



# **KINETO-ELECTRIC CONVERSION TREADMILL**

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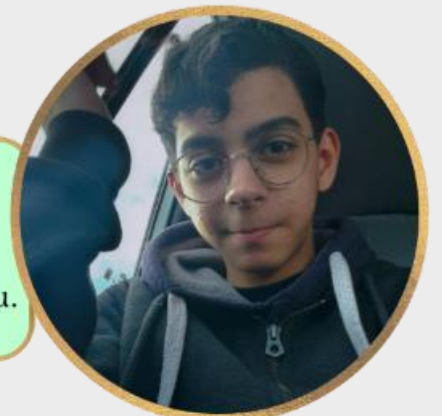
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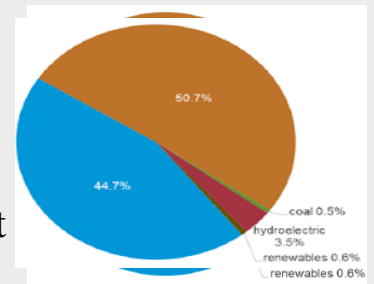
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# Introduction

The Egyptian society of today faces several detrimental issues. These Issues stand in the way of its development and success. (Addressing the **population issue** and **enhancing the use of alternate energy sources, growth, and its ramifications**, enhancing everyone's access to **science and technology**, and mitigating and adjusting to the impacts of **climate change**) are examples of these issues. Any problem requires further information before it can be solved. Let us examine these issues in general and discover their implications. Egypt lacks a considerable number of resources for renewable energy. The dearth of resources in its scientific milieu is the cause of this noticed in **fig (1)** Egypt is now dealing with a catastrophic population inflection pandemic. This also results in a host of economic issues. Furthermore, since with so numerous people living there, Egypt has a lot of energy-related issues. This is a result of the enormous number of people who need to have their energy demands met.



fig(1)

Moreover, Egypt is not exempt from the disastrous consequences of global warming. Egypt's already dry climate will be further stressed by climate change, with extremes in temperature erratic precipitation, rising sea levels, land subsidence, coastal flooding, shoreline erosion, declining soil salinity, and protracted drought among the effects. Energy is the element that all these issues have in common, if a close look is taken at the underlying variables that contribute to them. Consequently, the energy problem is the main obstacle in this semester's capstone. This semester, a capstone project is being worked by us, which requires us to harness the energy generated by the natural and human activities around us. To accomplish this flawlessly, the team began a thorough search for the earlier solution that had been applied to a situation of this kind. The previous solutions provide you with a general understanding of the issue. Utilizing their product has major advantages for us as well. Taking what they've learned and avoiding their mistakes. These answers were discovered after doing extensive research on potential solutions. Let us start with the **Three Gorges Dam**. When it comes to the ability to generate electricity, it is the biggest hydroelectric dam in the world. Situated on China's Yangtze River, it is an important component of an expansive development project designed to produce electricity, manage floods, and enhance river traffic in the area.

It has a length of roughly 2.3 kilometers and a height of roughly 185 meters. It can generate up to 22.5 gigawatts of power. Clean energy is one of this solution's benefits. Production, Flood Management, and Enhancement of Water Transport. But every enterprise has its share of problems. These are a few drawbacks associated with The Three Gorges Dam. The dam's construction caused extensive flooding of wetlands and wildlife habitats, water pollution, geological risks, and social impact. Another earlier option existed, namely **Mount Signal Solar Farm**. The project is a solar power producing facility situated in the United States' Southern California region. It is one of the biggest solar projects in the world and gives the local community a sizable supply of clean energy. It's in the southern region of California. Hundreds of megawatts of clean electricity are produced by it. It is dependent upon solar energy technologies, particularly solar with high efficiency. solar panels with sun tracking devices to increase the effectiveness of energy collecting. This method offers several benefits, including the production of clean energy, a decreased environmental effect, financial gains, and sustainability. But there were drawbacks as well. The high beginning costs, sporadic energy output, and resource constraints are examples of these drawbacks. Get the solution after carefully examining these options and weighing the benefits and drawbacks. A treadmill is the solution. Utilizing kinetic energy, the treadmill generates electrical power. Using the treadmill while walking and pushing a metal cylinder that houses a motor generator. This generator takes advantage of people walking and turns it into electricity. This was a brief of the prototype mechanism. The efficiency of the system is dependent on certain design constraints. Prior to anything else, the prototype must be able to generate more than 150 joules in 300 seconds or less, or a maximum of five minutes. However, the prototype demands that it be constructed out of leftover or salvaged components. It must also be functional. It ought to be ecologically sustainable as well. The last is that the cost ought to be kept to a minimum.

# **I. Present and Justify a Problem and Solution Requirements**



# Egypt's Grand Challenges

## i. Improve the use of alternative energy.

There are two forms of energy. They are renewable energy and nonrenewable energy. Both have pros and cons. For example, despite renewable energy, which exists and never runs out but is expensive, non-renewable energy pollutes the environment and is going to run out. **But what is renewable energy?**

It is energy that comes from existing resources in the environment and is completely unpolluted and never-ending, such as tidal energy, solar energy, and wind energy. Renewable energy or clean energy depends on converting a form of energy in the environment into electricity and has many types such as:



fig(2)

- Bioenergy.
- Geothermal Energy.
- Hydrogen and Other Renewable Fuels.
- Hydropower.
- Marine Energy.
- Solar Energy.
- Wind Energy.



fig(3)

## Renewable Energy's **Advantages:**

Several **economic**, **social**, and **environmental** advantages come with using renewable energy. Among them are:

- **Sustainability:** Self-replenishing and abundant, renewable energy sources include sun, wind, and hydropower. They offer a renewable energy source that doesn't harm the resources of our world.
- **Less Service:** Compared to traditional sources of energy, renewable energy sources often require fewer repairs, which can result in long-term cost savings.

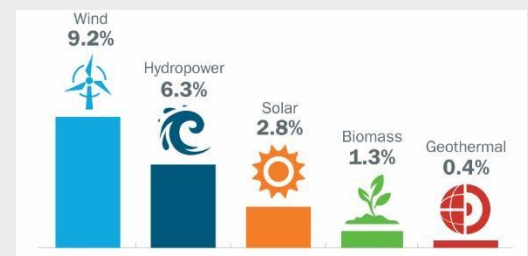
- **Financial Savings:** By removing the need for fuel purchases after initial setup, renewable energy sources can offer long-term savings. This may lead to reduced operational expenses.
- **Environmental Benefits:** Using renewable energy can improve environmental quality by lowering greenhouse gas emissions and air pollution.
- **Energy Independence:** Reducing a nation's reliance on imported fuels can increase energy security and independence.

