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Design and Manufacturing of Power Generation from Turnstile

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ABSTRACT

This project presents a comprehensive analysis of the turnstile gate mechanism, focusing on its design, functionality, applications, and engineering considerations. Turnstile gates play a crucial role in crowd control and security, and they have the potential to harness mechanical energy for electricity generation. This report helps valuable insights for engineering projects that involve turnstile gate systems. Turnstile gates are a common sight in various public spaces, including transportation hubs, stadiums, and secure facilities. They are designed to allow the controlled passage of individuals while preventing unauthorized entry. In recent years, engineers and designers have explored the possibility ofusing turnstile gates to generate electricity through the mechanical energy generated by users passing through.

Keywords: Dynamo, Power Generation, Sprocket, Turnstile Gate

INTRODUCTION

Increase in the demand of electric power and pollution due to production of electric power have sidetracked the world to focus on the green energy generation which would satisfy the need without polluting the environment. Though there are various form of green energy. This article targets on unused manual work into use full energy in this context Turnstile structure is taken to serve the above purpose. Turnstile structure is usually used to control the entry of people one after the other and to restrict the entry of animal. Normally these Turnstile are deployed in the places which are frequented by people such as railway stations, parks, tourist place, commercial mall, officers etc. Hence each time when a person enters via Turnstile it will rotate and this manual work is converted to electrical energy without any pollution. A prototype is designed and deployed in our workplace; electric power generated. This system seems to be fruitful solution for generating green energy in the cost-effective manner. The operation of turnstile gates typically involves the rotation of arms or barriers in a one-way direction. Users must present a valid credential or make a physical rotation to gain access. The mechanical components and locking mechanisms are designed for reliability and long-term use. Generating power from turnstiles involves harnessing the mechanical energy created when people pass through them. This energy can be converted into electrical power through various methods. One common approach is using kinetic energy harvesters. power generation from turnstiles works.

During the last decades, the interest in generating clean energy by unconventional methods has grown due to the high electricity demand, especially in urban areas. In this context, several strategies for the conversion of mechanical energy to electrical energy have been identified. Electricity generation from waves and generated electric power, from a wheel, to be used in the public transport system. Besides, other authors proposed the generation of electrical energy using Dynamometer. Designed and built a power generator through a system of mechanical Sprocket, chain drive, and dynamometer.

- **Research Articles**

Paz-Penagos H Electric power generation from a turnstile This research aimed to design, simulate in SolidWorks, build, and test two energy conversion mechanisms using mechanical gears and through 0 neodymium magnets. Theused source of mechanical energy was the rotational movement of the turnstile arm, generated by pedestrians who enter and leave the campus at Escuela Columbiana de Ingenieria Julio Garavito. To achieve it, the following tasks were performed: the literature review, parameterization of pedestrians' entrance and exit, characterization of the turnstile, simulation, construction, and the assessment of the mechanisms. The obtained energy conversion resultsvaried from 7v to 11v (1W) for

the mechanism using neodymium magnets, and from 12v to 17v (12W) for the mechanical gears. The developed system aims to promote environmental commitment and exploit the lost energyresulting from people's daily activities.

Saucedo et al. evaluated electricity generation from waves and generated electric power of 20V, from a magnetic wheel, to be used in the public transport system. Besides, other authors proposed the generation of electrical energy using piezoelectric devices. Furthermore, Márquez and Tlatelpa designed and built a power generator through a system of mechanical gears, chain drive, and alternator output to be used in the mass transport system in Mexico. Thus, 747.5 W were generated from a single turnstile of the station "Indian Green", for one hour. Moreover, Ahmadet al designed and fabricated a power generator induced by the movement of a door to charge a smartphone; as a result, it generated a voltage of 11.54V, which was enough to meet the target.

Blanchette and Al-Haddad implemented a permanent magnet generator of a double rotor with a magnetic gear to collect wind power directly without mechanical conversions; as a result, a prototype of a compact generator of 2,5kVA was proposed, which could be coupled directly to the source. Finally, Sepulveda designed and manufactured a power generator based on rotary piezoelectric, through a polygon-shaped gear. The power generator was built usingthe pair of the axle of the pedals of a gym's static bike. A previous device was developed to feed the control circuit ofthe bike. Therefore, a power of 16mW was generated, for an average input of 300 revolutions per minute.

