# Bolt

STEM October 11th district
Abdelrahman Waleed - George Nader – Moaaz Alaa – Mahmoud Hassan-Mohamed Mohy
Grade 10, Semester 2, 2023/2024, Group 29124
**Keywords**: (Ball – Generator – Pendulum – Rotation – Volt)

## Abstract

No one can deny that Egypt has been suffering from many grand challenges.so The problems that must be solved in this challenge are how to use alternative scientific energies, reduce and modify the impact of climate change, deal with population growth, and improve the environment and electronics for all. We were asked to generate electrical energy from human activities or the environment surrounding us that would be able to solve these challenges, so the football activity was chosen to be our solution and converting the mechanical energy resulting from the movement of the ball into electrical energy by moving a motor with a clock pendulum. In this way, we can achieved what was asked from us and more, the design requirements were to generate 150 joule in 5 minutes and after testing our prototype; We had produced more than 3.7v and 0.18 ampere which is more than the asked production(150 joules in 5 minutes).This simulate many experiments were done to Solve like this challenges and many small details were modified until our solution succeeded and was able to achieve the design requirements. The purpose of study was useful to know more about mechanical energy and converting into electric energy.

## introduction

All the countries faces some problems this problems are called challenges; Egypt as all countries has challenges specially 11 challenges each challenge needs a solution. The project challenge is to generate energy, so the ball will be made to solve one of the challenges which is generating electricity from renewable resources around us as sunlight ,wind and water or actually from the people's activities , as in the ball that was built the mechanism depends on the motion of the pendulum that rotates the motor to transfer mechanical energy into electric energy which moves directly to the bridge that makes the rotation of the motor always in the positive direction and then to the battery to store the electricity for using it in another time, so this ball doesn't impede the players during playing in the match because the device is inside the ball

Fig(1)

### Prior solution

And as in the football ball in the world cup 2022 in Qatar that called "Elrehla". One of its **strengths:** is the device which is fixed in it at the center of the ball to keep the center of the gravity in its position and to be far from the parts which is hit by the players. But one of its **weaknesses:** is that it doesn't produce energy .
After this search about the generating electricity from rotation, we Made the device to achieve the design requirements which are generating 150 joules in 5 minutes.
And now let's turn our attention to the design of our prototype and taking a closer look at our materials and methods.


Fig(2)

## Materials

| Item | image | Function | Quantity | Source |
|---|---|---|---|---|
| Dynamo |  | Transferring Kinetic energy into electric energy | 1 | Waste (toys) |
| Lithium battery |  | Storing the energy produced | 1 | Waste (rechargeable Car) |
| Electric Wires |  | Connection of the electric circuit | 1 | Recycled |
| 3d Printer filament |  | Making the pendulum for the motor | 1 | Fab lap tools |
| Sponge |  | Filling the shape of the ball | 1 | Recycled (from recycled mattresses) |
| Ball |  | Contain the materials of the project all together (key of the project) | 1 | Waste (old use) |
| Electric bridge |  | To get use of the two directions of the rotation | 1 | Recycled (from broken circuit) |

Table(1)

## Methods

The methods which are followed are as follow:

1. Making the mechanism between the motor(generator) and the bridge to get use of the two directions of rotation.
2. Making the pendulum using plastic filaments to rotate the generator.
3. Fixing the pendulum on the generator.
4. Making the circuit of the mechanism and applying the lithium battery for storing.
5. Making a box to contain all the parts of the mechanism.
6. Fixing the box inside the ball.
7. Filling the ball with the sponge to shape it.

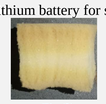


Fig.(3)


Fig.(4)

### Test plan

Our test was divided into two parts, and each part must pass completely the design requirements for the project to be ready for work.so we predicted some results for each test.


Fig.(5)

**1) The mechanism**:

-We must generate 150 joule/5minutes
**-This will be achieved by**: putting a pendulum that will be used to move the motor in two different directions (positive-negative) and an electric bridge will be placed to exploit both movements while the ball is moving.
- **This will be tested by:** using the following tools:

a) voltammeter to measure voltage. (fig.6)

b) Ammeter to measure the ampere.(fig.7)


Fig(6)


Fig(7)

**2)The design of the ball:**

-We are asked to generate electricity from human activities, so we chose football as our model. A regular ball will be brought and filled with sponge from the inside to absorb shocks so that no damage occurs to the device.