### Renewable Energy's **Disadvantages:**

- **High Upfront Costs:** The initial outlay for renewable energy technologies, such as wind turbines and solar panels, can be substantial.
- **Temporary:** A lot of renewable energy sources can change based on the season and the weather.
- **Storage Challenges:** Because renewable energy sources, such as solar and wind, are intermittent, storing them efficiently remains a technological challenge.
- **Geographic limitations:** Depending on the region, various technologies may work better in some areas than others when it comes to renewable energy sources.
- **Not Always 100% Carbon-Free:** Although renewable energy sources greatly lower carbon emissions, some processes related to their production and upkeep may nevertheless release carbon dioxide into the atmosphere.

### Renewable Energy in the **United States:**

Renewable energy generates over 20% of all U.S. electricity, and that percentage continues to grow. The following graphic breaks down the shares of total electricity production in 2022 among the types of renewable power

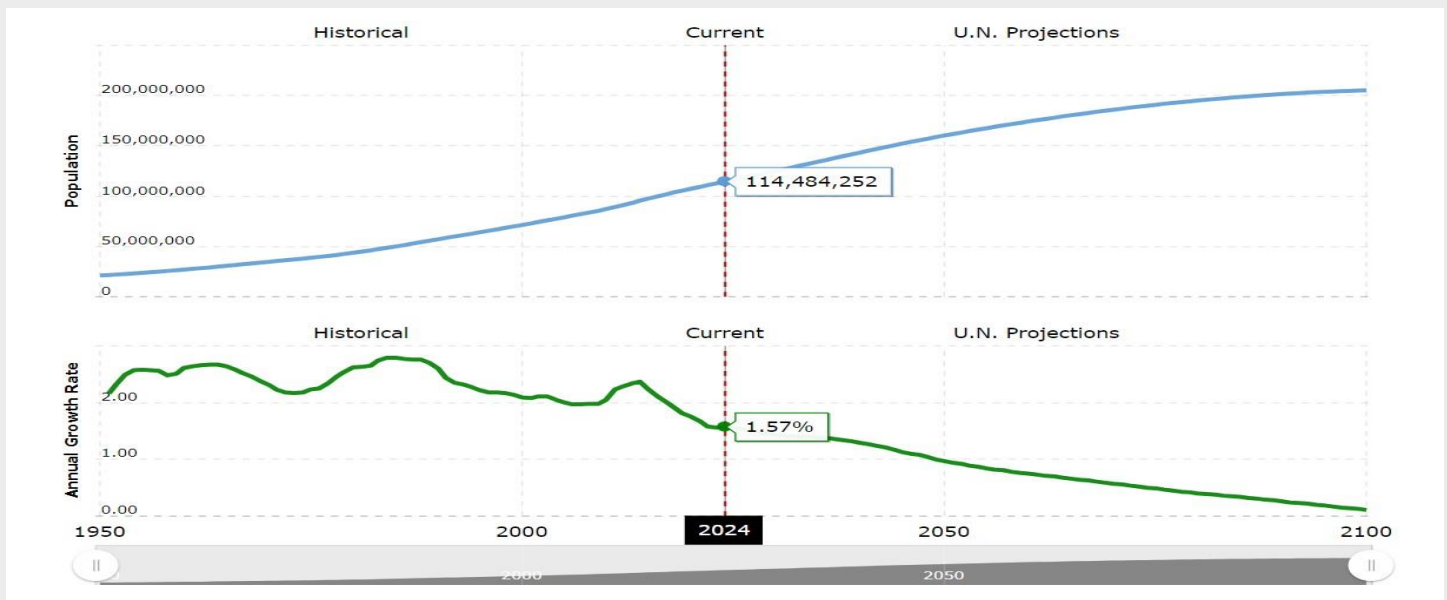


fig(4)



## ii. Deal with population growth and its consequences.

Population growth in Egypt during the 21st century has been a topic of significant concern due to its impact on the country's resources, economy, and social structures. As of 2024, Egypt's population is estimated to be over 114 million, a 1.57% increase from the previous year. This continuous growth poses challenges to sustainable development and has prompted the government to take measures to address the situation.



fig(5)

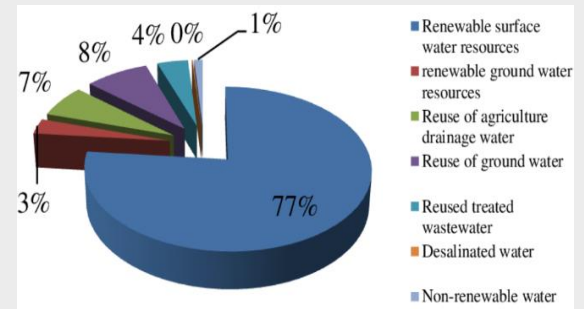
**Economic Challenges:** Growing population has significant consequences for the economy. Higher people mean a greater need for jobs, housing, and services. But the economy of Egypt has found it difficult to keep up with the country's swift population growth. High unemployment rates are an ongoing issue, especially for young people and recent graduates. Every year, many new workers enter the job market, which causes underemployment and a dependency on the unofficial economy.



fig(6)

**Resource Management:** There is a demand on Egypt's natural resources. Given the limited resources of the Nile River, water scarcity is a serious problem. Climate change and environmental degradation pose

dangers to Egypt's agriculture sector, which accounts for a substantial portion of the country's GDP and jobs. More food, water, and energy are needed to feed the growing population, which causes resource overuse and pollution.



fig(7)

**Government Initiatives:** To slow down population increase, the Egyptian government has started family planning programs and public awareness efforts. The goal of tactics like "Two is Enough" is to promote smaller family sizes. To enhance living standards and generate employment opportunities, the government is also funding infrastructure and development initiatives.



fig(8)

In conclusion Egypt's population increase must be controlled if the nation is to survive. It necessitates a multidimensional strategy that incorporates social changes, resource management, and economic development. Egypt must be able to support its populace while protecting its environment and cultural heritage, which will require the government's efforts in addition to international cooperation and societal reform. The main concerns about Egypt's population expansion in the twenty-first century are briefly discussed in this overview. To achieve the desired word count and amount of material, more investigation and data from reliable sources would be required for a more thorough analysis that includes pictures and statistics.

### **iii. Improve the scientific and technological environment for all.**

In terms of science, our modern culture is extremely impoverished. It is unable to keep up with the rate of contemporary development because of its poverty. But first, we need to learn more about the issue and its negative effects. Many societies, particularly Egyptian society, suffer from a generalized lack of knowledge, are technologically illiterate, and lack a vibrant scientific environment. This is a result of both widespread interest in education and institutional negligence. But there are other approaches and answers to this issue, **including:**

- **Promote innovations and developments in science.**

Science significantly impacts our lives in various areas such as energy, conservation, agriculture, health, transportation, communication, defense, economics, leisure, and exploration. As such, we need to support scientists morally and financially for further research.



fig(9)

- **Focus on education and development to ensure that schools have modern content.**

Education helps individuals understand right and wrong, develops personal growth, and increases employment opportunities. However, Egypt has a high illiteracy rate, with 18.4 million people illiterates in 2017, a 3.9% decrease from 2006. The 2021 Labor Force Survey shows 17.9% illiteracy. The Egyptian government needs to expand rural schools and address this issue.

