"DESIGNING AN ELECTRICITY GENERATING TILE "

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE

OF

BACHELOR OF ENGINEERING IN

MECHANICAL ENGINEERING BY

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UNDER GUIDANCE OF

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MGMCET KAMOTHE, NAVI MUMBAI.

(INTERNAL GUIDE)

Department of Mechanical Engineering

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UNIVERSITY OF MUMBAI

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Project report Approval for B.E

This project report ***"*DESIGNING AN ELECTRICITY GENERATING TILE*"*** by **SIDDHESH D. DADDIKAR *(419ME3116A), MOHAMMED ZAKI A. BHATKAR (419ME3140A),* HRITHIK V. MANE *(419ME3093A),* AADESH P. TAKALE (419ME3148A),** is approved for the degree of the ***Bachelor of Engineering*** in ***Mechanical Engineering.***

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CERTIFICATE

This is to certify that the project entitled **"DESIGNING AN ELECTRICITY GENERATING TILE "** is a bonafide work submitted to the University of Mumbai in partial fulfillment of the requirement for the award of the degree of **"BACHELOR OF ENGINEERING"** in **"MECHANICAL ENGINEERING"** during the academic year 2021-2022.

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Declaration

I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

Acknowledgement

We would like to express our sincere gratitude to our Guide Dr. Vaibhav Pawar discussions with him on numerous occasions have made his work possible. It has for him guidance and steady fast support during the course of this project work. Fruitful and rewarding been a great pleasure for us to work under his guidance.

We would like to express our sincere thanks to all the faculty members of Mechanical Engineering Department for their kind co-operation.

Abstract

At electricity has become a lifeline for human population. Its demand is increasing day by day. Modern technology needs a huge amount of electrical power for its various operations. Electricity production is the single largest source of pollution in the whole world. At one hand, rising concern about the gap between demand and supply of electricity for masses has highlighted the exploration of alternate sources of energy and its sustainable use. On the other hand, human population all over the world and hence energy demand is increasing day by day linearly. Accordingly, it is an objective of the present invention to provide a method of electrical power generation from this ever increasing human population that does not negatively impact the environment. This technology is based on a principle called the piezoelectric effect and mechanical power generation in which certain materials and assisted mechanism have the ability to build up an electrical charge from having pressure and strain applied to them. Piezoelectricity refers to the ability of some materials to generate an electric potential in response to applied pressure and generator producing power output. Harvesting of energy which means energy is already available, but is going to waste if not utilized. The Electricity generating tiles have undeniable potential as an energy source.

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CHAPTER 1 : INTRODUCTION

A growing fossil-fuel and non-renewable energy depletion has been called for a critical need to replace the depletion with an alternative source of energy, and for the continued increase of the energy demand. The desire to do business is energy.

Electricity is one of the common energy uses and grows according to the population. The purpose of this innovation is to use the increase of the human population and to increase energy while at the same time reducing the environmental impact. Equally, the energy used does not rely on or depend on the environment . The excess of energy must be used to produce the electricity required.

The lack of urban physical space and steady growth of the energy matrix, allow us to envision a future where the constant improvement of the existing matrix, becomes an essential practice towards more intelligent and self-sustainable cities. Thus our solution (Electricity generating tile) is "One of the possible solutions to this problem are called energy harvesting techniques, these allow collection of residual energy from environmental sources, clean and free."

However, this is a challenge, since creating new options to satisfy the growing energy needs, leads to an essential increase in R&D of such power generation support. On the subject, do we imagine power generation being supported just by traveling on public roads, and/or visiting the park and/or, while commuting to work, and/or exploit the waves swing of the seas Since 1880, this is possible thanks to phenomenon of piezoelectricity and electric motor.

Currently, there are various studies for the use of this phenomenon, ranging from special bricks or tiles on the sidewalk for pedestrians, pressure points in roadways and railroads, up to specialized breakwaters for coastal zones.

Considering the above, the purpose of this survey is to summarize methods of energy harvesting and their socio-economic implications, of applying such methods of power generation, which does not completely alter urban spaces.

By this, solutions to the steady growth of the energy matrix, and a comparison of energy production between the methods, as well as a comparison with other energy parameters to measure its applicability are sought.

CHAPTER 2: PROBLEM DEFINATION

A growing fossil-fuel and non-renewable energy depletion has been called for a critical need to replace the depletion with an alternative source of energy, and for the continued increase of the energy demand. The lack of urban physical space and steady growth of the energy matrix, allow us to envision a future where the constant improvement of the existing matrix, becomes an essential practice towards more intelligent and self-sustainable cities. Thus our solution (Electricity generating tile) is "One of the possible solutions to this problem are called energy harvesting techniques, these allow collection of residual energy from environmental sources, clean and free."

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CHAPTER 3: LITERATURE REVIEW

3.1 Footstep Voltage Generator using Piezo-Electric Transducers

- International Journal of Scientific & Engineering Research

Shrimoyee Poddar, Mohuya Dutta, Debashree Chowdhury, Abhinaba Dey, Debasis Maji have done generation electrical power as non-conventional method by simply running on the train in the foot step. Non-conventional energy system is very essential at this time to our nation. Non-conventional energy using foot step needs no fuel input power to generate the output of the electrical power. This project uses simple drive mechanism.

Study of Piezo Electric materials :

Piezoelectric ceramics belong to the group of ferroelectric materials. Ferroelectric materials are crystals which are polar without an electric field being applied. The piezoelectric effect is common in piezo ceramics like PbTiO3, PbZrO3, PVDF and PZT. The main component of the project is the piezoelectric material. The proper choice of the piezo material is of prime importance. For this, an analysis on the 2 most commonly available piezoelectric material - PZT and PVDF, to determine the most suitable material was done. The criterion for selection was better output voltage for various pressures applied. In order to understand the output corresponding to the various

forces applied, the V-I characteristics of each material namely, PZT and PVDF were plotted. For this the Piezo transducer material under test is placed on a Piezo force sensor.

The voltage from PZT is around 2 V where as that of PVDF is around 0.4V.We can thus conclude that better output is obtained from the PZT than the PVDF

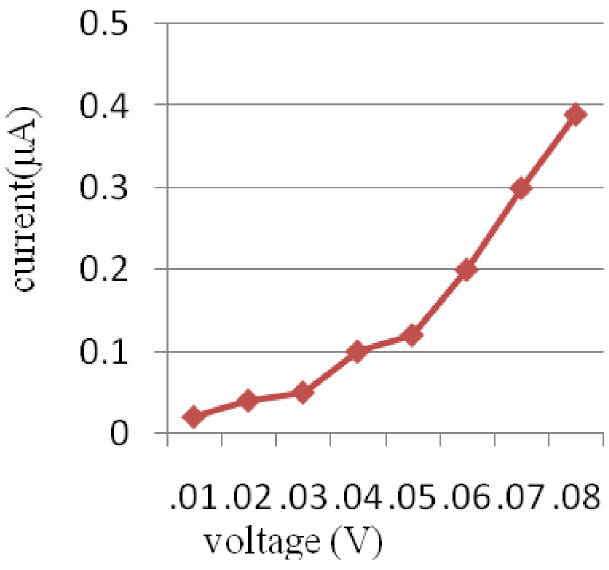


Fig.3.A

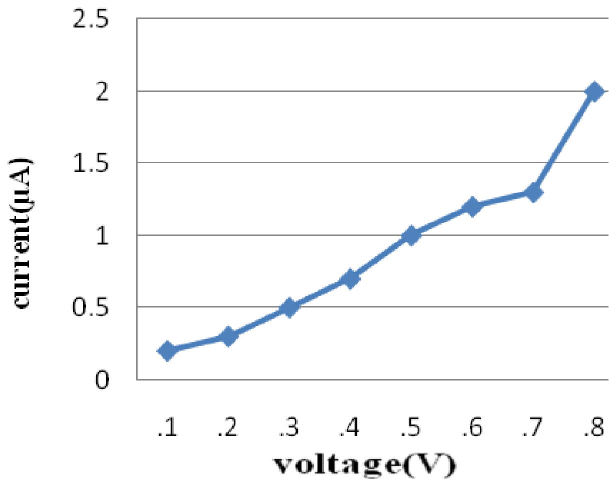


Fig. 3. B

Study of connections:

Next to determine the kind of connection that gives appreciable voltage and current necessary, three PZT are connected in series. A force sensor and voltmeter is connected to this series combination. As varying forces are applied on this connection, corresponding voltages are noted. Also the voltage generated across the series connection and the current is measured. Similarly the connections are done for parallel and series-parallel connections are done

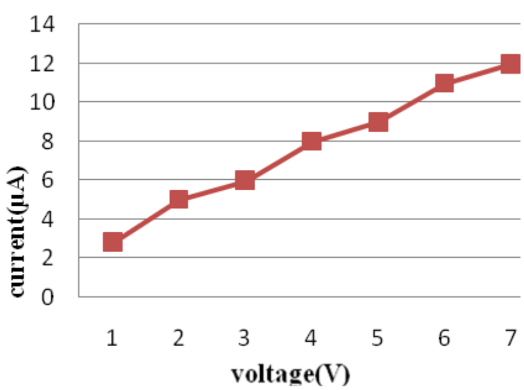


Fig. 3. C

ANALYSIS ON PIEZO TILE :

People whose weight varied from 40kg to 75 kg were made to walk on the piezo tile to test the voltage generating capacity of the Piezo tile. The relation between the weight of the person and power generated is plotted in figure 8. From the graph it can be seen that, maximum voltage is generated when maxi-mum weight/force is applied. Thus, maximum voltage of 40V is generated across the tile when a weight of 75 Kg is applied on the tile.

3.2 Design of Kinetic-Energy Harvesting Floors

-Energies

Thitima Jintanawan , Gridsada Phanomchoeng , Surapong Suwankawin ,Phatsakorn Kreepoke , Pimsalisa Chetchatree and Chanut U-viengchai have done Ddesign of Kinetic Energy harvesting floors.

The dynamic models of the electro-mechanical systems were developed using MATLAB®/Simulink to predict the energy performances of Genpath and help fine-tune the design parameters. The system in Genpath comprises two main parts: the EM generator and the Power Management and Storage (PMS) circuit. For the EM generator, the conversion mechanism for linear translation to rotation was designed by using the rack-pinion and lead-screw mechanism. Based on the simulation analysis, the averaged energy of the lead-screw model is greater than that of the rack-pinion model. Thus, prototype-II of Genpath with 12-V-DC generator, lead-screw mechanism was recently built. It shows better performance when compared to the previous prototype-I of Genpath with 24-V-DC-generator, rack-pinion mechanism. Both prototypes have an allowable displacement of 15 mm. The Genpath prototype-II produces an average energy of up to702 mJ (or average power of 520 mW) per footstep. The energy provided by Genpath prototype-II is increased by approximately 184% when compared to that of the prototype-I. The efficiency of the EM-generator system is ~26% based on the 2-W power generation from the heel strike of a human'swalk in one step. Then, the PMS circuit was developed to harvest energy into the batteries and to supply the other part to specific loads. The experiment showed that the designed PMS circuit has the overall efficiency of 74.72%.

Conceptual Design

The two proposed designs of the generator system in Genpath, with the only deference in the mechanisms for the movement converter. A set of Genpath comprises a floor-tileblock embedded with the translation-to-rotation conversion mechanism which is connected to the DC generator and the PMS circuit board. The entire dimension is 40 _ 40 _ 10 cm3 with the maximum allowable displacement of 15–20 mm. Two types of mechanisms, rack pinion and lead screw, are used to convert the translation from a footstep to the rotation of the generator. For the rack-pinion mechanism in Figure 2a, the pinion connected to the floor-tile drives the DC-generator shaft through the additional pinion gears which help transform low-speed power to high-speed power. For the lead-screw mechanism in Figure 2b, the nut fixed to the floor-tile's center moves up and down and drives the lead screw to rotate about its axis. The set of bevel gears transmits the rotation from the lead screw to the DC generator and changes the direction of rotation by 90_. The rotation of the DC generator in both designs then induces the voltage. The springs with the maximum displacement of 15–20 mm connected to the four corners of the block help restore the top floor-tile back to the equilibrium position. Considering the limits of the dimension and the displacement, thus, the small size of 12/24-V-DC motor was decided for the DC generator.

