cost of between $10-15. The fact that it can also function using outlet power converted to DC leaves the option of opting out of using strictly batteries for this device, thus increasing versatility, and decreasing expense incurred due to purchasing batteries. It conserves energy by reducing the energy needed to access an individual's closet in his or her room.

Conclusion

Overall the device succeeded in achieving designated parameters by remaining less than $200, functioning on only two 9 Volt batteries with the added bonus of being able to use outlet power converted to DC, and being fairly easy and non-labor intensive to construct. This provides proof of concept that our idea is not only feasible, but able to be employed easily. The potential implications of the employment of our device are a 97% increase in both energy, and money saved (refer to the calculations in the "Methods" section). When employed widely enough, not only will this device be convenient to the masses, but it will help them save money and conserve energy all at the same time.

About

Sarah Don, Dorma Flemister, Malik Miller and Nathan Porter are first year students at the Massachusetts Institute of Technology. Designing energy saving devices is of great importance and interest, hence the continuing progress to 'electric nirvana'.