- **Raising people's understanding of science and technology and their significance**

Finally, it is critical to raise people's knowledge of its significance. We also point them in the direction of science and technology content that will benefit their minds. By doing these actions, we can create a developing nation with a scientific atmosphere that will enable it to compete globally in many disciplines.

#### **iv. Reduce and adapt to the effect of climatic change.**

Although generating only 0.6% of the world's yearly carbon dioxide (CO<sub>2</sub>) emissions, Egypt is increasingly among those most severely impacted by the harsh weather. The Middle East often experiences hot, dry weather with mild winters and minimal precipitation. The Middle Eastern countries are experiencing intense heat waves, droughts, and arid conditions because of climate change. The Middle Eastern countries are facing issues related to power generation and electricity as a result. Increasing the capacity of generating from renewable resources without resorting to conventional methods of generation is one strategy to tackle this challenge.

Energy-related issues can be readily mitigated by renewable resources such as wind and solar power since coal will eventually run out of supply and rising sea levels are a direct result of climate change. Additional environmental pressures, such as high temperatures, erratic precipitation, coastal flooding, shoreline erosion, and damaged soil



fig(10)

salinity, would exacerbate Egypt's already dry climate. These interdependent consequences will worsen water scarcity, impede food security, uproot vulnerable communities, and destabilize Egypt's economy. The cost of adapting to the changing environment will also be costly, as current governance flaws will be revealed and deficits will rise. It will become increasingly critical for the nation to take preventative action as climate change increases the strain on the state's resources. Egypt must thus step up its efforts to manage the environment if it is to safeguard its most endangered citizens and preserve its economy.

Increasing temperatures and severe weather patterns have resulted in devastating losses in several Middle Eastern and Central Asian nations. Egypt is particularly vulnerable to the negative effects of climate change, such as droughts, increasing sea levels, and water scarcity. Communities along the shore that depend on agriculture, tourism, and other.



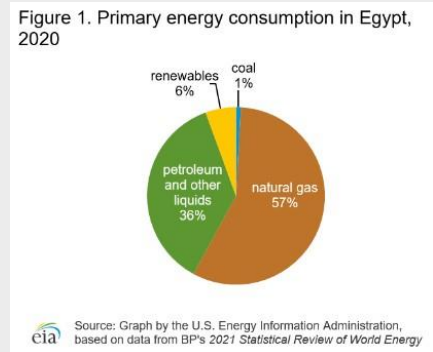
fig(11)

industries will be especially vulnerable if a solution to this issue is not found. The National Climate Change Strategy (NCCS) was recently introduced by the Egyptian government to aid in the shift to a more environmentally friendly and climate-resilient economy. The corporate sector will be heavily involved in this shift and is stepping up its adaptation efforts. In addition to organizing international action on climate adaptation, mitigation, and financing, Egypt is hosting COP27.



## Problems to be solved.

The significance lack of renewable energy resources in EGYPT is very harmful for the Egyptian environment. Egypt as the most countries in the world who depending on the fossil fuels as a major resource of energy. Fossil fuels are represented in (coal, oil, gas). According to the latest estimates in BP's 2021 Statistical Review of World Energy, the most-consumed fuels in Egypt were petroleum and other liquids (36%) and natural gas (57%) in 2020. To solve this problem. First, we must know what makes the countries go to use fossil fuels. After a lot of research, the scientists found a lot of advantages with using fossil fuels. These advantages represent in point which are: -



fig(12)

- **Efficiency** and **availability**.
- Transported **easily** through pipes.
- Despite limited resources, **abundant**.
- Capable of generating **large amounts** in one location.



fig(13)

On the other side, fossil fuels have numerous disadvantages which most of countries around the world neglect these disadvantages and go to use these non-renewable without any care about the environment. In addition to, these disadvantages represent in:

- Emitting primary greenhouse gas, **carbon dioxide**, contributing to pollution and **global warming**.
- Emitting sulfur dioxide, causing **respiratory issues** and acid rain.
- Acidifying the environment.
- Finite supply of **non-renewable** energy resources.
- **Harvesting** leads to fatal diseases like Black Lung Disease and hazardous chemicals in natural gas drillers.

As a result, Egypt must start using alternative energy more, which does not harm the environment. There are a lot of examples of renewable energy which are used nowadays. Therefore, what makes Egypt and abundant countries around the world do not use the renewable in energy significantly. However, the numerous significant of the renewable energy, there are some hardships to make.



fig(14)

Using them is not the best decision for some countries including Egypt. These problems are such as:

- May not be **economical**.
- It isn't always **available**.
- Could have a major effect on the **environment**.
- In contrast to **fossil fuels**, they don't provide ample energy.

Therefore, the various societies including Egypt must give some attention to using the alternative energy and work hard to solve the problems which is a significant obstacle to use it.

## If problems are solved

- I. Saving more power:** Renewable energy sources require less investment in the power sector, leading to lower electricity prices, reducing production costs and increasing profit.
- II. Saving money for parents:** Building renewable energy stimulates the economy by reducing power consumption, allowing households to spend more on other activities.
- III. Saving the economy:** We will no longer need to import electricity from abroad and will have access to renewable energy, which will significantly benefit our economic situation.
- IV. Decrease the consequences of climate change:** We can produce energy without fossil fuel emissions and reduce certain types of air pollution.



**V. Improve the scientific environment:** We will have a development environment which depends significantly on renewable energy.

**VI. Reducing health problems:** We will get rid of the health problems which are produced while using fossil fuels such as heart attacks, respiratory disorders, stroke, asthma, and absenteeism at school and work.

## If problems are not solved

**I. The significant change in climate change:**

Climate change will increase significantly. As a result, the flooding of coastal cities, the desertification of fertile areas, the melting of glacial masses and the proliferation of devastating hurricanes will increase too.

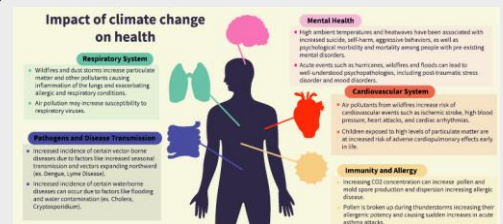


fig(15)

**II. Damaging the economy:** We will continue importing fossil fuels from abroad which will damage our economy and numerous problem will occur too.

**III. Increasing pollution and harmful diseases:** The pollution will increasedue to factory exhaust which is working.

by fossil. Furthermore, the health problems will increase and there are some diseases will significantly increase such as heart attacks, respiratory disorders, stroke, asthma, and absenteeism.



fig(16)

**IV. Damaging the marine live:** The marine environment will damage due to the harmful factory exhaust which will cause pollution of water and the death of the fish.