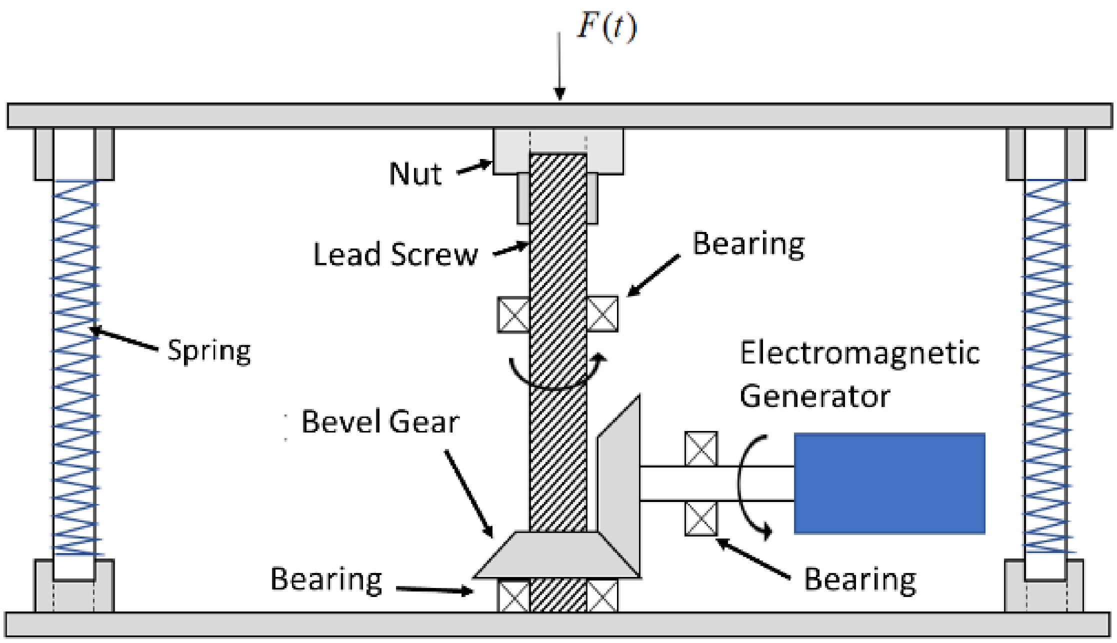

$F(t)$
Nut
Lead Screw
Bearing
Spring
Electromagnetic
Generator
Bevel Gear
Bearing
Bearing

Fig.3.D

CHAPTER 4: Methodology and Mechanism

A set of Mechanical tiles comprises a floor-tile block embedded with the translation-to-rotation conversion mechanism which is connected to the DC generator and the PMS circuit board. The entire dimension is 40 x 40 x 10 cm3 with the maximum allowable displacement of 15–20 mm. Two types of mechanisms, rack pinion and lead screw, are used to convert the translation from a footstep to the rotation of the generator. For the rack-pinion mechanism in Figure 2a, the pinion connected to the floor-tile drives the DC-generator shaft through the additional pinion gears which help transform low-speed power to high-speed power. For the lead-screw mechanism in Figure 2b, the nut fixed to the floor-tile’s center moves up and down and drives the lead screw to rotate about its axis. The set of bevel gears transmits the rotation from the lead screw to the DC generator and changes the direction of rotation by 90^0. The rotation of the DC generator in both designs then induces the voltage. The springs with the maximum displacement of 15–20 mm connected to the four corners of the block help restore the top floor-tile back to the equilibrium position. Considering the limits of the dimension Considering the limits of the dimension and the displacement, thus, the small size of 12/24-V-DC motor was decided for the DC generator.

4.1 Rack and Pinion

A **rack and pinion** is a type of linear actuator that comprises a circular gear (the *pinion*) engaging a linear gear (the *rack*), which operate to translate rotational motion into linear motion. Driving the pinion into rotation causes the rack to be driven linearly. Driving the rack linearly will cause the pinion to be driven into a rotation. A rack and pinion drive can use both straight and helical gears. Though some suggest Helical gears are noted for "quieter" operation, there is no science to support this theory. Helical racks while being more affordable, have proven to increase side torque on the datum, increasing operating temperature leading to premature wear. Straight racks require a lower driving force and offer increased torque and speed per percentage of gear ratio which allows lower operating temperature and lessens visual friction and energy use. The maximum force that can be transmitted in a rack and pinion mechanism is determined by the tooth pitch and the size of the pinion as well as the gear ratio.

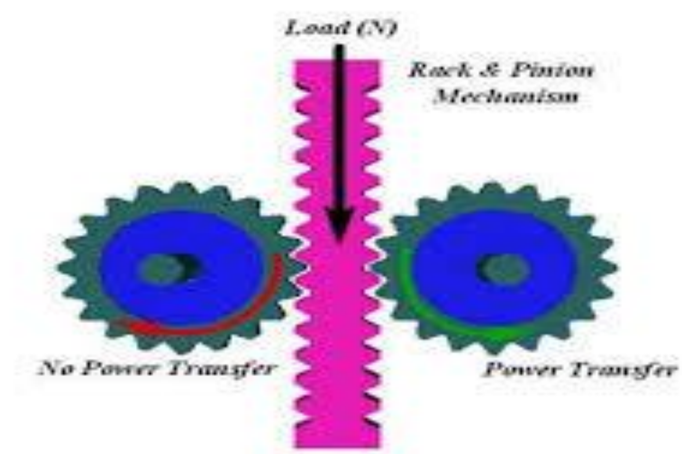
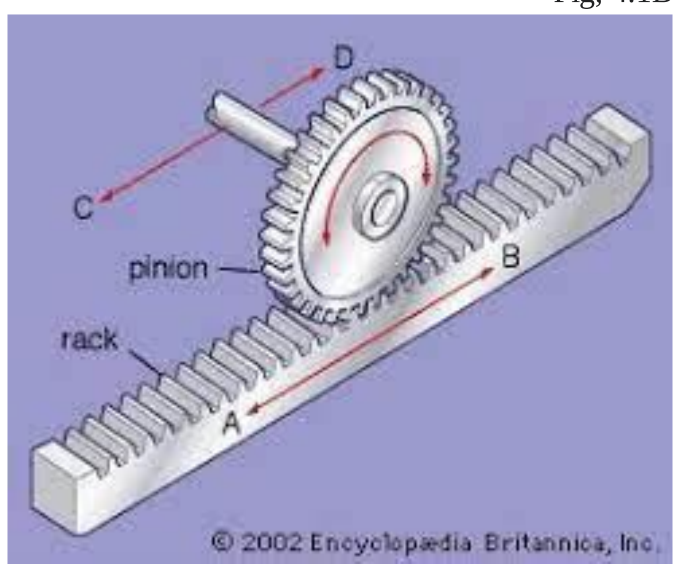


Fig.4.1A

Fig, 4.1B



4.2 DC Motor

A **DC motor** is any of a class of rotary electrical motors that converts direct current (DC) electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current in part of the motor.

DC motors were the first form of motor widely used, as they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight brushed motor used for portable power tools and appliances. Larger DC motors are currently used in propulsion of electric vehicles, elevator and hoists, and in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications.

Fig 4.2A

4.3 Piezo-Electric Transducer

A transducer is any device used to convert energy from one form to another - typically when converting input energy into output energy. For transduction to occur, a change from one form of energy must also take place, such as a conversion from mechanical to electrical energy or vice versa. There are many types of transducers and the uses of transducers are widespread, impacting us in many ways. A common example is a microphone, which converts the input energy - or the sound waves produced by a voice or instrument - to output energy, or the electrical impulses in the form of amplified sound.
Other types of electro acoustic (involving a conversion between electrical energy and sound) transducers include hydrophones, which convert changes in water pressure to an electrical output, and pickups on musical instruments such as guitars, which convert the vibration of the instrument's strings into an electrical impulse.

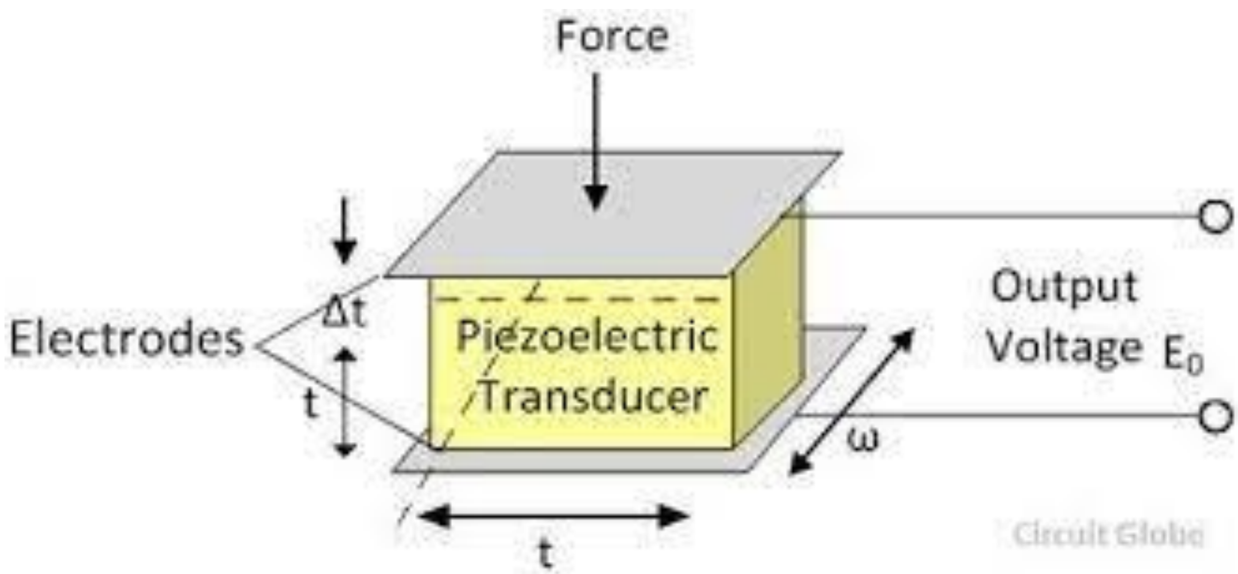


Fig. 4.3A

What is the Piezoelectric Effect?

Piezoelectric Effect is the ability of certain materials to generate an electric charge in response to applied mechanical stress. The word Piezoelectric is derived from the Greek piezein, which means to squeeze or press, and piezo, which is Greek for "push".

One of the unique characteristics of the piezoelectric effect is that it is reversible, meaning that materials exhibiting the direct piezoelectric effect (the generation of electricity when stress is applied) also exhibit the converse piezoelectric effect (the generation of stress when an electric field is applied).

When piezoelectric material is placed under mechanical stress, a shifting of the positive and negative charge centers in the material takes place, which then results in an external electrical field. When reversed, an outer electrical field either stretches or compresses the piezoelectric material.

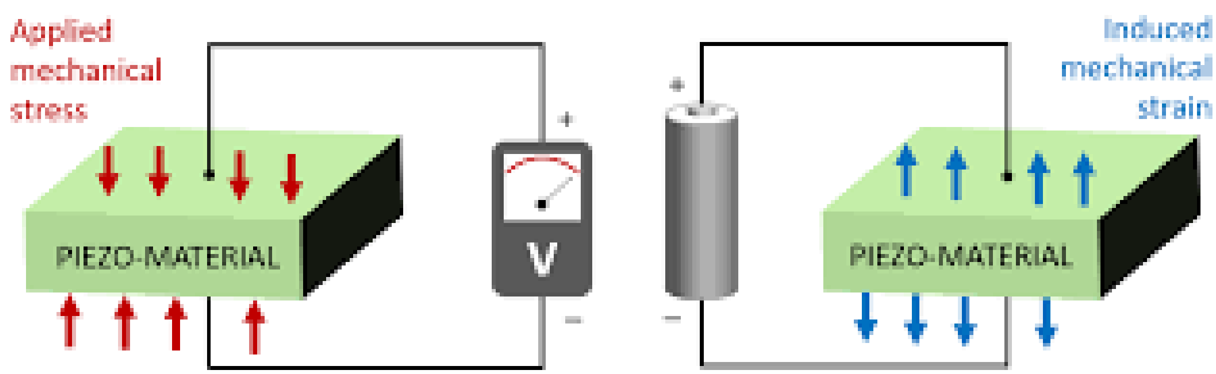


Fig. 4. 3B

The piezoelectric effect is very useful within many applications that involve the production and detection of sound, generation of high voltages, electronic frequency generation, microbalances, and ultra fine focusing of optical assemblies. It is also the basis of a number of scientific instrumental techniques with atomic resolution, such as scanning probe microscopes (STM, AFM, etc). The piezoelectric effect also has its use in more mundane applications as well, such as acting as the ignition source for cigarette lighters.

