Our energy by kids

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Abstract- The increasing demand of energy has led scientists and engineers to explore creative alternatives to generate electricity. This has prompted many to think outside the box and explore new possibilities.

This project aims to develop an interactive game for children that merges activities with the generation of electrical energy. Inspired by Juan José Arreola's story "Baby H.P." which explores the concept of transforming children's activities into electrical energy, the game involves spinning wheels and different pieces to generate kinetic energy.

The game's theoretical foundation rests on the first law of thermodynamics, stating that energy is conserved and can be transformed but not created nor destroyed. By utilizing kinetic energy characterized by the mass and velocity of moving objects, the game effectively converts it into electrical energy using an electric engine.

The history of electromagnetism and generators, including the contributions of Michael Faraday and Galileo Galilei, is discussed to provide context for the development of the device.

The proposed toy Designed as a compact box incorporates three electricity generators: a rotor and two wheels on one side and a power outlet on the other. The kinetic energy generated by the movement of the rotor or wheels is converted into electrical energy by a generator and then stored in a battery for later use.

keywords- - Kinetic energy, Electrical energy, Generators , Interactive toys, Batteries

Energy is the fundamental force behind many aspects of modern life, like powering homes and industries, fueling transportation and supporting education. energy as the ability or capacity to do work [1].Kinetic energy refers to the energy an object possesses due to its motion [2].

The first law of thermodynamics, known as the law of energy conservation states that energy can not be created nor destroyed, only transformed. It asserts that the total energy of an isolated system remains constant at all times. This means that while energy can change forms, the total amount of energy within the system remains without change [3] .This law is often exposed mathematically as equation (1):

$$\Delta Ek + \Delta Ep + \Delta U = Q - W \quad (1)$$

ΔEk: Kinetic energy.
ΔEp: Potential energy.
ΔU: Internal energy.
Q: Heat added to the system.
W: Work done by the system.

Most forms of energy require conversion before we can use them. Specifically, they need to be transformed into electrical energy and stored in batteries, then, it becomes readily available for use. Batteries are electromechanical devices that consist of one or more electromechanical cells. Each cell contains two electrodes, an anode and a cathode separated by an electrolyte.

This project focuses on kinetic energy, the energy of motion. This term was first introduced by William Thompson in 1849, who later became Lord Kevin [4] , where:

$$Ke = \frac{1}{2}mv^2 \quad (2)$$

Ke: Kinetic energy (J)
m: Mass of the object (kg)
v: Velocity of the object (m/s)

or:

$$Ke = \frac{1}{2} * I * w^2 \quad (3)$$

Ke: Kinetic energy (J)
I: The moment of inertia of a wheel
w: Angular velocity (rad/s)

where

$$I = 1/2 * m * r^2 \quad (4)$$

I: The moment of inertia of a wheel (kg·m2)
m: Mass of the wheel (kg)
r: Radio (m)

and

$$w = v/r \quad (5)$$

In order to implement kinetic energy for practical use, it must be converted into electrical energy. The most common way of doing this is by a generator and electromagnetic Induction. Generators are devices that convert mechanical energy into electrical energy through the principle of electromagnetic induction. [5].

Kinetic energy is also prevalent in everyday life, particularly in the area of sports and recreational activities. For example, such activities include running, cycling, and swimming. Kinetic energy is utilized to propel athletes forward.

We often hear that children are full of energy and that excessive candy can make them uncontrollably active. In the short story "Baby H.P." [6], the renowned Mexican writer Juan José Arreola's offers a unique and creative perspective on energy and its utilization. In a world where children are seen as an inexhaustible and valuable source of energy, he proposed that their seemingly endless energy could be extracted and stored in batteries for future use by connecting them to a system named "Baby H.P.". Arreola's narrative ingeniously challenges societal norms regarding the role of children by suggesting that their energy could be harnessed and used in constructive ways. Rather than simply being consumers of energy. Children are portrayed as active participants in its generation.