**V. Increasing acid rain:** Burning fossil fuels releases harmful elements like carbon dioxide and sulfur, leading to acid rain and other issues. Acid rain dissolves essential nutrients for trees and releases aluminum, making water absorption difficult for trees.



fig(17)

# Research

## Topics for researching the problem.

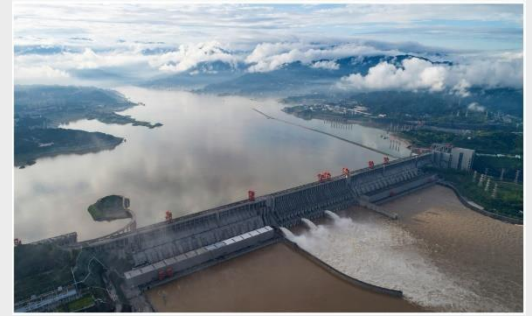
- ❖ What are the different forms and sources of energy in the world?
- ❖ What kinds of renewable energy are there globally?
- ❖ How do water contamination and oil production relate to one another?
- ❖ Disadvantages of renewable energy and solutions to issues with it.
- ❖ What is fossil fuel and what are the drawbacks?
- ❖ What constitutes pollution and what harm does it cause to the environment?
- ❖ What are the negative effects of climate change, what causes it, and how can its issues be resolved?
- ❖ What impact does pollution have on living things?
- ❖ How does the use of non-renewable energy affect the environment negatively?

## Topics for researching the solution.

- ❖ What occurs when the environmental issue becomes solved and how to deal with it.
- ❖ What is climate change?
- ❖ In a year, how much energy is required to feed everyone on the planet?
- ❖ Which earlier methods made use of kinetic energy to produce electricity?
- ❖ What are the functions and how does a dynamo operate?
- ❖ In what situations might we use kinetic energy?
- ❖ Strategies for resolving environmental issues and protecting plant and animal life.
- ❖ A technique for transforming mechanical energy into electrical energy.
- ❖ How to use the treadmill's motion to generate clean energy
- ❖ The connection between human health and sports

# Other Solutions Already Tried

I **The Three Gorges Dam** is the world's largest hydroelectric dam in terms of power generation capacity. Located on the Yangtze River in China, it is a significant part of a large-scale development project aimed at generating power, controlling floods, and improving water transportation in the region.



fig(18)

- **Hydraulic Structure:** The dam consists of a wall approximately 2.3 kilometers long and reaching a height of about 185 meters. It is designed to impound water from the Yangtze River and generate hydroelectric power.
- **Power Generation Capacity:** The hydroelectric power generation capacity of the Three Gorges Dam is estimated at about 22.5 gigawatts, making it the world's largest hydroelectric power station.
- **Navigation and Trade:** The dam also contributes to improving water transportation along the Yangtze River, facilitating ship traffic and trade.
- **Engineering Project:** The construction of the Three Gorges Dam was a massive and complex engineering challenge that took decades to complete and required a significant investment.

## ➤ **Advantages: -**

- **Clean Energy Generation:** The dam generates significant amounts of hydroelectric power, considered a clean energy source, reducing reliance on fossil fuels and lowering greenhouse gas emissions.
- **Flood Control:** It helps control flooding on the Yangtze River, which previously experienced devastating floods causing loss of life and property destruction.
- **Improvement of Water Transportation:** The dam enhances water transportation along the Yangtze River, facilitating the flow of goods and fostering trade in the region.

### ➤ **Disadvantages: -**

- **Environmental Impact:** The dam's construction caused extensive flooding of wetlands and wildlife habitats, causing ecosystem damage, biodiversity loss, and population displacement.
- **Water Pollution:** Dam waters caused sediment buildup and release of toxic gases, impacting water quality, and affecting wildlife and other species.
- **Geological Risks:** Dam impoundment can alter Earth's crust's pressure distribution, increasing the likelihood of earthquakes and soil slippage.
- **Social Impact:** The displacement of thousands of residents resulted in the loss of agricultural land and natural resources, affecting their communities and traditional ways of life.

**II Mount Signal Solar Farm** is a solar power generation project located in the Southern California region of the United States. It is one of the largest solar projects in the world and provides significant supplies of clean energy to the area.

- **Location:** Mount Signal Solar Farm is situated in the Calexico area of Southern California. The farm spans over a large area of desert land in the region.
- **Production Capacity:** The farm has a substantial production capacity, estimated to generate hundreds of megawatts of clean electricity.
- **Technology Used:** Mount Signal Solar Farm employs the latest solar energy technology, including high-efficiency solar panels and sun-tracking systems to maximize energy collection efficiency.



fig(19)

### ➤ **Advantages: -**

- **Clean Energy Generation:** Mount Signal Solar Farm produces clean, renewable energy from sunlight, reducing reliance on fossil fuels and lowering greenhouse gas emissions.
- **Reduced Environmental Impact:** Solar farms like Mount Signal, unlike conventional power plants, do not emit pollutants during operation, resulting in improved air quality and reduced environmental degradation.
- **Sustainable Resource:** Solar energy is an abundant and sustainable resource, ensuring long-term energy security and reducing dependence on finite fossil fuel reserves.
- **Economic Benefits:** Mount Signal Solar Farm's construction and operation generates job opportunities in the renewable energy sector, boosting local economies and promoting sustainable development.
- **Energy Independence:** Solar farms generate electricity locally, promoting energy independence, reducing reliance on imported fuels, and enhancing energy resilience.

### ➤ **Disadvantages: -**

- **Intermittent Energy Production:** Dependence on weather conditions and daylight hours leads to intermittent power output.
- **Land Use:** Large installation areas for solar farms can cause habitat disruption and agricultural land loss.
- **Visual Impact:** Solar panels may be perceived as unattractive, leading to opposition.
- **High Initial Costs:** Initial investment for solar farms can be substantial, requiring financing and long payback periods.
- **Resource Limitations:** Geographical location, sunlight availability, and panel efficiency can limit solar energy production feasibility.



**III Itaipu Dam** is a hydroelectric dam located on the border between Brazil and Argentina, on the Paraná River. Construction of the dam took place from 1975 to 1984, and it became operational in 1984. Itaipu Dam is one of the largest hydroelectric dams in the world and the largest hydroelectric power plant in terms of generating capacity.



fig(20)

- **Generating Capacity:** The total generating capacity of the Itaipu Power Plant is approximately 14,000 megawatts (14 gigawatts), making it one of the largest power plants in the world.
- **Purpose:** The dam was constructed with the primary purpose of generating hydroelectric power to meet the energy needs of Brazil and Argentina.
- **International Cooperation:** The dam was built in cooperation between Brazil and Argentina, demonstrating significant international collaboration in the energy sector.