The History of the Piezoelectric Effect

The direct piezoelectric effect was first seen in 1880, and was initiated by the brothers Pierre and Jacques Curie. By combining their knowledge of pyroelectricity with their understanding of crystal structures and behavior, the Curie brothers demonstrated the first piezoelectric effect by using crystals of tourmaline, quartz, topaz, cane sugar, and Rochelle salt. Their initial demonstration showed that quartz and Rochelle salt exhibited the most piezoelectricity ability at the time.

Over the next few decades, piezoelectricity remained in the laboratory, something to be experimented on as more work was undertaken to explore the great potential of the piezoelectric effect. The breakout of World War I marked the introduction of the first practical application for piezoelectric devices, which was the sonar device. This initial use of piezoelectricity in sonar created intense international developmental interest in piezoelectric devices. Over the next few decades, new piezoelectric materials and new applications for those materials were explored and developed.

During World War II, research groups in the US, Russia and Japan discovered a new class of man-made materials, called ferroelectrics, which exhibited piezoelectric constants many times higher than natural piezoelectric materials. Although quartz crystals were the first commercially exploited piezoelectric material and still used in sonar detection applications, scientists kept searching for higher performance materials. This intense research resulted in the development of barium titanate and lead zirconate titanate, two materials that had very specific properties suitable for particular applications.

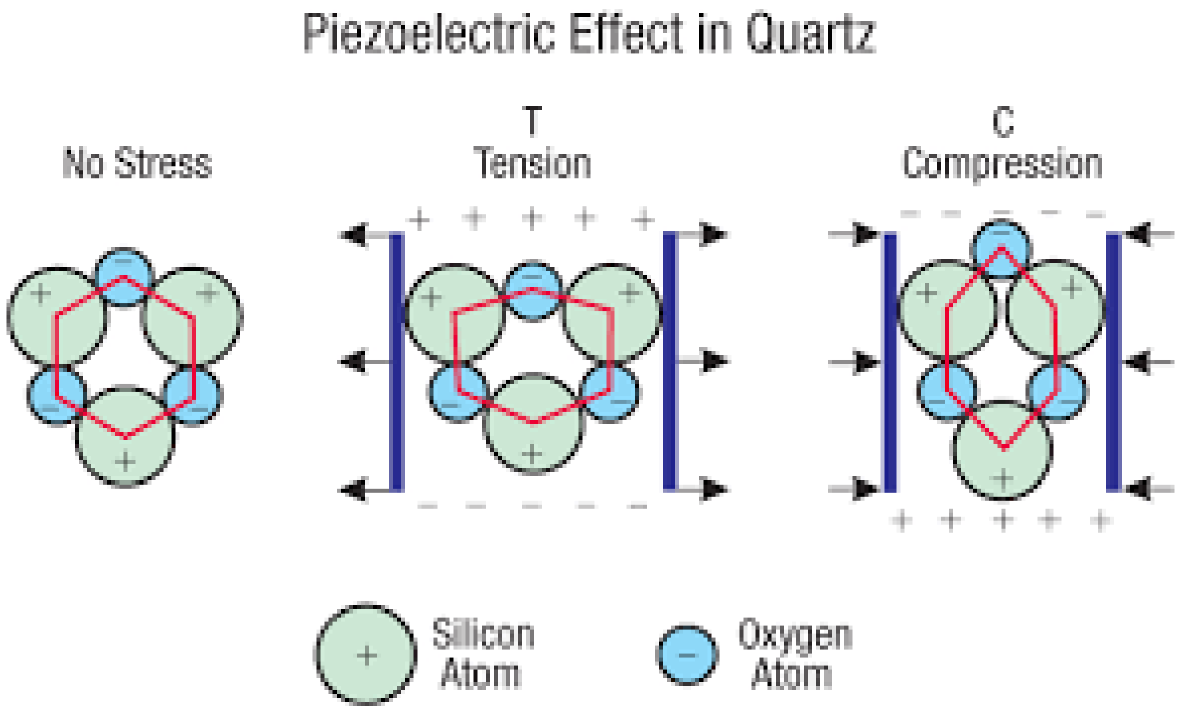


Fig .4.3.C

Piezoelectric Materials

There are many materials, both natural and man-made, that exhibit a range of piezoelectric effects. Some naturally piezoelectric occurring materials include Berlinite (structurally identical to quartz), cane sugar, quartz, Rochelle salt, topaz, tourmaline, and bone (dry bone exhibits some piezoelectric properties due to the apatite crystals, and the piezoelectric effect is generally thought to act as a biological force sensor). An example of man-made piezoelectric materials includes barium titanate and lead zirconate titanate.

In recent years, due to the growing environmental concern regarding toxicity in lead-containing devices and the RoHS directive followed within the European Union, there has been a push to develop lead free piezoelectric materials. To date, this initiative to develop new lead-free piezoelectric materials has resulted in a variety of new piezoelectric materials which are more environmentally safe.

Applications Best Suited for the Piezoelectric Effect

Due to the intrinsic characteristics of piezoelectric materials, there are numerous applications that benefit from their use:

High Voltage and Power Sources

An example of applications in this area is the electric cigarette lighter, where pressing a button causes a spring-loaded hammer to hit a piezoelectric crystal, thereby producing a sufficiently high voltage that electric current flows across a small spark gap, heating and igniting the gas. Most types of gas burners and ranges have a built-in piezo based injection systems.

Sensors

The principle of operation of a piezoelectric sensor is that a physical dimension, transformed into a force, acts on two opposing faces of the sensing element. The detection of pressure variations in the form of sound is the most common sensor application, which is seen in piezoelectric microphones and piezoelectric pickups for electrically amplified guitars. Piezoelectric sensors in particular are used with high frequency sound in ultrasonic transducers for medical imaging and industrial nondestructive testing.

Piezoelectric Motors

Because very high voltages correspond to only tiny changes in the width of the crystal, this crystal width can be manipulated with better-than-micrometer precision, making piezo crystals an important tool for positioning objects with extreme accuracy, making them perfect for use in motors, such as the various motor series offered by Nanomotion.

Regarding piezoelectric motors, the piezoelectric element receives an electrical pulse, and then applies directional force to an opposing ceramic plate, causing it to move in the desired direction. Motion is generated when the piezoelectric element moves against a static platform (such as ceramic strips).

The characteristics of piezoelectric materials provided the perfect technology upon which Nanomotion developed our various lines of unique piezoelectric motors. Using patented piezoelectric technology, Nanomotion has designed various series of motors ranging in size from a single element (providing 0.4Kg of force) to an eight element motor (providing 3.2Kg of force). Nano motion motors are capable of driving both linear and rotary stages, and have a wide dynamic range of speed, from several microns per second to 250mm/sec and can easily mount to traditional low friction stages or other devices. The operating characteristics of Nanomotion’s motors provide inherent braking and the ability to eliminate servo dither when in a static position.

Fig 4.3.D

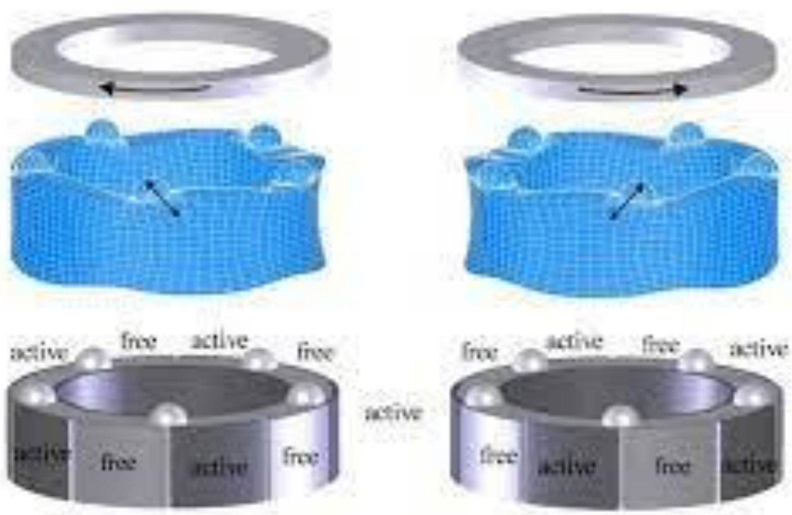


Fig 4.3.E

CHAPTER 5 : Material selected

Sr. No.	Part	Material
1	Rack and pinion	Alloy Steel (40Ni2Cr1Mo28)
2	Spring	High Carbon (SAE 1090)
3	Frame	Mild Steel
4	Rod	Mild steel
5	Tile / plate	Mild steel
6	Peizo Electric Transducer	Quartz

Table 5.A

CHAPTER 6: Calculation

6.1 Design of rod

Diameter of Bolt = 5mm

Material Of Bolt : Grade 2 Steel

σ_{UT} = 60000 PSI

F.O.S. = 4

$[\sigma_t]$ = 60000/4 = 15000 PSI

$[\sigma_{cr}]$ = 22500 PSI

$[\tau]$ = 51.71 N/mm^2.

$[\sigma_{cr}]$ = **F/A**

=F/ π/4xd²

155.13 = $F/\pi/4 x 5^2$

F = 3045.9 N

One bolt can carry **3045.9 N**

Therefore Total time can be Carried = 3045.9 N

Considering Average Weight of person 10 be 80kg which is 784.8 N

Then we can say that our system can easily take heavy load.

Checking for shearing in thread of the nut ,

$[\tau]$ = **F/A**

51.71 = $F/\pi d^2$

51.71 = $F/\pi \times 5^2$

F = 4061 N.

For 4 nut = 16245.17 > 784.8 N.

6.2 Top Plate

The considerations for selecting Suitable Size of Top Plate are follows

1) **It should be big enough to cover the components below .**

2) **It should not be too large than required as if it is too large then it will take more space and decrease the overall efficiency of the Assembly.**

3) **It should be large enough for a human foot to comfortably step on.**

4) **It should not be much larger than average size of human foot so that is doesn't cause interference to other things .**

5) **It should be strong enough so that any possible load variations or load concentration should not cause deformation.**

Considering the above requirement,

We have selected

22cm x 22cm x 0.1 cm

Bending In top Plate ,

Assume load to be 60 Kg = 588.6 N

There are 4 rods on edges which take the load

Load taken on each rod = 588.6/4 = 147.15 N

Assuming the load applied to be **Uniformly distributed load ,**

$\mathbf{W_o}$= 588/22 = 26.75 N/cm.

$\mathbf{BM_{max}} = W_0$ X 22/2/ x 22/4 -W/2 x 13/2

= 26.75 x 22^2/ 8 – 588.6/2 x 13/2

= | -294.375|

=294.575 Ncm.

$\boldsymbol{\sigma_b}$ **= M/Z**

$= M/bh^2/6$

$= 294.575 / 22x\ 0.1^2 / 6$

$= 8033.86\ N/cm^2$.

$\boldsymbol{\sigma_b} = 80.33\ N/mm^2$.

6.3 Rack and pinion

The following considerations were taken into account for selecting a suitable rack and pinion :-

1) **The rack and pinion did not have too much of a strength requirement .**

2) **It should not rust easily.**

3) **It should be easily available .**

4) **The budget of the project should be considered.**

Considering the above ,

We have selected a rack and pinion which we had already available to us so we did not have to buy a separate unit.

Rack length = 13.5 cm.

Pinion : No. of teeth = 38

Pitch circle diameter = 57

Module = pitch circle diameter / no. of teeth

= 57/38

=1.5mm.

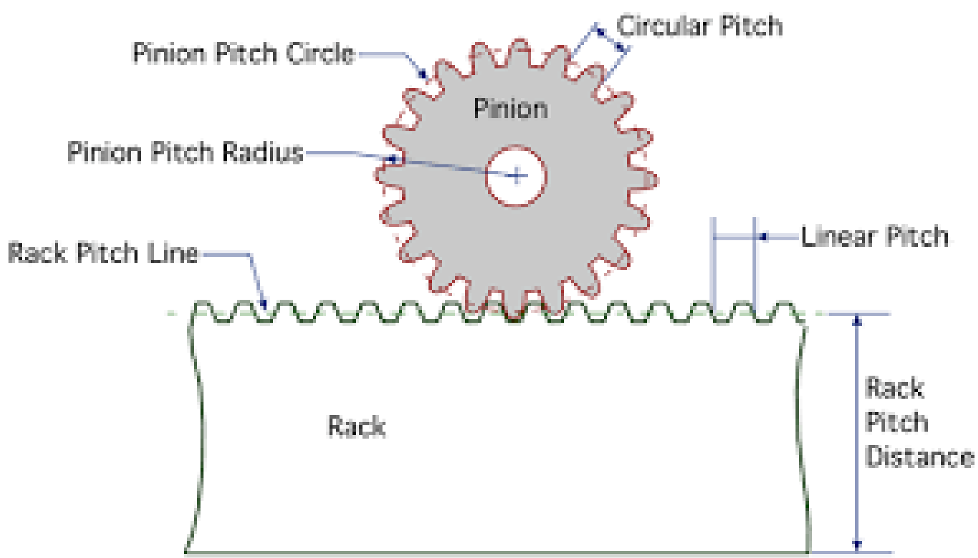


Fig. 6.3.A

6.4 L-Rod

We used L rod to hold the rack in place in the assembly.