**-This will be achieved by:** using sponge to fill the ball and plastic for the frame of the ball, because of what we studied in Lo9 Chemistry, that the sponge has high bouncing and elasticity, which maintain the balance of the ball

- **This will be tested by:** applying pressure on the ball to test the elasticity of the ball and the resistance of the materials to the pressure

## Results

After testing the prototype according to the test plan, these results were collected:
**Negative results:**
1- After forming the circuit using the motor, pendulum and so on The rotation of the ball was only useful in one direction.as the generator could only generate positive electricity in the positive direction and in the other direction it didn't generate electricity.
Solution: This problem was solved by using the electric bridge which is used to unify the positive charges in one direction and the negative charges in other direction

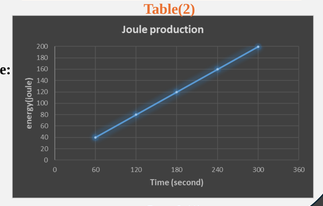
2- After finishing the design of the pendulum, we had founded an error of about (-100) gram the mass we needed
Solution: This problem was solved by changing its mass by putting a piece of metal to make it heavier .
**Positive results:**
The generator could produce from two directions and an amount of (3.7±0.7) volt and (0.180±0.03) ampere was generated which is approximately equals (0.66±0.2369) watt
So, the design requirements were fulfilled, and more than 150 joules were produced.

**This graph shows the energy production per minute approximately during testing the revolving of the box :**

| voltage | ampere | watt | time | joule |
|---|---|---|---|---|
| 3.7 | 0.18 | 0.666 | 60 | 39.96 |
| 3.7 | 0.18 | 0.666 | 120 | 79.92 |
| 3.7 | 0.18 | 0.666 | 180 | 119.88 |
| 3.7 | 0.18 | 0.666 | 240 | 159.84 |
| 3.7 | 0.18 | 0.666 | 300 | 199.8 |

Table(2)

**-As shown below the final results were: Production of approximately 199.8 J**



Graph(1)

## Analysis

### Laws and theories

The laws that we were used during building and testing the prototype:
- It is ordered to produce 150 joules in 5 minutes:
Watt= joules/time(second).
So, the energy production should be 0.5 watt

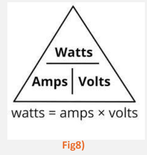
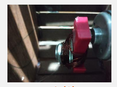


Fig8)

- The equation of volts, ampere, and watt:
Power = electric potential *electric current
Watt = volt*ampere.
So, the product of voltage and ampere should be equals to 0.5 watt.


Fig(9)

- The prototype should withstand the pressure applied on the ball.
Pressure = force/area

### Trial 1 (failed)

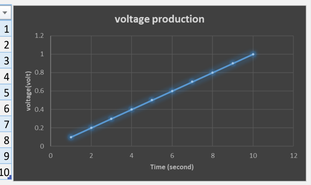
The first trial for the prototype didn't come with positive results:
- The pendulum weight was lighter than what was needed. Which caused a decrease in the rate of its revolving and a decrease in the voltage rate. (As shown in graph 2)
This problem was solved by: increasing the weight of the pendulum as it is needed to be.


Fig(10)

**This graph shows a weak voltage power due to the problem with The pendulum's Weight:**

| voltage | time |
|---|---|
| 0.1 | 1 |
| 0.2 | 2 |
| 0.3 | 3 |
| 0.4 | 4 |
| 0.5 | 5 |
| 0.6 | 6 |
| 0.7 | 7 |
| 0.8 | 8 |
| 0.9 | 9 |
| 1 | 10 |

Table(3)



Graph(2)

### Trial 2 (partially failed)

- The pendulum weight was fixed correctly; the problem was that the energy produced in two different directions wasn't useful. Only one direction of rotation was used by the generator.
This problem was solved by using an electric bridge to unify the two directions of rotation.