➤ **Advantages: -**

- **Clean Energy Generation:** The dam relies on hydroelectric power generation, making it a clean energy source that doesn't produce greenhouse gas emissions.
- **High Production Capacity:** Itaipu Dam is one of the largest hydroelectric projects globally, with massive generating capacity that meets the energy demands of Brazil and Argentina.
- **Enhanced International Cooperation:** The construction of the dam was a result of cooperation between Brazil and Argentina, fostering stronger international relations between the two countries.
- **Flood Control:** The dam helps regulate river flows and mitigate flood damage by storing and controlling water flow.
- **Tourism:** Itaipu Dam is a major tourist attraction in the region, with visitor tours organized to observe the power generation process and the massive infrastructure of the dam.



### ➤ **Disadvantages: -**

- **Environmental Impact:** The construction of the dam can lead to environmental changes and disruptions in the local ecosystem, including alterations in river flow and the loss of natural habitats.
- **Impact on Indigenous Communities:** Building the dam may require the relocation of indigenous communities, negatively affecting their lives and traditional cultures.
- **Cost of Construction and Maintenance:** Building and maintaining Itaipu Dam requires substantial financial investments, and high costs can be a limiting factor for implementation and upkeep.
- **Biodiversity Impact:** The construction of the dam can result in the loss of local wildlife and plant life, negatively impacting biodiversity.

**IV Alta Wind Energy Center (AWEC)** also known as **Mojave Wind Farm**, is the second largest onshore wind power project in the world. It is owned by Terra-Gen Power, a subsidiary of Arclight Capital Partners and Global Infrastructure Partners. The project will provide 1,550MW of clean renewable energy for Southern California Edison (SCE) for more than 25 years as part of 3,000MW 's initiative to develop wind energy upon completion. The purchase agreement was signed in 2006.

- Located in **Kern Province, California**, over 3200 acres in the Tehachapi Mountains.
- Wind farms were built in the **1970s** and **1980s**.
- Turbines are installed at altitudes ranging from **3,000** to **6,000** feet above sea level.
- The first phase started in **July 2010** with units I to V, completed in **April 2011**.
- Construction of **sixth** and **eighth** units began in **early 2011** and was completed in **late 2011**.
- **Seventh** and **ninth** units began in **April 2012** and were completed in **December 2012**.
- The project involves the installation of **600 wind turbines**, supporting facilities, propulsion stations, service roads, power collection system, transmission lines, switches, and substations.

### ➤ **Advantages: -**

- **Renewable Energy Generation:** AWEC contributes to reducing reliance on fossil fuels and helps in the transition to cleaner, renewable energy sources.
- **Job Creation:** The construction and operation of the wind farm creates jobs in the renewable energy sector, benefiting the local economy.
- **Low Operating Costs:** Once constructed, wind farms like AWEC have relatively low operating costs compared to traditional fossil fuel power plants.
- **Environmental Benefits:** Wind energy is clean and does not produce greenhouse gas emissions or air pollutants during operation.

### ➤ **Disadvantages: -**

- **Unpredictability:** The wind is unpredictable in the non-coastlines.
- **Visual impacts:** Some people consider offshore wind farms to be visually unappealing, especially when located close to the coast.
- **Noise:** Wind turbines can produce noise during operation, which can be a concern for nearby residents.
- **Birds and Bats Collisions:** There is a risk of bird and bat collisions with wind turbines, which can impact local wildlife populations.
- **Land Use:** Large wind farms require significant land area, which can impact local ecosystems and land use patterns.
- **Unsustainable for non-coaster lines**

**V Benban Solar Park** is a power complex of 41 solar power plants being developed in Benban, located in the Aswan governorate, Egypt. Benban is touted to become the biggest solar photovoltaic park in the world, upon completion. State-owned New and Renewable Energy Authority (NREA) is overseeing the **1.8GW** project, which includes several small solar power plants being developed by different companies at a total cost of **\$4bn**.



fig(21)

- Egypt, located in the central part of the global solar belt, is the primary energy supplier.
- The largest solar power plant is in Benban village, Aswan, with a total capacity of **1600 MW**.
- The site was chosen based on **NASA** studies and international scientific reports.
- The Benban Solar Park comprises **32 subsystems**, each with a capacity of approximately **50 MW**.
- The park is connected to Egypt's high voltage network through four MERE-built plants.
- The park is part of Egypt's Fit program and is a major national renewable resources energy project.
- Each subsystem has a capacity of **50 MW AC** and is divided into **12** pieces.

### ➤ **Advantages: -**

- **Renewable energy generation:** The garden generates clean and renewable energy from sunlight, reducing reliance on fossil fuels and reducing carbon emissions.
- **Energy Security:** By diversifying Egypt's energy mix, the park enhances energy security and reduces exposure to fuel price volatility.
- **Economic development:** The park stimulates economic growth through investment, job creation and domestic spending. It also has the potential to reduce electricity costs over time.
- **Scalability:** Benban's modular design allows for easy expansion, absorbing future increases in energy demand and supporting population and economic growth in Egypt.
- **Technology transfer and innovation:** The development and operation of the park facilitates technology transfer and innovation in the renewable energy sector, contributing to Egypt's sustainable development goals.

### ➤ **Disadvantages: -**

- **Land use:** The park requires a large area of land, which may affect local ecosystems and agricultural activities.
- **Interruption:** Solar power generation depends on sunlight, making it intermittent. This requires backup power sources or energy storage solutions to ensure stable electrical supply.
- **Cost:** While the cost of solar energy has decreased significantly, the initial investment costs of large-scale solar parks such as Benban can remain high.
- **Transport infrastructure:** The park requires investment in transportation infrastructure to connect the power generated to the grid, which can be expensive and complex.
- **Maintenance and Operation:** Solar panels require regular maintenance and cleaning to ensure optimal performance, which can add to the overall cost of the project.

## **II. Generating and Defending a Solution**

# Solution and design requirements

To solve the problem, we should select the most ideal solution. A successful solution should be implemented without any mistakes, and it should be implemented in a creative and innovative way. The general requirements that should be in any efficient, effective, and successful solution are:

- It must be created from **recycled** or **wasted** materials.
- It must be **environmentally friendly**.
- It must be **costless**.
- Also, it must be **efficient**.

For our solution to be **successful**, these conditions must be met. We'll now talk about why each of those is necessary to create the **ideal one**.

**The first one**, which discusses waste materials and recycling, The project needs to be made from recycled or wasted materials to solve the pollution issue facing our nation and turn something useless into something useful.

**The second** is important because using recycled or waste materials to create a project is not enough if they are not environmentally friendly materials (like **plastic**), as this will cause a **catastrophe** and destroy the ecosystem.

**The third requirement** deals with cost; the project must be efficient and cost-effective overall. Even if a project is effective but expensive overall, it is useless, so we need efficient and cost-effective projects. Therefore, the project will be **successful** and **creative** if it is efficient and cost-free.

**The fourth one** talks about how the project must be efficient in order to produce electricity and more than 150 joules in less than five minutes. Since the treadmill project satisfies the previously mentioned design requirements, it should be creative, successful, and effective. This guarantees that the project is innovative and productive, differentiating it from other projects of a similar nature.