Length = 10.5 cm.

Thickness = 3mm.

The Centre rod (frame),

A centre rod is needed to hold the assembly.

Its consist of 2 parts : **Male rod**

Female Rod

The male rod would be welded to top plate.

The female rod would be welded to the bottom plate.

1. **The main purpose of this is to provide rigidity to the assembly.**

2. **It does not have much of strength requirement as most of the load would be carried by the 4 side rods.**

3. **It should provide good up and down motion smoothly.**

4. **Even though it does not have much strength requirement, a strong material must be selected as it is part of the main frame and it must be long lasting.**

Considering the above,

Selecting M.S. square rod (hollow) for both male and female part.

Male part dimension :-

1.5 cm X 1.5 cm

Thickness = 2mm Length = 10 cm

Female part dimensions :-

2.5 cm x 2.5 cm

Thickness = 2mm

Length = 12.5 cm.

6.5 Power Generated in motor

Force I generated when someone step on the top plate thus applying weight. This weight is in kg and can be taken as

F = m x g in (N)…………… (1)

Where,

m = weight of person

g = acceleration due to gravity

The pitch circle diameter of gear is known to us.

Therefore torque can be calculated by,

T = R x f in (Nm)……………………………(2)

Where ,

R= radius in (m).

Power can be calculated using the torque

We obtained previously

P = T x ω In (W)……………………..(3)

Where, **ω** = angular velocity = **2πN/ 60.**

P = Power generated in one stroke

If,

X = no. of steps on the top plate in one minute

Then,

Total power ,

Generating in one minute = **P x X**

= **P x X**

And Total power generation in one hour = **P. x/60**

Compiling the above steps ,

$\mathbf{P_T = P}$

$= \mathbf{T \times \omega}$

$= \mathbf{r \times F \times 2\,\pi\, N/60}$

$= \mathbf{r \times m \times g \times 2\,\pi\, N/60}$

$= \mathbf{2/60 \times r \times m \times g \times \pi \times N}$

$\mathbf{P_T = r \times m \times g \times \pi \times N /30}$

In the above equations,

1) **π** and **g** are **constants.**

2) for a given system,

R and **N** are also **constant**

Therefore the remaining variable which can cause a change in power is **m** (mass)

Therefore power obtained can be called as **a function of mass.**

Examples for power generated for different mass (m)

Given :

R = 28.5 mm

$= 28.5 \times 10^{-3}$ m

= 0.0285 m.

N= 20 rpm

Assuming no. of steps in one minute (x) = 10

1) for m= 60 kg

$\mathbf{P_T = r \times m \times g \times \pi \times N /30}$

$= 0.0285 \times 60 \times 9.81 \times 3.14 \times 20 / 30$

= 35.11 W.

Total Power generated in one minute

= 35.11 x X

= 35.11 x 10

= 351.1 W.

2) for m =50 kg

P_T= r x m x g x π x N /30

= 0.0285x 50 x 9.81 x 3.14 x 20 / 30

= 29.26 W.

Total power in one minute = 29.26 x X

= 29.26 x 10

= 292.6 W.

3) for M = 40 kg

P_T = r x m x g x π x N /30

= 0.0285 x 40 x 9.81 x 3.14 x 20 /30

= 23.41 W

Total power in one minute = 23.41 x X

= 23.41 x 10

= 234.1 W.

Power increase feom 40 kg to 50 kg ,

= 8.77 – 7.023
=1.747

Power increase from 50 kg to 60 kg ,

= 10.534 – 8.77

= 1.764

Therefore the power increase as mass increases at a constant rate .

Peizo electric power generation,

No. of peizo sensors = 4

Peizo sensors are connected in series ,

Let $\mathbf{V_1}$, $\mathbf{V_2}$, $\mathbf{V_3}$,and $\mathbf{V_4}$ be the voltage generated by the four peizo sensors.

Since the load acting on all sensors is same

$\mathbf{V_1=V_2=V_3=V_4}$

We know that,

Total voltage generally any peizo electricity 50 kg

Total voltage measured = 5 V

$5= V_1+ V_2 +V_3 +V_4$

$5 = 4 (V_1)$

$V_1 = 5/4$

$V_1 = 1.25$ V

$V_1=V_2=V_3=V_4= 1.25$ V.

CHAPTER 7: RESULT

1) Power developed in the system

Force (kg)	Power generated in one step	Power generated in one minute
40	23.41 W	234.1 W
50	29.26 W	292.6 W
60	35.11 W	351.1 W

Table 7.A

2) Voltage generated in motor in one step = 7 V

3) Voltage generated in one step = 5V

4) No. of peizo sensors connected in series = 4

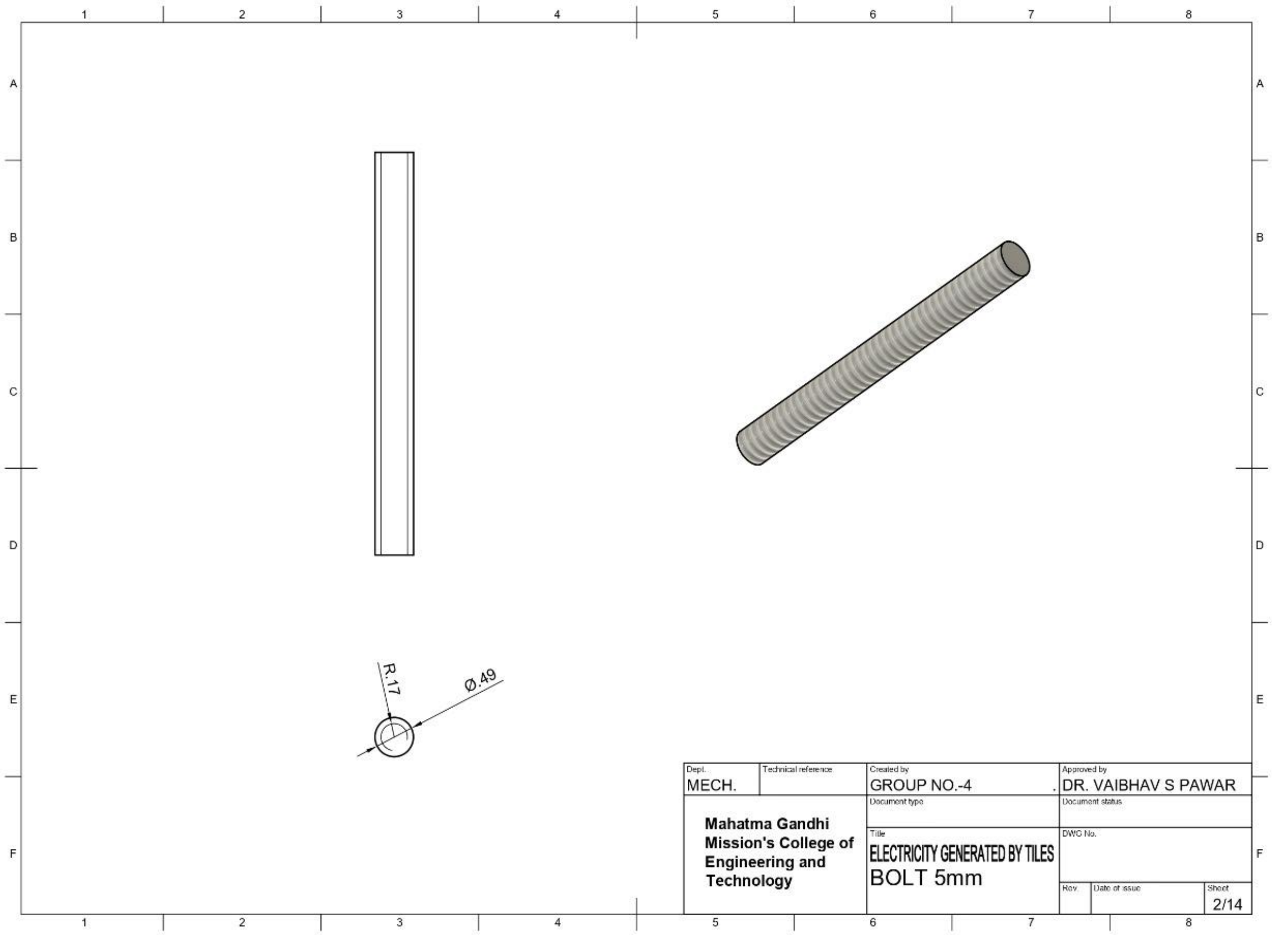
5) Voltage generated in one sensors = 1.25 V

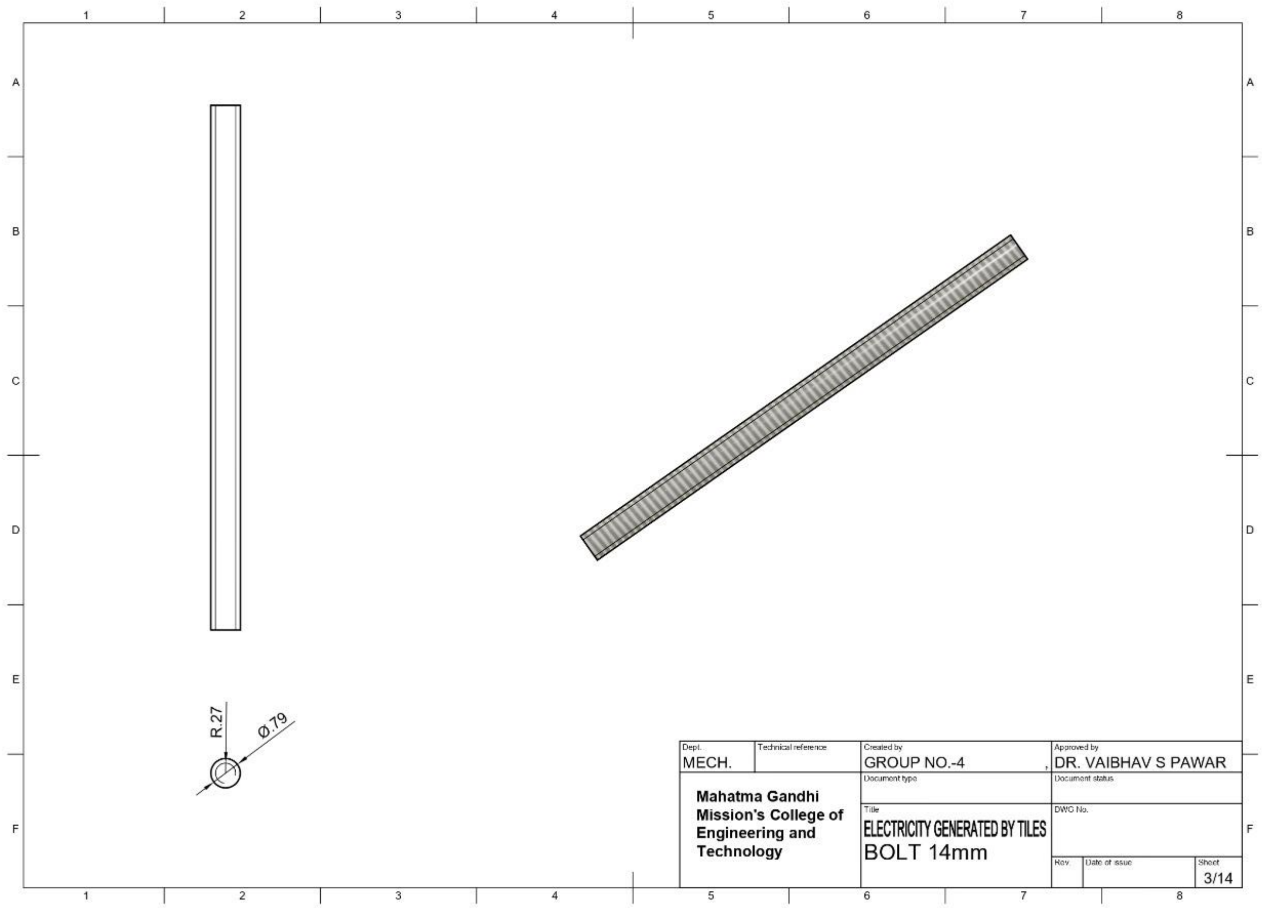
6) Time required to charge a battery:-

Batteries (Ah)	Ideal Time (hrs)	Actual time (hrs)
10	7 hrs 8 min 24 sec	10 hrs
20	14 hrs 16 min 48 sec	20 hrs
30	21 hrs 25 min 12 sec	30 hrs
40	28 hrs 31 min 2 sec	40 hrs