This was the spark that inspired this project. While it may not involve belts and ropes to harness childrens energy, as in Arreolas tale, our playful toy does store the energy from the childrens activity in batteries. This has a lot of similarities with Baby HP, such as utilizing the movement of the kids to generate electrical energy. Instead of a needle to indicate when to remove the bottle, our battery has a light that indicates when it is fully charged. The ultimate goal is simple: to utilize the stored energy.

Because of the importance of energy and its rapidly increasing demand we came to the idea of harvesting the energy that children have and converting it into a renewable source of electrical power, Thus, our project's goal is to create a recreational device that captures the kinetic energy produced by children's activities and transforming it into electrical energy that can be applied to different scenarios.

Batteries
Batteries and currents are important elements that help to understand how electricity is generated, stored and used for its various applications. There are many types of batteries like Lead-Acid batteries that are the oldest and most common types of rechargeable batteries. There are Lithium-Ion Batteries that have gained popularity over the last years due to their high energy density and long life cycle [7].

Most of the batteries give its capacities in mAh, and can be calculated in equation (6):

$$mah = wh * 1000/v \qquad (6)$$

wh: Energy (Wh).
v: Voltage (v).
mah: Capacity of the battery(mAh).

The Power of the battery can be calculated by equation (7) :

$$P = V * I \qquad (7)$$

P:Power (w).
V: Voltage (V).
I: Current (Å).

Prototype
The toy consists of three electricity generators: a rotor, and a pair of wheels, when set in motion, they convert kinetic energy into electrical energy using an engine, also known as a generator. The generated energy is then directed through wiring into a battery, where it is stored for future use, for example, recharging electronic devices.

This prototype was made of wood because it is cost-effective and also environmentally suitable, expanding its accessibility. By being cheaper it widens the range of possible clients and makes it more accessible for most populations.


Image 1: Prototype tractor   Image 2: Prototype


Image 3: Prototype boat Image 4: Prototype car

Image 4: Prototype in movement

By spinning the wheel we can see how the battery lights indicate to us that it is charging as image 4 shows it.

Methodology of construction

1. Get all the pieces required.
- Box of wood
- Engine
- Wheels
- Battery
- Cables

2. Check the electrical system and ensure that the movement of the wheels charges the battery.
3. Mark the holes where the engines will go.
4. Do holes on the box so that the wheels lay outside and the engines are not seen.
5. Paint the box.
6. Identify the different cables, positive, negative, ground wire, and data wire
7. Paste the Engine and connect the cables to the battery.
8. Put the switch and check that it works
9. Assemble everything and test

Methodology of measurements

1. Get a voltmeter.
2. Spin the wheel as if a kid was playing with it.
3. With the voltmeter get the volts and write down in a data table.

Methodology of measurements

1. Get a kid to play with the toy.
2. Count the times the wheel is spinning in thirty seconds..
3. Write down in a data table.

Data

Table I
Voltage

Wheel rotations	Volts
1	6.5
2	5
3	4.5
4	3
5	5.5
6	5.6
Average	5

Table II
Use in 30 s

Repetition 30 s	Turns
1	58
2	47
3	62
4	36
5	77
Average	56

As table 1 shows this data was obtained using a voltmeter simulating the speed, force and movement a child would do by playing with this toy.

We made the calculations and obtained the data by repeating the lapses 6 times because the movement and the energy generated by the kids will not be the same every time and we did an average.

The table 2 depicts the times a kid spins the wheels in thirty seconds.

Calculations and formulas

Time for the battery to charge

To calculate the energy that the battery needs using education (6): $20000(mAh) = \frac{1000}{5(v)} * Wh$

$$Wh = 100 = 360000\,J$$

Theoretical calculations

To get the watts that a battery needs we will be using equation (7)

$$120(v) * 1.5(A) = 180W = 180\,J/s$$

To calculate the time to charge the battery:

$$\frac{360000\,J}{180\,J/s} = 2000s$$

$$2000s\,\frac{1h}{3600s} = 0.55\,h$$

$$0.55\,h\,\frac{1h}{60\,min} = 33\,min$$

The voltage done by a kid in a minute by using the device was calculated by:

$$5v\ *\ 56(turns) = 280v\ in\ 30\ seconds$$

$$280v\ *\ 2 = 560\ v\ in\ a\ minute$$

Using this ecuation (2)

$$560(v\ *\ min)\ *\ 1.5(A) = 840\ j/min$$

To calculate the time to charge the battery:

$$360000\,J/\,840\,J/min = 428.57\text{min}$$

$$428.57min\,\frac{1h}{60min} = 7.1428\text{ h}$$

We could be playing with two hands making the time decrease by half making it the time to charge at 100% :

$$\frac{7.14h}{2} = 3.57\text{h}$$

To calculate the efficiency of this toy

$$ef = \frac{real\ calculations}{theoretical\ calculations} * 100$$

$$ef = \frac{28\,J/s}{180\,J/s} * 100 = 15.55\%$$

In 30 minutes = 1800s

$$\frac{12600s}{200\%}\ \frac{1800s}{t} = t = 28.57\%$$

As a form to simplify how much energy is produced we compared the results with the energy needed to light a lightbulb.

$$J = 840\,j/min\ *\ 30\,min = 25200$$

$$25200\,J = 5j/s\ *\ s$$

s = 5040 = 84 min

This gives an hour and 24 minutes of light.

Results and analysis

The battery that was used for this toy has the capacity of charging 2 cell phones to 100%, as the calculations say by playing this toy in 3.57 hours you would be able to charge two phones.

Approximately a kid will be able to play continuously for half an hour. The energy generated in that time would be able to charge a phone to approximately 29% .

Using this same premise that a kid will play for 30 minutes we can calculate the time a light bulb will stay on and the results were that by a kid spinning this toy 30 minutes a light bulb will stay on for one hour and 24 minutes.

The efficiency of this process was about 15% this is in comparison to the same battery charged by the current we get most places, this alternate current is of 120v giving it more energy and charging the battery faster than with the toy.

By charging the battery to 100% you would be saving approximately $56 mexican pesos. The toy cost approximately 200 Mexican pesos.

Future work

We could implement little led lights that with the movement of the rotors, the little lights turn on and make incentives so that the kids would want to keep moving the pieces so that the lights flashes.

Another improvement for the next prototype is to add a small stick to one of the wheels, which would make it easier to grip and function as a handle. This way, it becomes easier to rotate and aids in fine motor skills.

We could also have better engines, as it was the first prototype and we didn't have that much resources. The engines that we have only generate electricity if you spin it in one direction, but in the second prototype we aim to have better engines and also engines that give a higher voltage.

Possible applications for the future.

This project has many possible applications, it could be just a toy or it could be a house generator for energy. This toy was made in wood so that it may be cheaper than a plastic one, and it would be more sustainable. This mechanism could also be utilized by doctors and therapists for motion exercises for muscular atrophies, and it could be an incentive to see how much battery they can charge.

Many people feel like the airport and travel is an overwhelming time. Using this toy as a toy for trips helps keep the kids entertained and to have a battery to charge your phone.

This toy could also be used by teachers in preschool by having didactic material that would help kids with the developing of their gross motor.

Conclusions

This project demonstrates the potential of kinetic energy, and some of the uses that we may give them. It demonstrated the feasibility of a toy that converts kinetic energy into electrical energy through an engine and stores it in a battery.

The prototype, made of wood, successfully generates electricity through child-powered movement. Calculations indicate that by playing 30 minutes with it you would be able to charge your phone to 29% and light a light bulb.

While the efficiency of this toy is lower than traditional charging, it offers a sustainable and engaging alternative that aligns with the growing emphasis on renewable energy. This toy not only provides a practical solution for charging electronic devices but also promotes physical activity.

Its simplicity and accessibility makes it suitable for a wide range of settings, from homes to educational institutions and beyond.

This project continues to undergo improvement processes and aims to do other prototypes with upgrades that hopes to make it more efficient and attractive by implementing LED lights activated by movement for added incentive, and the upgrade of engines.

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