# Selection of solution

Generating electricity from kinetic energy depends on converting **kinetic energy** into **electrical energy**. This is usually done by hydraulic turbines coupled with electric generators. This is what applies to our project.

**Advantages** of generating electricity from kinetic energy: -

- **Sustainable and renewable:** Kinetic energy is continuously available from wind, water, and geothermal heat, and can therefore be exploited sustainably.
- **No Pollution:** The process of generating electricity from kinetic energy does not produce harmful emissions to the environment, making it an environmentally friendly option.
- **Cost savings in the long run:** Despite the initial infrastructure costs, operating kinetic energy power plants is less expensive in the long run.



**Rance Tidal Power Station**  
fig(22)

**Disadvantages** of generating electricity from kinetic energy: -

- It requires **physical effort** to generate electricity.
- **Irregular Electrical Current** in Operation due to voltage difference during operation.

**Our project idea:** -

When a person uses the treadmill, we will transfer his energy to create electricity. By doing this, we will have generated electricity and encouraged individuals to exercise.

In the end, using kinetic energy to generate electricity is an effective way to meet our increasing energy needs, but doing so will present both advantages and disadvantages in terms of the environment and the economy.

# Selection of prototype

There are many ways to produce energy, but we decided to produce electrical energy through kinetic energy produced by treadmill.

The treadmill is divided into several parts: the frame, hinges, movement tubes, handle, and control panel.

The outer frame measures 70 cm in length, 50 cm in width, and 5 cm in height. It is made of recycled iron. It has spots for our hinges and the electric motors that we will use as a dynamo.

After that, we install 48-cm-long metal pipes with motors that were salvaged from old fans. This allows the motors to move and generate electricity when the pipes move.



3D model of our treadmill  
fig(23)

Two 100 cm long poles attached to two 30 cm long handles (one with a sponge surface so the runner can grip them) and a wooden piece fixed between the two poles are located at the end of the metal frame.








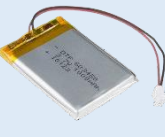
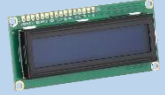
To get the most amps of electricity possible, we will connect the recycled motors in parallel. After that, we will connect the two wires that are left over to a charging cable so that we can use and charge the batteries without having to take them apart and install them. To use electricity, we connect them to three 3.7-volt lithium batteries, which are connected to a charger. The phone is additionally connected to an Arduino chip for charging. To determine whether the batteries are charging or not, this chip is connected to an LCD screen, three LEDs, and a timer that shows the player's start time.

A person weighing over 120 kg can be carried on the treadmill, and by using more generators, we can produce more electricity.

Ultimately, we create a form that is like the popular treadmill, but each part is recyclable and operates differently—for example, running produces electricity rather than the other way around.




### **III. Constructing and Testing a Prototype**

# Materials and Methods

Item	Quantity	Description	Usage	Cost	Source	Picture
<b>Metal Frame</b>	1	Metal frame that has the dimension of 70 cm by 50 cm	It is the frame that everything is going to be installed on	150	Supplies store	
<b>Metal tubes</b>	1	Metal tubes rotates by motion	They are those ones which will help to move	150	Supplies store	
<b>Generator</b>	1	It is a device used to convert mechanical energy into electric current	It will generate AC electricity from mechanical energy	60	Old fan	
<b>Ball bearing</b>	6	They are pieces of metal that spin with very little friction	It will be the thing the metal tubes gets supported on	100	Old bicycle	
<b>Metal Gear</b>	2	It is a piece of metal that has teeth that cling onto a chain	It will transfer the mechanical energy from the tubes to the chain.	20	Old bicycle	
<b>Chain</b>	1	It is a tight small chain the has gaps in it for things to attach onto it	It will transfer the mechanical energy from the tubes to the Generator.	20	Old bicycle	
<b>Nails</b>	16	Small nails fix the tubes	They are used to install the tubes into the frame.	80	Supplies store	
<b>Lithium batteries</b>	3	Charging batteries to store energy	It used to store the electricity that produced from the generator	120	Online store (lampatronics)	
<b>LCD screen</b>	1	Screen to display time	It used to display exercise seconds	150	FAB Lab	

fig(24)

# Safety Precautions

Item	Usage	Picture
Lab coat	To protect the body of the person working.	
Latex gloves	To protect against the dirt and microbes that the person working on the project might get exposed to.	
Goggles	To protect the eyes of the person.	

fig(25)



# Test plan.

Additionally, the prototype needed to be tested once it was completed.

- ❑ In the beginning, we must adhere to safety and protection rules, such as wearing a coat and gloves, and always be at a safe distance.
- ❑ After that, someone must get on the treadmill and run on it to run the generator.
- ❑ In addition, when the generator is moving, we connect it to the batteries so that we can charge them, and to an ampmeter to measure the amps and volts generated by the treadmill.
- ❑ The last step, Calculate the electricity generated by the device, and after charging the batteries, it is used to light the bulb or charge a cell phone and connect electricity to the Arduino chip to light the LCD screen and some small LED lights.



**fig(26):actual prototype**



**fig(27): 3D model for the prototype**

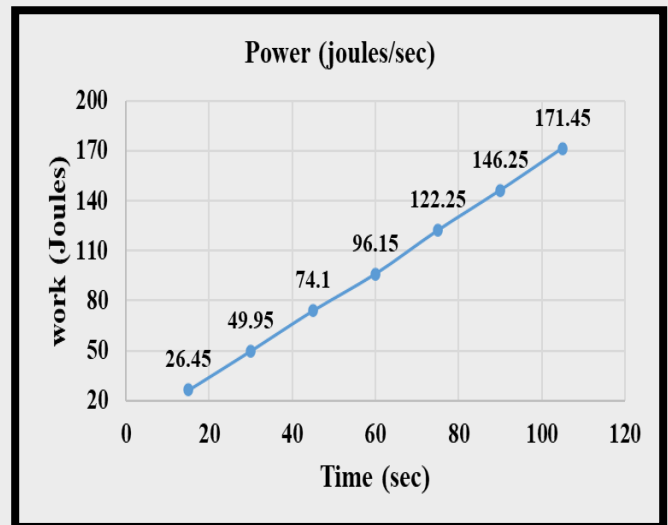
## Data Collection.

The measurement tool that was used to make the test plan is the "**Amphometer**", the amphometer is multipurpose device which is used to measure the **potential difference** and the **current intensity**.