Table .7B

CHAPTER 8 : DRAFTING

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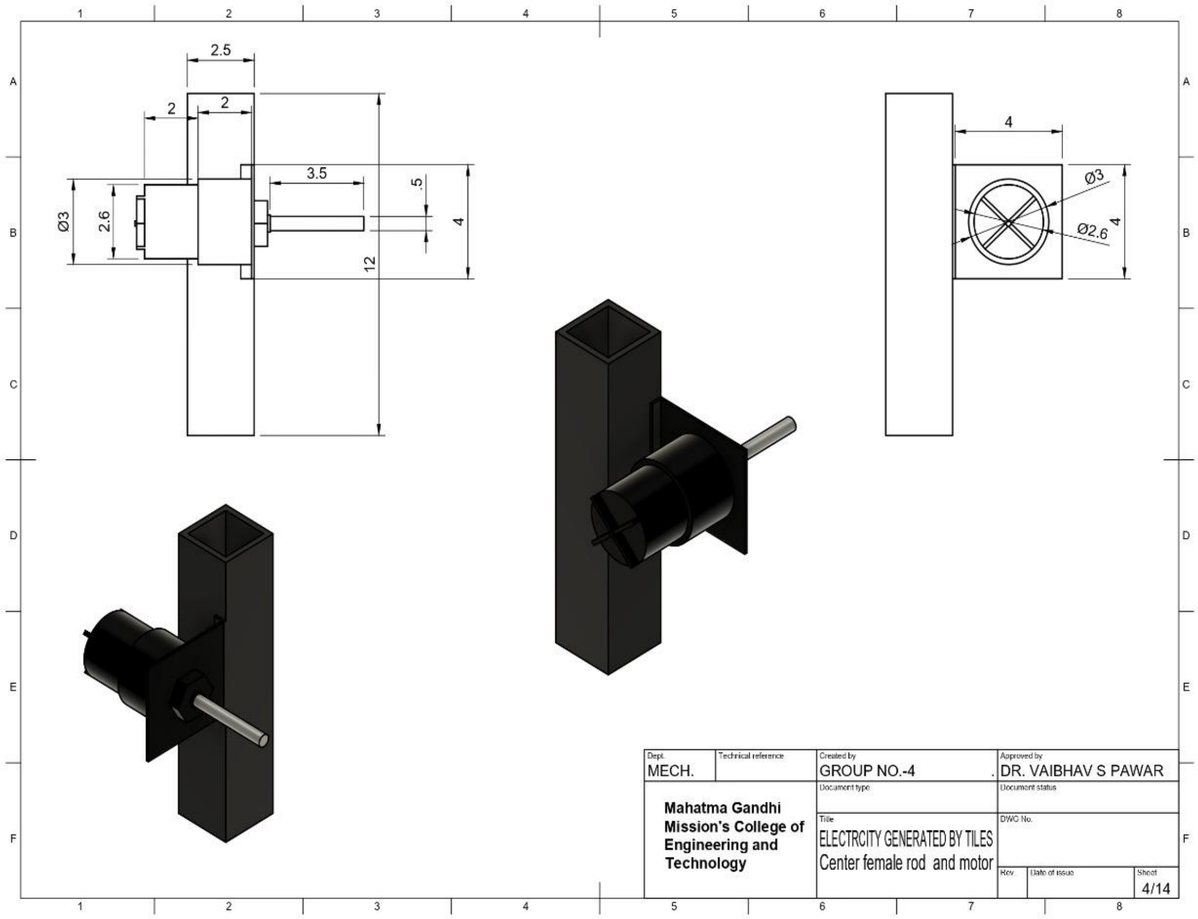
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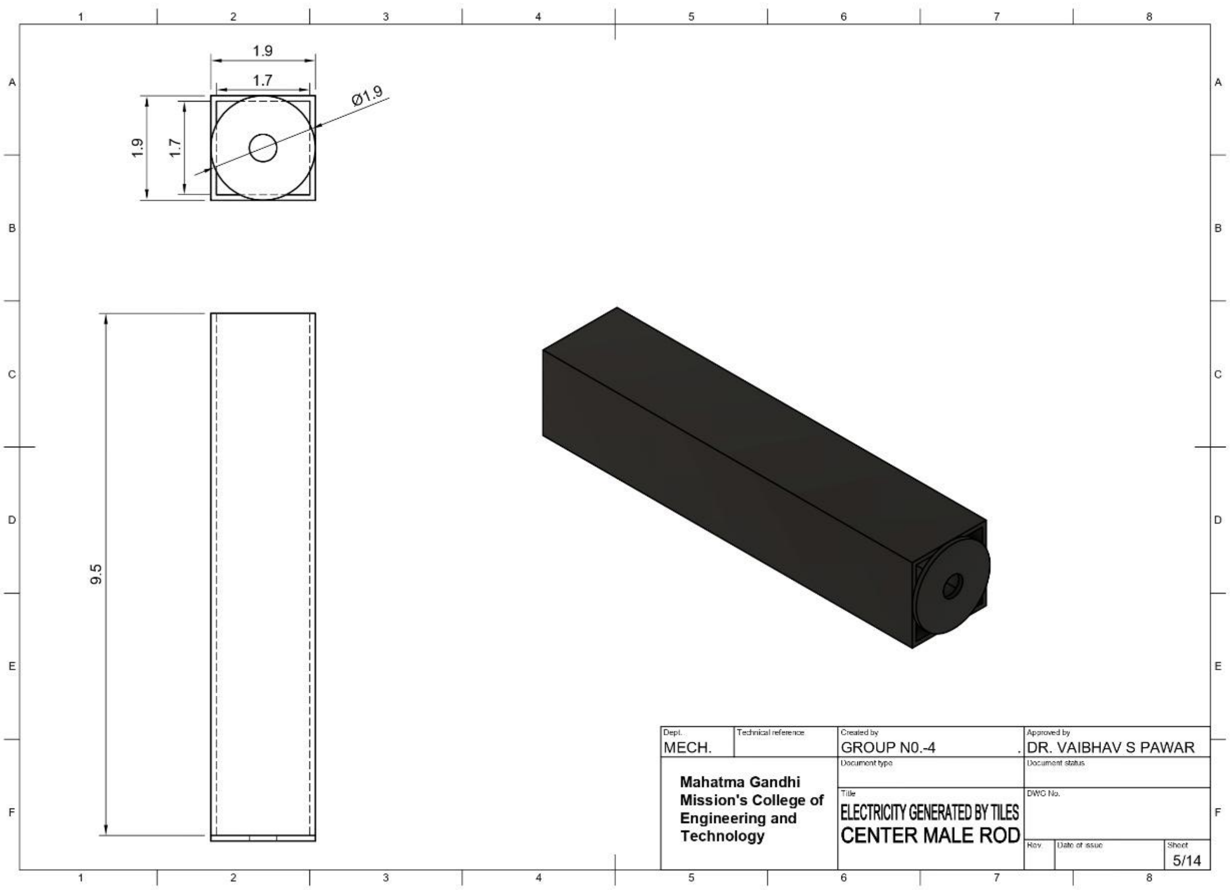
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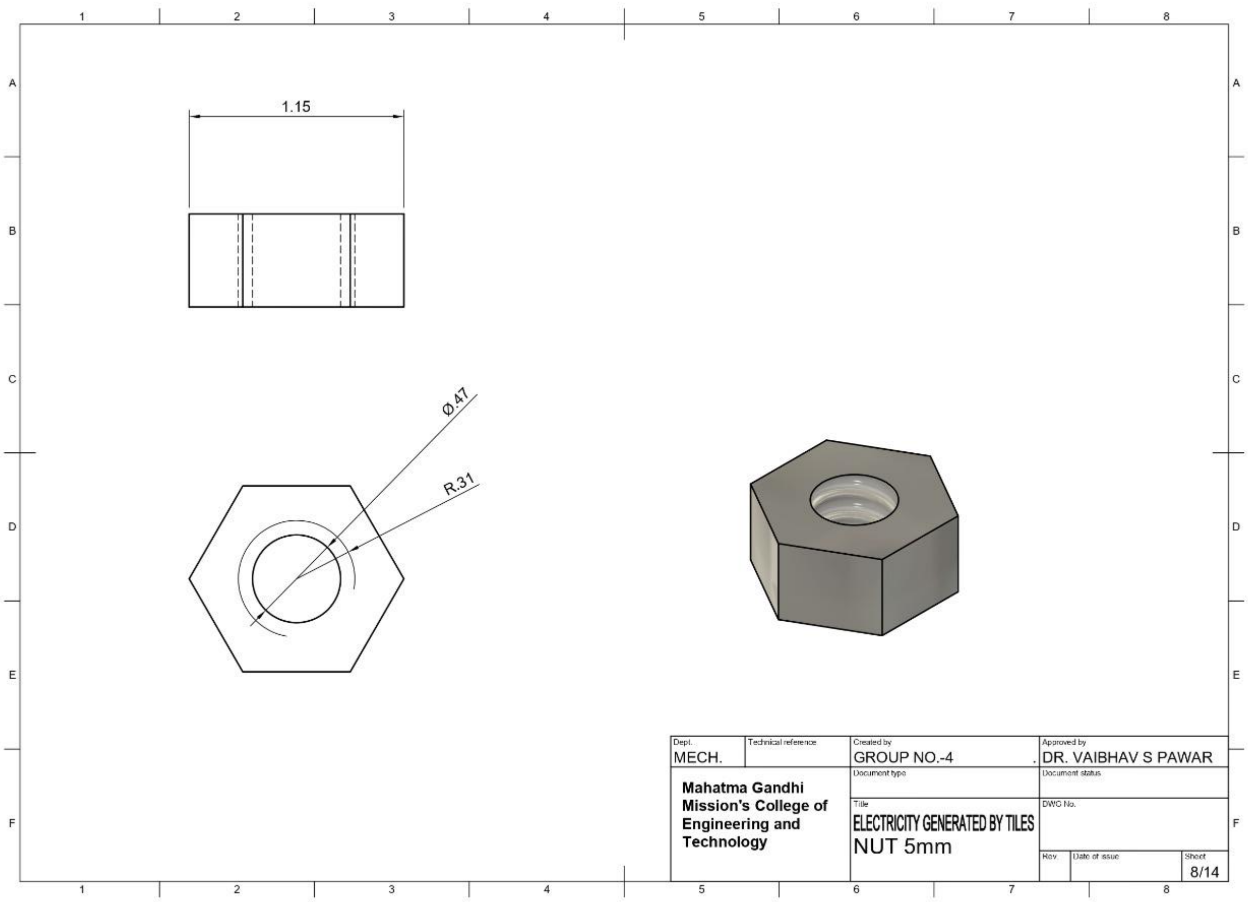
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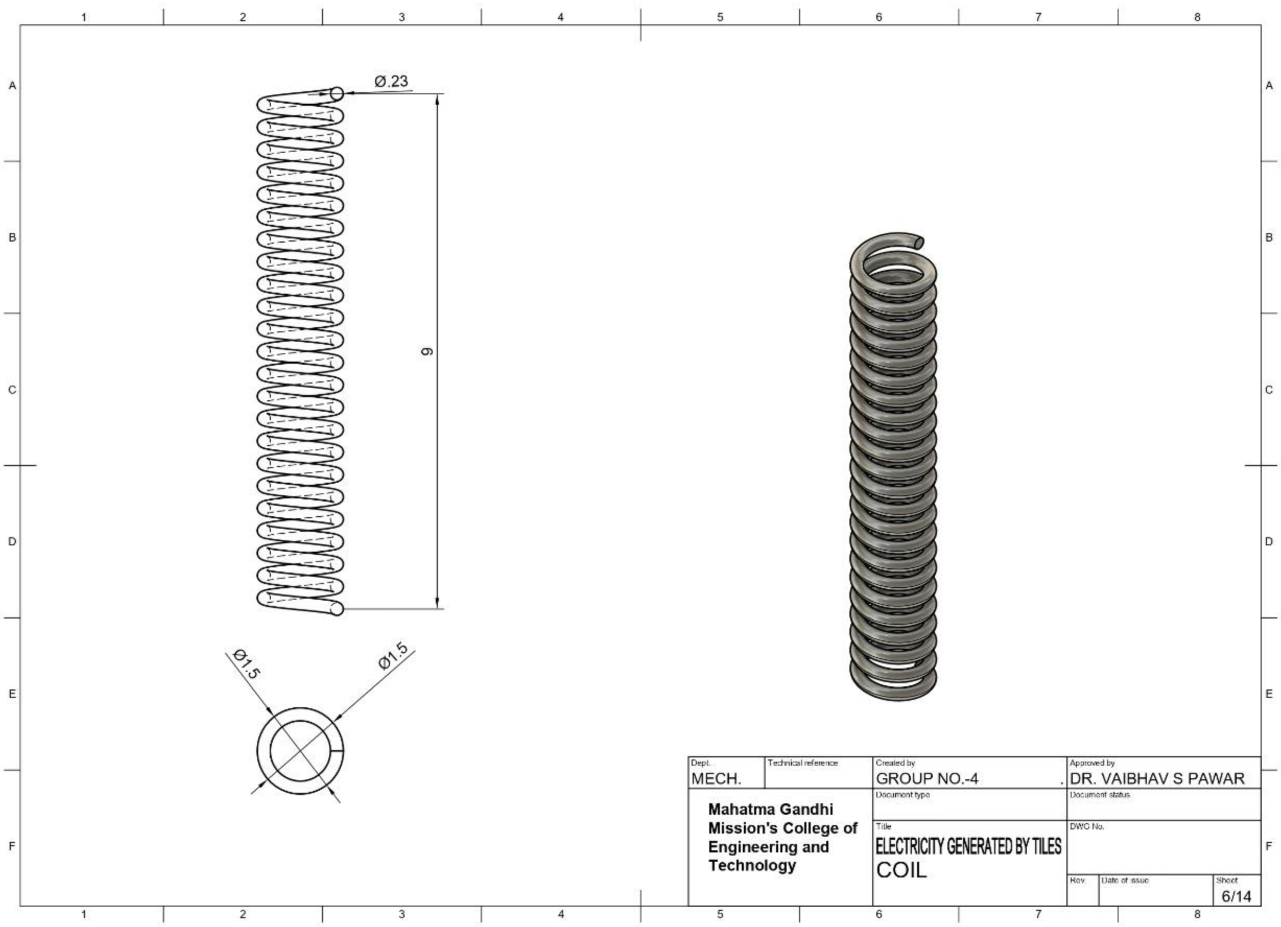