Generating Electricity Using Piezoelectric Material Jedol Dayou, Man-Sang, C. , Dalimin, M. N. & Wang, S. This paper discusses the use of piezoelectric material to generate electricity. This includes the basic theoretical modelling of the electrical power generation mechanisms and optimization of the piezo-host system. It is shown that with proper configuration, a single piezo-film can generate enough electrical density that can be stored in a rechargeable battery for later usage. In this paper, a theoretical model on the generation mechanisms of electricity by piezoelectric material attached to a flexible structure has been developed and tested experimentally. The Euler-Bernoulli method was proven to be the most appropriate model in reference to the experimental data and its practicality. The piezo-host configuration was then optimized with huge increment in the voltage output. With the configuration optimized, the voltage and current density from the piezoelectric were made high enough to be stored in a 1.2V-2500 mAh nickel metal hydride battery for later applications.

A mechanical design of power generator using door openings for household use Electricity is one of the most important human resources in the life of today's human being. It keeps the lights on, air conditioners and fans runningthroughout the hot weather and connecting people through smart phones. These household appliances will be causinghigher dependency on electricity among consumers. The electricity requirements are hiking at alarming rate where the fossil fuels and other conventional resources that are being used for generation of electrical energy may no longerbe sufficient to keep pace with increasing demand of the electrical energy of the world. This power generation depends on fossil fuel which also causes pollution and changes to the global climate. Thus, the main objective of this study is to propose a mechanical design of power generator which the input is from the movement of door openings. The power generator is designed and fabricated through various manufacturing processes and it consists of bevel gears, shafts and wheels. The power generator is then attached to a moving door and connected to a voltmeter. Result shows that the power generator is able to generate approximately of 12V and this is sufficient to charge a smart phone. To conclude, the designed power generator is not only environmentally friendly but also has potential to be used by households because of its simple input requirement and small in size.

MATHEMATICAL CALCULATION

Let the Force put by human hand on turnstile = 5 kg. and rotational rpm = 30 rpm5 x 9.815 = 50 N

Torque calculations
T= F x Radius of turnstileT = 50 x 300
T1 = 15000 N-mm
Now, Chain sprocket of 44 and 18 teeth is mountedSo, ratio: 2.44
T2 = T1 / 2.44 = 6147.54 N-mmN2 = 73.33 rpm

Therefore, Speed of Bigg Pulley will be 73.3 RpmDiameter of Big pulley = 300 mm
Diameter of Dynamo pulley = 60mm Velocity ratio = 300: 60
= 1:5
T3 = T2 / 5 = 6147.54/5 = 1229.50 N-mm

Therefore, Speed of Dynamo Pulley = 73.3 x 5 = 366.65 Rpm.
So, we will buy 300 Rpm standard dynamo from the market, which will produce 10 watts power at his fullspeed.
Calculation for Theoretical Power$P=2\pi NT/60$

$P=2\pi x366.65x1.2/60$
P = 45.99 watt.

Below chart describes the material used to manufacture the testing setup.

RAW MATERIAL & STANDARD MATERIAL

SR NO	PART NAME	MAT	QTY
1.	SQUARE TUBE	MILD STEEL	10 KG
2.	SHAFT	MILD STEEL	5 KG
3.	SPRAY PAINT	STD	1 NO
4.	NUT BOLTS	STD	1 KG
5.	BELT	STD	1NO
6.	CHAIN	STD	1 NO
7.	DYNAMO	STD	1 NO
8.	SHEET	MILD STEEL	5 KG
9.	WIRES	COPPER	2 M
10.	BEARING	MILD STEEL	4 NOS
11.	FREEWHEEL	STD	1 NO
12.	PEDESTIAL BEARING	STD	4 NOS
13.	PULLEY	STD	2 NOS
14.	PIPE	MILD STEEL	3 KG
15.	MISCELLINOUS	-	-

Fig. 4 Material Sheet

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RESULTS

With the help of above two methods which used to analyse the performance of Frame, ARM and Shaft the results from Ansys are below based on the Static Structural the results are below-