## Results

Time	Work (Joules)
15 sec	26.45 joules
30 sec	49.95 joules
45 sec	74.10 joules
60 sec	96.15 joules
75 sec	122.25 joules
90 sec	146.25 joules
105 sec	171.45 joules

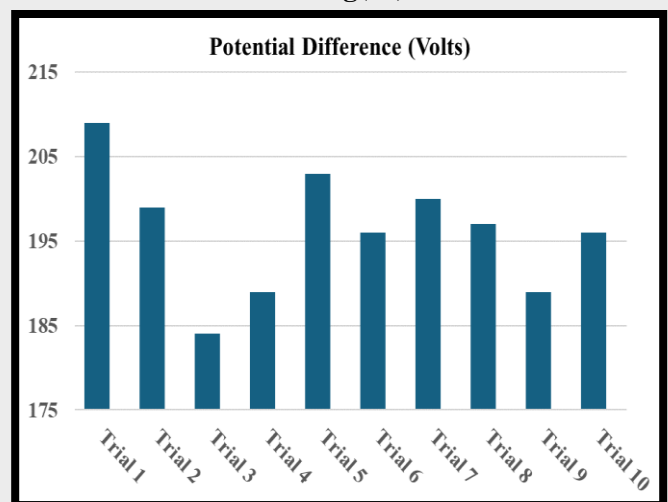
fig(28)



fig(29)

No. of trials	Potential Difference (Volt)
Trial 1	208 $\pm$ 0.001 volts
Trial 2	199 $\pm$ 0.001 volts
Trial 3	197 $\pm$ 0.001 volts
Trial 4	189 $\pm$ 0.001 volts
Trial 5	203 $\pm$ 0.001 volts
Trial 6	196 $\pm$ 0.001 volts
Trial 7	200 $\pm$ 0.001 volts
Trial 8	196 $\pm$ 0.001 volts
Trial 9	189 $\pm$ 0.001 volts
Trial 10	184 $\pm$ 0.001 volts
Average	196 $\pm$ 0.001 volts

fig(30)



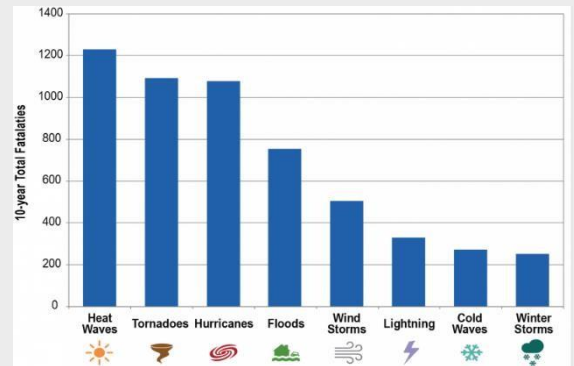
fig(31)

## **IV. Evaluation, Reflection, and Recommendations.**

# Analysis and Discussion.

Egypt suffers from numerous problems such as a lack of alternative energy forms, Not making the most of the surrounding environment, and vulnerability to the impact of climate change.

The dependence on one type of energy is not optimal especially if it is a fossil fuel, because if this type of energy runs out or its price becomes too expensive it will be a catastrophe for the economy. Not taking advantage of the surrounding environment is a problem, there are a lot of beneficial things in the environment that must be used, to have a good economy.



fig(32)

Climate change increases the average temperature, which increases the vulnerability to more climatic disasters.

This solution helps to solve the problems mentioned above, where it would use an alternative and clean source of energy which is the kinetic energy from the student activity. In the past, the energy of students was wasted without taking advantage of them, this solution will take advantage of this wasted energy. As the source and the form of energy used in this solution are clean, the dependence on it will reduce the impacts of climate change as the dependence on it reduces the usage of fossil fuels which increases the climate change impacts.

In brief, the project is a treadmill that converts kinetic energy to electric energy. It successfully meets the specified design requirements. The treadmill's efficiency in producing energy is shown by the fact that it can produce over 150 joules of energy in less than five minutes. The project shows a dedication to sustainability and reduces its environmental impact by using waste and recycled materials in its construction.

### Features of the prototype: -

Using recycled materials in construction the prototype reduces costs and encourages sustainability. Also, how effectively it generates sustainable energy encourages individuals to play sports.

However, the prototype has a few issues, such as: -

It requires continuous maintenance. Furthermore, few people play sports. Moreover, the user's physical abilities limit the amount of energy that can be produced.

In addition, the treadmill's overall efficiency may be affected by energy loss during the process of converting kinetic energy to electric energy.

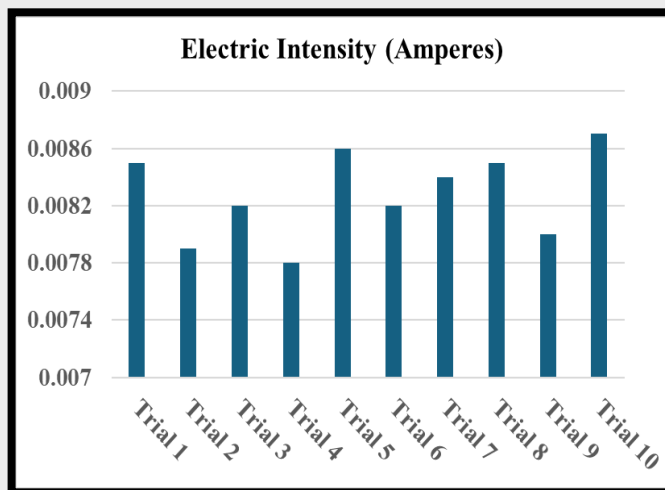
To get further data about the project, it is required to obtain some additional quantities to analyze this project deeper.

The **Electric power**, which indicates how much work is done per second, is the first quantity that has been calculated, it has been indicated many times to be more accurate and it has been calculated using the following formula: -

$$\text{Power [watt]} = \text{current intensity} \times \text{potential difference}$$

(Law 1)

By taking the average of **current intensity** from fig(34) and the average of **potential difference** from table Then, **Electric power** equals  $0.00828 \times 196 \cong 1.6 \text{ Watt}$ .



fig(33)

No. of trials	Electric Intensity (ampere)
Trial 1	0.0085 ± 0.001 amps
Trial 2	0.0079 ± 0.001 amps
Trial 3	0.0082 ± 0.001 amps
Trial 4	0.0078 ± 0.001 amps
Trial 5	0.0086 ± 0.001 amps
Trial 6	0.0082 ± 0.001 amps
Trial 7	0.0084 ± 0.001 amps
Trial 8	0.0085 ± 0.001 amps
Trial 9	0.0080 ± 0.001 amps
Trial 10	0.0087 ± 0.001 amps
Average	0.00828 ± 0.001 amps

fig(34)

Now it is the time for calculating **Motor Torque**.