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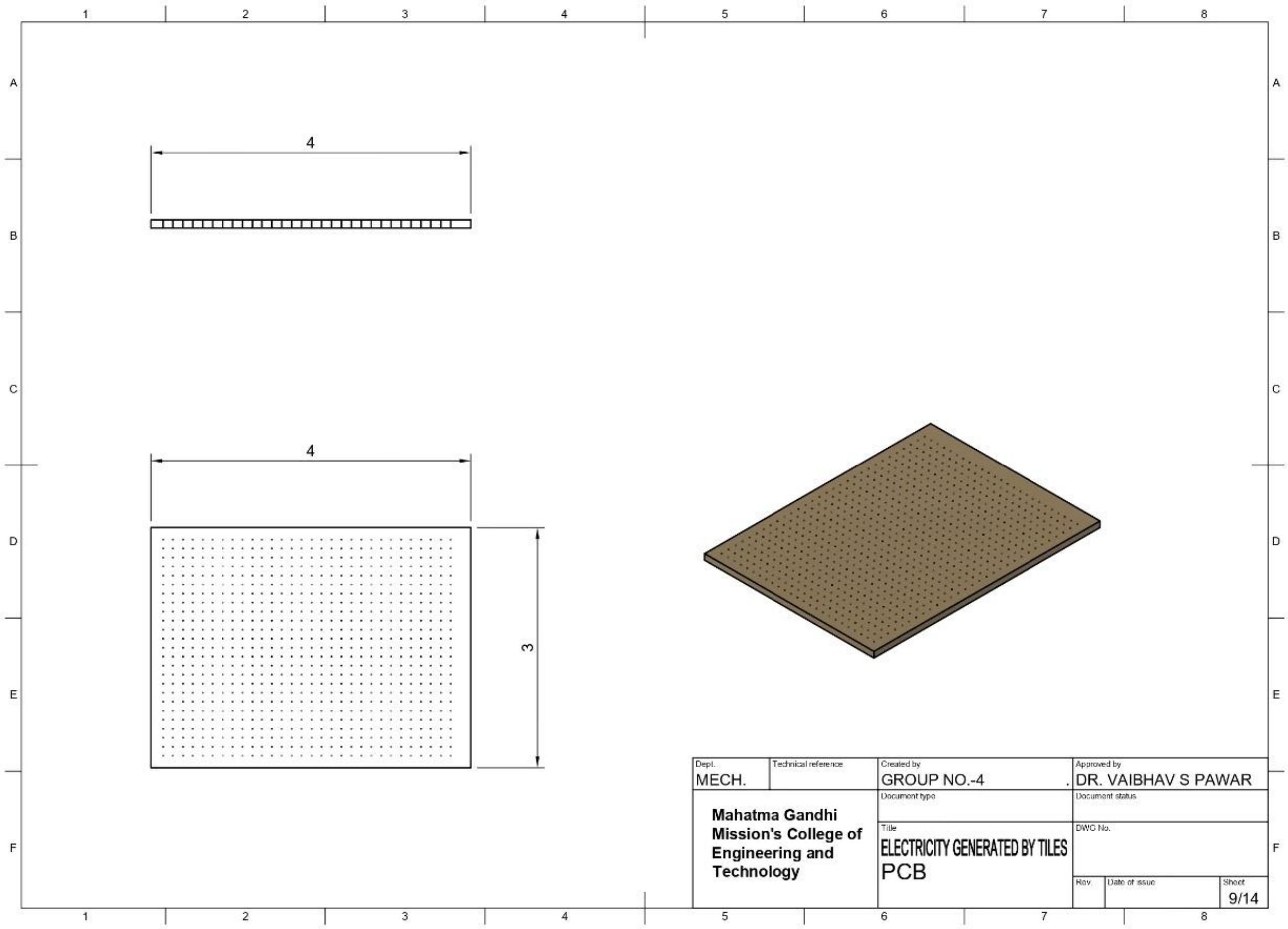
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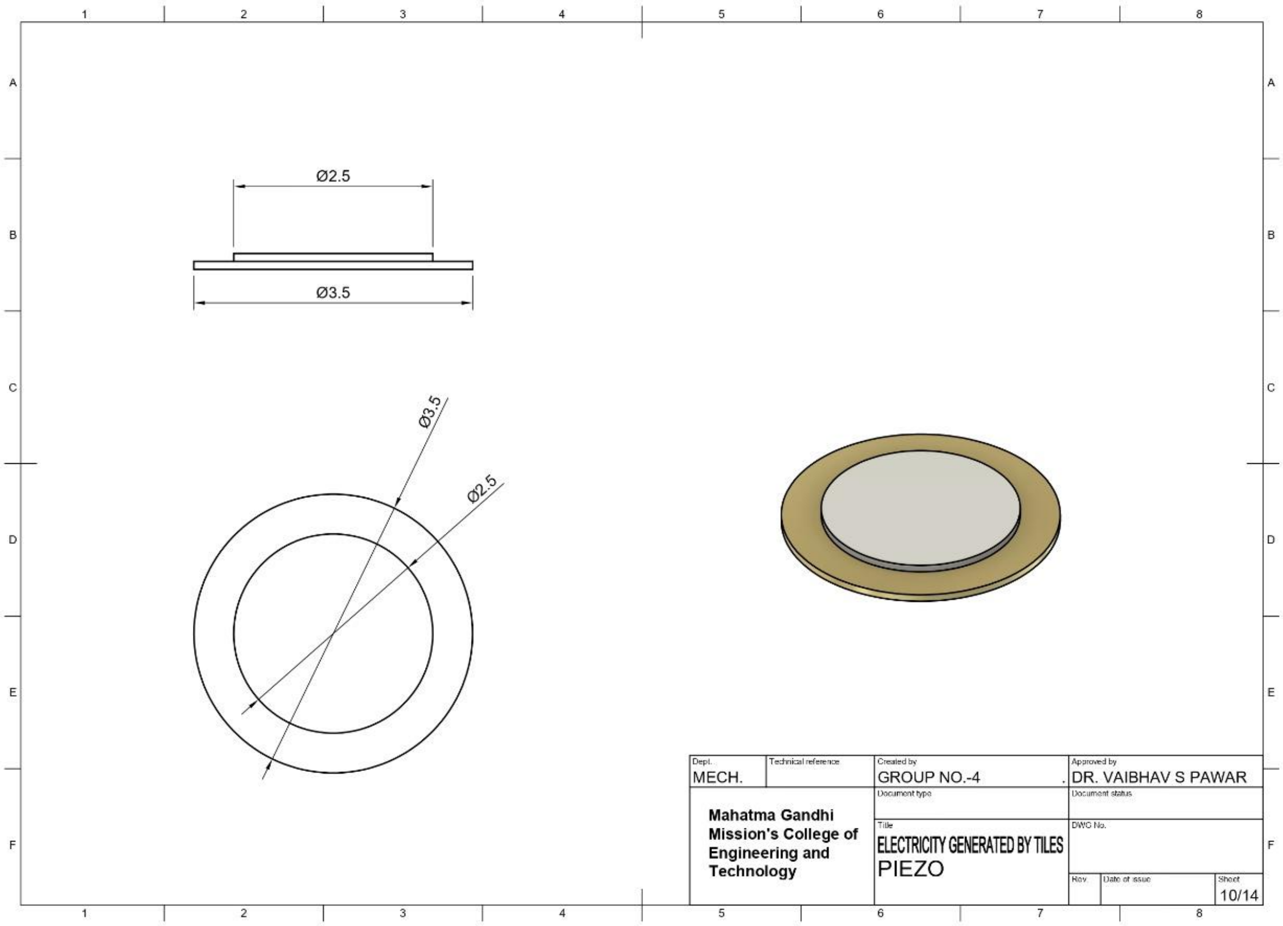