### Trial 3 (Succeeded)

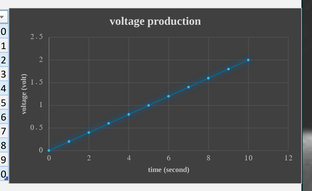
- This trial came up with promising results:
The voltage data was
(As shown in graph 3)
**This graph shows the voltage power after fixing the pendulum's weight**


Fig(11)


Fig(12)

| voltage | time |
|---|---|
| 0 | 0 |
| 0.2 | 1 |
| 0.4 | 2 |
| 0.6 | 3 |
| 0.8 | 4 |
| 1 | 5 |
| 1.2 | 6 |
| 1.4 | 7 |
| 1.6 | 8 |
| 1.8 | 9 |
| 2 | 10 |

Table(4)



Graph(3)

## Learning transfer

| Subject | Connection |
|---|---|
| Chemistry (lo9) | through chemistry we learned bounce, texture, strength, and elasticity which helped to choose the appropriate material needed. |
| Earth science (Lo 9) | We learned more about the Renewable resources such as: solar, wind, and biomass power. Other sources of energy can also be used for electricity. These sources include water,geothermal energy, solar thermal energy, photovoltaic energy, and biomass. |
| Earth science (Lo 8) | We learned more about the Earth's energy resources, such as solar, geothermal, and magnetic energy, by using earth science. |
| Physics (lo9) | We used it to measure the pressure applyied on the ball as we learned in. |
| English (writing academic English) | It helped us in writing our portfolio and poster |

Table(5)

## Conclusion

*{Things that starts well ends well.}*

The project was concluded in the following points:

Energy shortage is one of the most challenges that faces Egypt. This problem was solved by getting use of the alternative sources of energy. The chosen one was the mechanical (rotational) energy of the ball.

After finishing the project, the **results** were as follows:

- The generator could produce from two directions and an amount of (3.7±0.7) volt and (0.180±0.03) ampere was generated which is approximately equals (0.66±0.2369) watt
So, the design requirements were fulfilled, and more than 150 joules were produced.
After comparing our results with the prior solutions that we searched about, we found that our project is so close to what we searched about and what we have taken as a role model. Also, in the prior solution we found that most of them pollute the environment, so we used recycled materials in order not to pollute the environment. Finally, the prototype achieved the design requirements and produced energy which helped in solving the problem of energy shortage.

## Recommendation

- Filling the ball with ethylene-vinyl acetate because it is too soft, light and has high bounce.
- Or Making an airless ball by 3D printer using material called polymer lattice which has high bounce, and it is so light.
- Replacing the rotation of pendulum with a rotation of something like spinner that when you spin it with a small force it rotates fast that produce a lot of electricity.
- Increasing efficiency by using help of factories to make your prototype more professional and has a smaller number of errors that can found.
- Get use of all directions of the rotation by making the shape of the box as ball to rotates inside the ball as gyroscope.
- Fixing a bigger capacity lithium battery to charge bigger appliance (smart phone)
- Choosing better materials for the ball frame to increase the bouncing
- In the large scale, the frame of the ball should be formed on the mechanism of the generator (not vice versa) and then the ball will be closed,

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## Acknowledgement

We want to thank Allah for completing this project and we want to thank:
Dr/Mohamed Gouda (the old deputy of our school)
Dr/ Sayed (Physics Dr in MUST college)
Dr / Sally Hussain ( capstone manager at STEM 11th district school)
Mr / Mohamed Elsheikh ( Capstone leader at STEM 11th district school)
Dr/ Mohamed Kotb ( Math teacher at STEM 11th district school)
Dr/ Salah sabagh (Physics teacher at STEM 11th district school)
Mr/ Mostafa Ahmed (cap teacher at STEM 11th district school)
Mrs / Amira Younes ( English teacher at STEM 11th district school)

## For further information

Abdelrahman.2923002@stemoctober2.moe.edu.eg
George.2923028@stemoctober2.moe.edu.eg
Moaaz.2923040@stemoctober2.moe.edy.eg
Mohamed.2923043@stemoctober2.moe.edu.eg
Mahmoud.2923036@stemoctober2.moe.edu.eg