**The torque** of an electric motor is the amount of rotational force the motor develops., torque can optimize the generators' energy consumption, leading to more energy-efficient operation and potentially lower electricity costs, the following **law** is used to calculate it: -

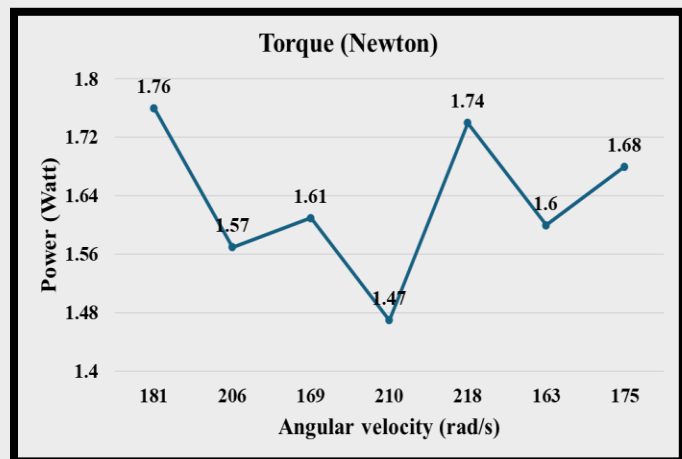
$$\text{Torque [newton]} = \text{Power [watt]} \div \text{Angular velocity [rad/s]}$$

(Law 2)

must be calculated using average of the angular velocity (**188 rad/s**) and the average of the electric power (**1.6 watt**) so the average of the torque equal **1.6 ÷ 188 = 0.0085N** the remaining results has been plotted in **fig(35) & fig(36)**

Power (Watt)	Angular velocity (rad/s)
1.76 watt	181 (rad/s)
1.57 watt	206 (rad/s)
1.61 watt	169 (rad/s)
1.47 watt	210 (rad/s)
1.74 watt	218 (rad/s)
1.60 watt	163 (rad/s)
1.68 watt	175 (rad/s)

fig(35)



fig(36)

As it has shown that prototype can produce **1.6 watt** so, in **300 sec** it may generates about **480 joules (output)** then the kinetic energy should be calculated to detect the efficiency of the prototype.

so kinetic energy equal

$$K.E = \frac{1}{2}mv^2 \quad \frac{1}{2} \times 70 \times 5^2 = 875 \text{ Joules}$$

(Law 3)

Use the following law to calculate the efficiency: -

$$\text{Efficiency}_{\%} = \frac{\text{Output}}{\text{Input}} \times 100 = \frac{480}{875} \times 100 = 54\%$$

(Law 4)



# Conclusion

The prototype ought to be able to convert mechanical energy into electrical power. based on the prototype's testing and outcomes. The results demonstrate that the prototype can generate about **170 joules** in less than **110 seconds**. The power (Watt) and the number of joules is directly correlated. The number of joules also grows with time, enabling the prototype to fulfill design requirements. The generator transforms kinetic energy into electrical energy, which is necessary for producing electricity. The torque of the generator determines its efficiency. Whenever the torque increases, the power (watt) increases as well, increasing the total number of joules. After carefully examining the previous solutions, utilizing its benefits, and avoiding its drawbacks, the solution has been reached. The solution varies from previous approaches in several ways. It does not damage the environment with toxic emissions, and it has no adverse effects on the nearby creatures. Rather, it is extremely suitable for the environment. In addition, the entire construction was done with recyclable materials, making it affordable and accessible to all. It can produce a significant amount of electricity despite its small size if it is constructed more professionally and certain adjustments are made to make it practical.

# Recommendations

It is believed that everything around us is being developed day by day, from a **wireless heart rate monitor** to **interactive games**, each feature contributes to our shared vision of a greener, healthier planet and more efficient project.

- ❑ **Wireless Heart Rate Monitor:** Use the energy produced by the treadmill to power a wireless heart rate monitor.
- ❑ **Adaptable Resistance:** Include varying resistance settings in the treadmill's design. Users have the option to increase the difficulty, which requires more work and power.
- ❑ **Kinetic Tiles:** Replace part of the treadmill belt with kinetic tiles that generate electricity when stepped on. These tiles can be used for specific exercises or as a fun feature.
- ❑ **Pedal-Powered Accessories:** Attach pedals or footplates to the treadmill frame. Users can pedal to generate additional electricity.
- ❑ **Bluetooth Speaker System:** Integrate Bluetooth speakers powered by the treadmill. Users can enjoy music while exercising.
- ❑ **Smartphone App Integration:** Set up an extension app that syncs with the treadmill. Users can set goals and observe their energy production.
- ❑ **Interactive Display Games:** Use the treadmill console to create interactive games. Users generate electricity by playing these games during their workout.

# Learning Transfer

Subject	Connection with capstone project
<b>CH.1.08</b>	Solubility can help in the understanding of the lubrication in different materials which is important for our prototype to know the right lubricant for our treadmill.
<b>CH.1.09</b>	Understanding the physical properties of different materials help choose the ideal material for constructing the prototype.
<b>CH.1.10</b>	Percentage yield can help in identifying the efficiency of the solution by obtaining the theoretical yield and the actual yield.
<b>MA.1.07</b>	Quadratic equations can be used to model the relationship between variables such as energy output, efficiency, required time and input parameters.
<b>MA.1.08</b>	Exponential and logarithmic functions can be utilized to model the decay of kinetic energy and the charging of batteries using the electric energy produced from the treadmill.
<b>BI.1.09</b>	Plant adaptations, such as the ability to withstand high levels of mechanical stress (like wind or water flow), could inspire design elements that improve the treadmill's durability and resistance to wear and tear.
<b>BI.1.10</b>	Understanding photosynthesis and cellular respiration can improve treadmill energy conversion systems, enhancing efficiency by simulating plant cell mechanisms for mechanical energy conversion.
<b>BI.1.12</b>	Ecosystem function can inspire sustainable treadmill design, incorporating diverse materials and technologies to enhance resilience and efficiency, showcasing the importance of biodiversity in ecosystem health.
<b>ME.1.05</b>	Projectile motion principles aid in impact analysis, assessing energy transfer and damage from projectiles on materials or structures, aiding in the design of protective measures and materials.
<b>ME.1.06</b>	The design and the structure of the treadmill can be optimized. By using Lami's rule and the triangle of force, the resultant of forces acting on the treadmill can be calculated, to ensure that the treadmill endure the weight of the running persons on it.

<b>CS.1.07</b>	Python can be used to develop control algorithms for the treadmill, ensuring that it operates efficiently and responds appropriately to user input and environmental conditions. This can include optimizing energy conversion processes and managing energy flow within the system.
<b>ES.1.08</b>	Understanding the properties of different earth materials can help in selecting the most suitable materials for constructing the treadmill. For example, certain materials may be chosen for their durability, strength, or ability to conduct electricity, which are important factors in the design of a treadmill that converts mechanical energy to electric energy.
<b>ES.1.09</b>	The process of converting mechanical energy from the treadmill into electrical energy may involve similar principles to those used in generating electrical energy from natural resources. Understanding these principles can help optimize the energy conversion process in the treadmill.
<b>ES.1.10</b>	Understanding the variety of natural resources used for energy production can help in selecting an appropriate energy source for the treadmill. For example, if the project aims to use renewable energy sources, such as solar or wind energy, this knowledge can guide the design and implementation of the energy conversion system in the treadmill.

**fig(37)**

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