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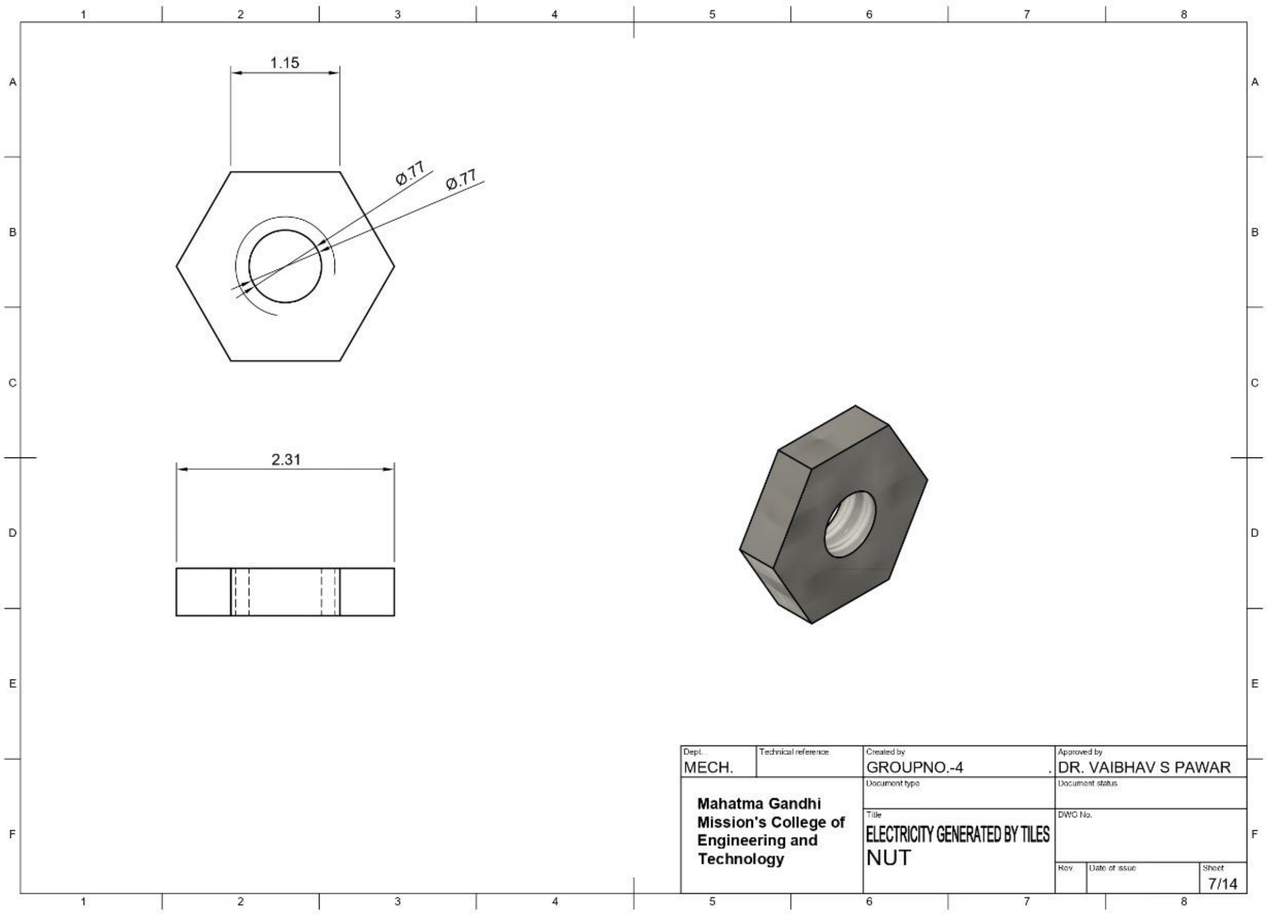
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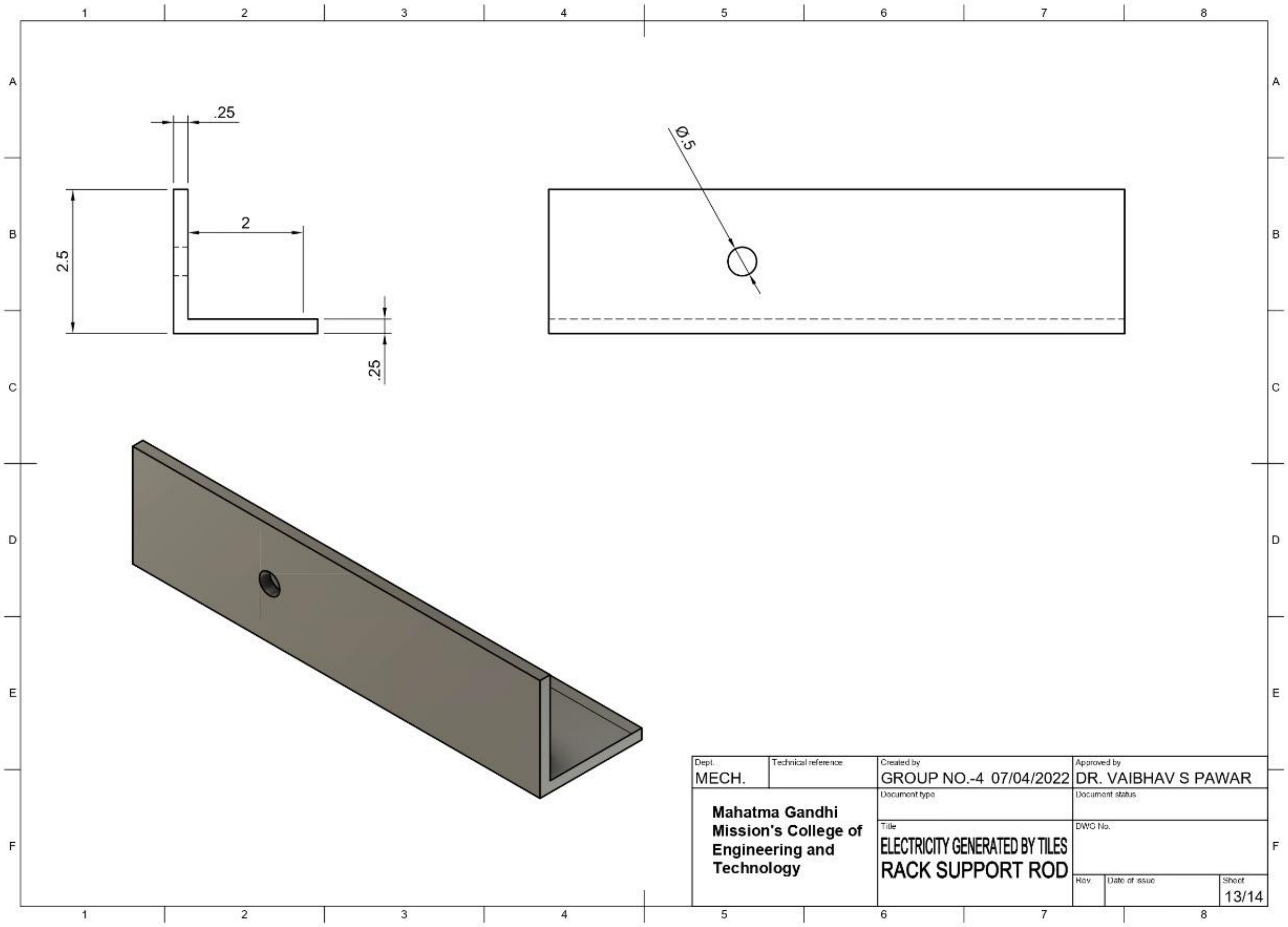

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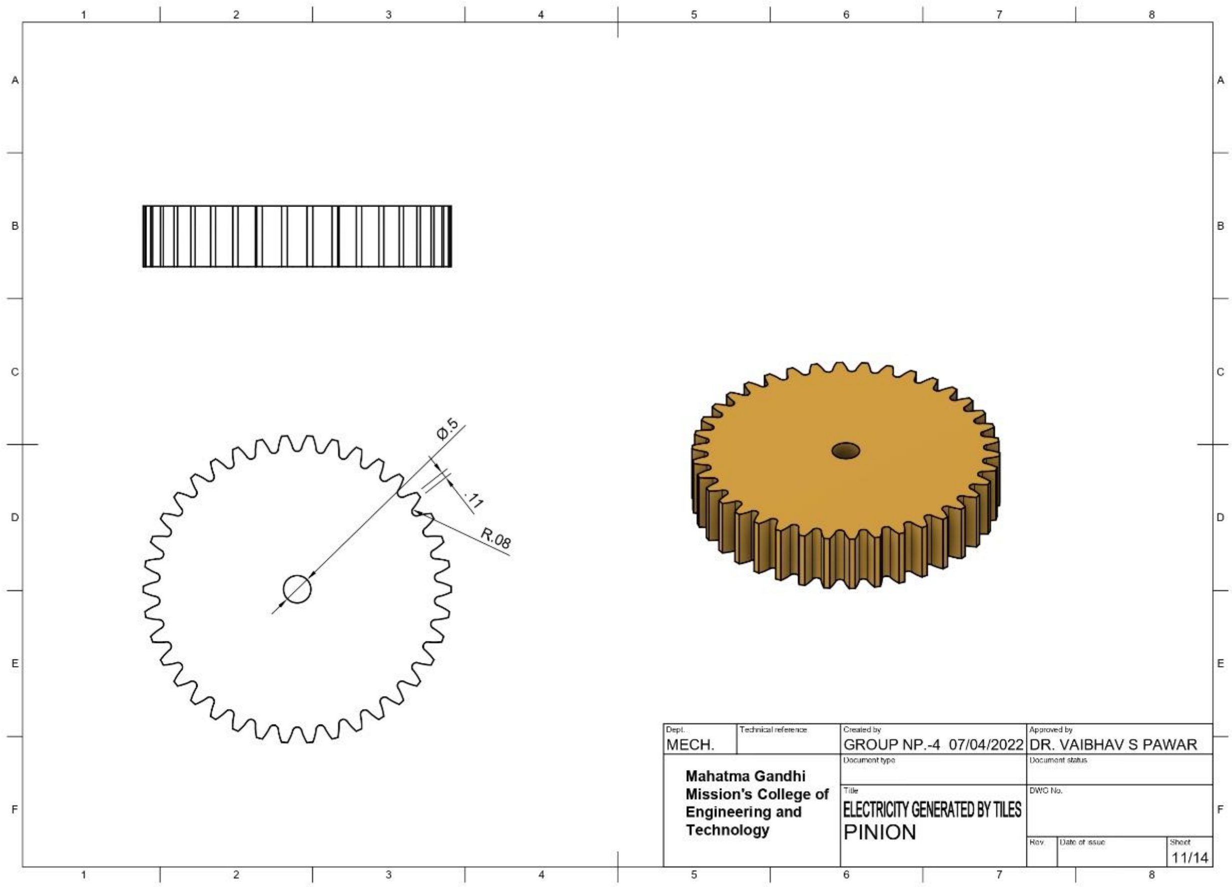
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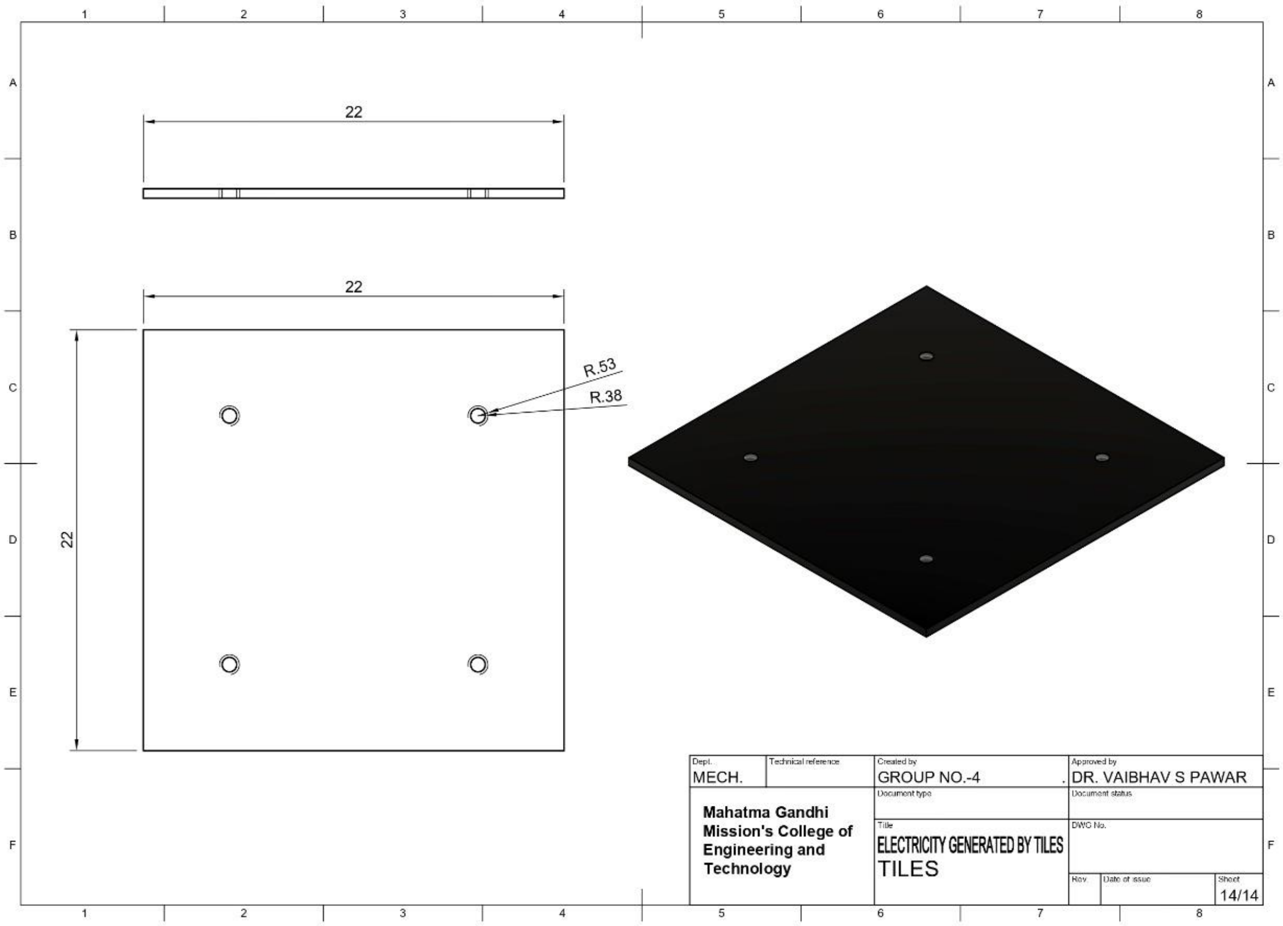
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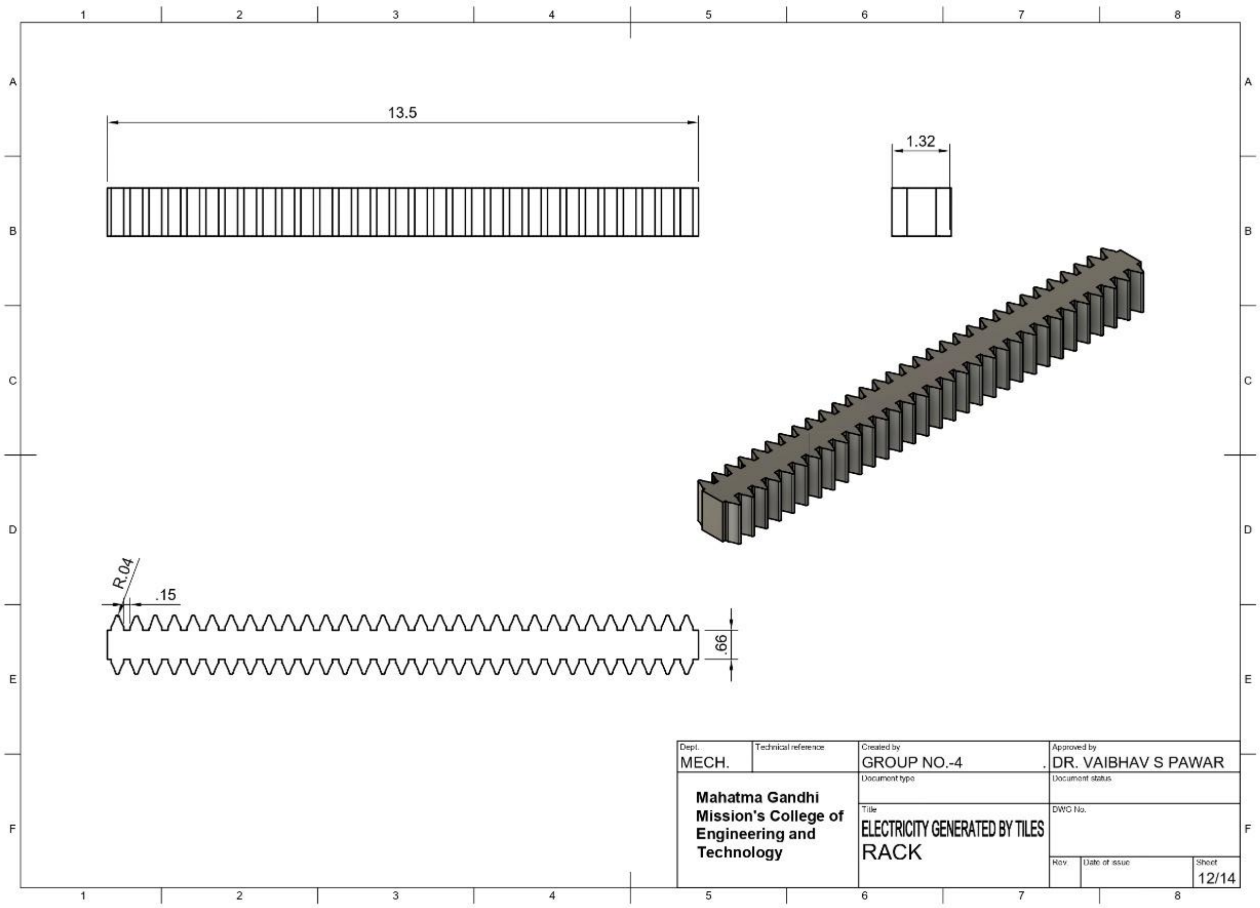