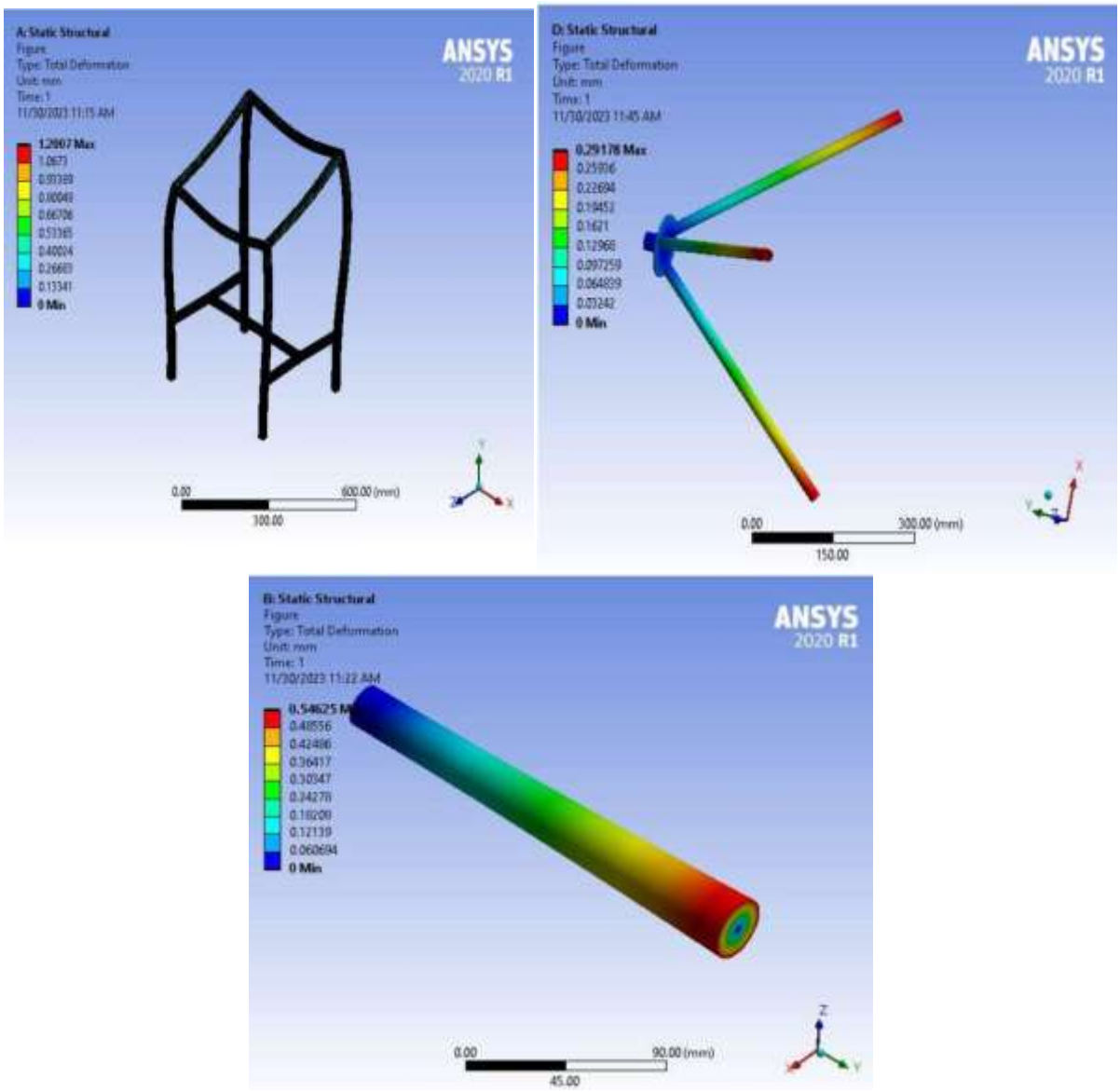

Fig. 5 Force measurement in Ansys

Final Model

CONCLUSION

Turnstile gate mechanisms are versatile and serve essential roles in crowd control and security. Recent innovations in energy generation through turnstile gates offer an exciting opportunity for sustainable energy solutions. Proper engineering design, careful consideration of energy conversion methods, safety measures, and maintenance planning are essential for the success of projects involving turnstile gates. As technology continues to evolve, the potential applications and benefits of turnstile gate mechanisms are likely to expand, making them a promising area for engineering projects. Stylish half-height sensor barrier designed for public and commercial buildings and airports that need efficient turnstiles. It features durable, high-quality materials, full access reader and destination control integration, stylish lighting options, and visual guidance alternatives. To complement our security turnstiles as well as easy-to-install guidance barriers can be added to a turnstile access control system.

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