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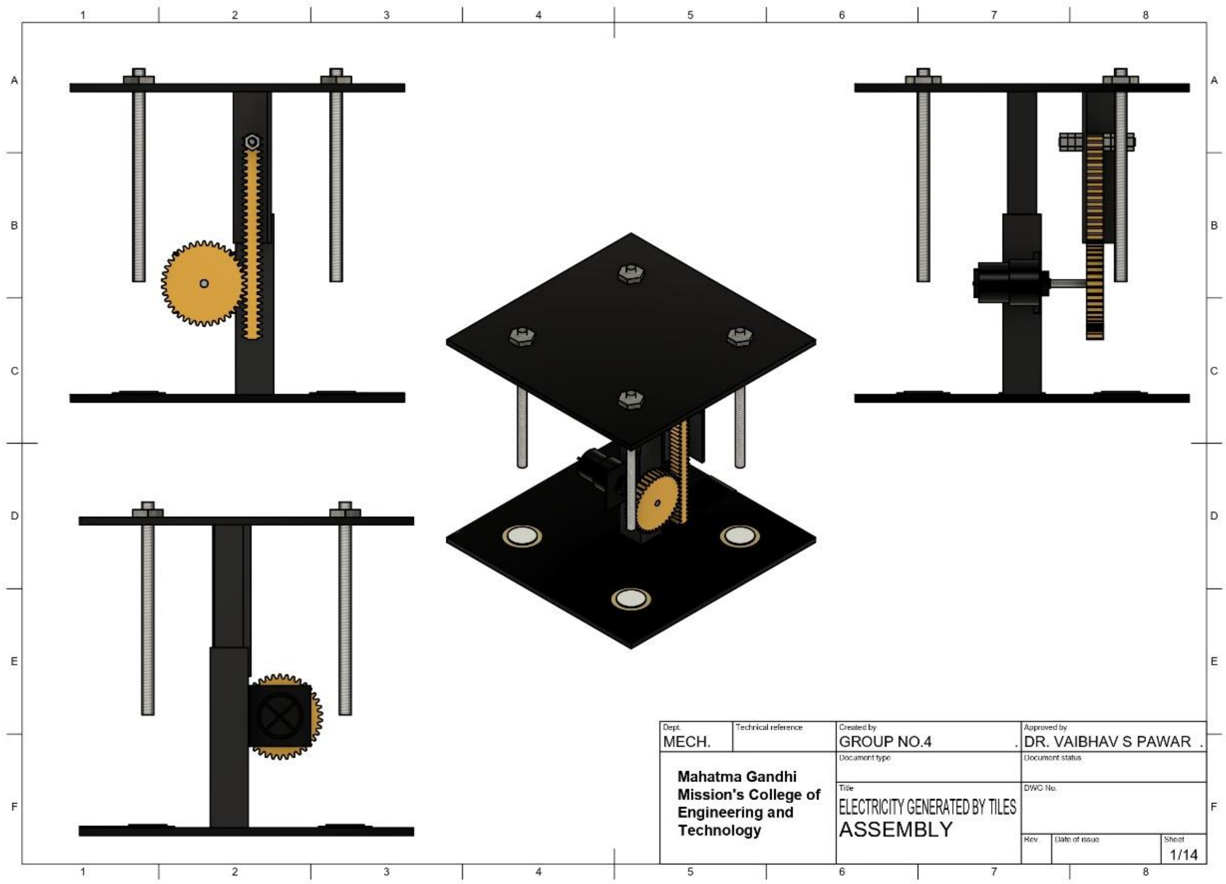

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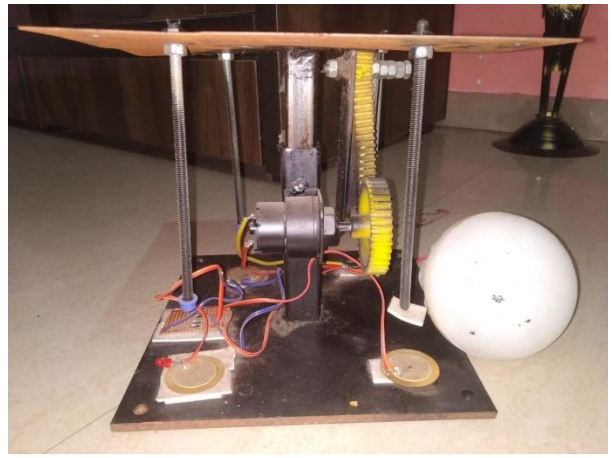
CHAPTER 9: CONCLUSION

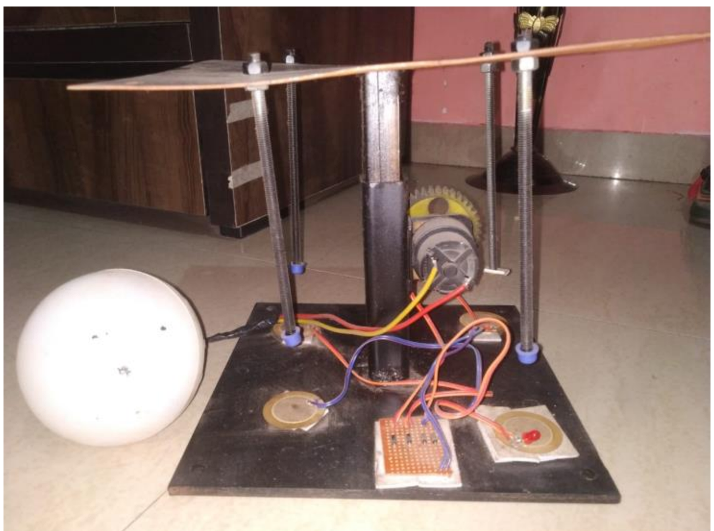
Mechanical Footsteps Power Generator is a risk-free electricity generation system. Much of the energy that is wasted when people are moving is well utilized and transformed to electrical energy which can be used in schools and other institutions. This method of power generation is cost effective when used continually. Basically, the cost efficiency is realized in the long term. This method of power generation can be installed in areas such as malls, schools, colleges, at the railway stations or any other areas where people movement is intensive.

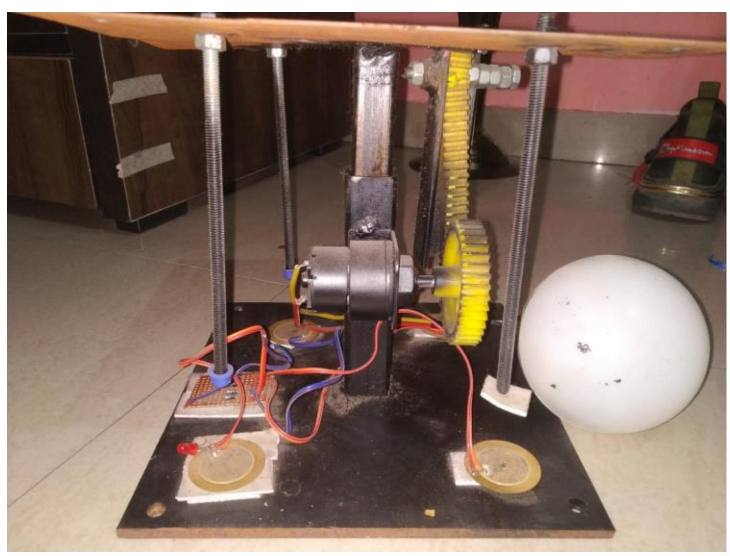
The production of electricity using this method is environmental conservative because power is produces without polluting the environment. Also, the power that is wasted by human while working is utilized by this system to produce electricity. Therefore, the system ensures maximum utilization of available energy. The energy source is renewable and is available continuously. Therefore, the method is very convenient than other methods of power generation. The power generated by this system can be used in the rural areas. The method is also very eco-friendly; the production does not require fueling, that produce smoke and other pollutants. The tests that have been done so far have confirmed that the system is best because being provides affordable energy solution to people.

Although the method seems advantageous in most aspects, the amount of power that can be generated by this system may not be used in places where mass electricity is needed. Therefore, the system can only generate power for lighting and powering simple electricity gadgets. However, more improvement can be done to increase its production such as coming up with a method of stepping up the generated power.

WORKING MODEL







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