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Design and Fabrication of Green Power Appliance: Mechanical energy to electrical energy conversion and its real-life usage.

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Abstract

This project aims at designing and fabrication of a Green Power Appliance that utilizes power from human work mainly fitness equipments and harness it into consumable electric energy. Utilizing the maximum amount energy by depleting minimum resources is the objective of any industry. It is being perceived that human tend to dissipate energy into the environment by doing mechanical work on fitnessequipments. The present subject emphasizes on the consumption of such energy and converts it into consumable power. The idea disclosed is a portable assembly of dynamometer and rectifier which takes mechanical energy as the input and convert it into standard electrical energy, which further gets stored into a battery and later, can be used to charge electronic devices as the output. This method can also be applied on community scale by connecting to the main grid so that the power generated is then community owned. Hence, social aspects of producing green energy can be justified.

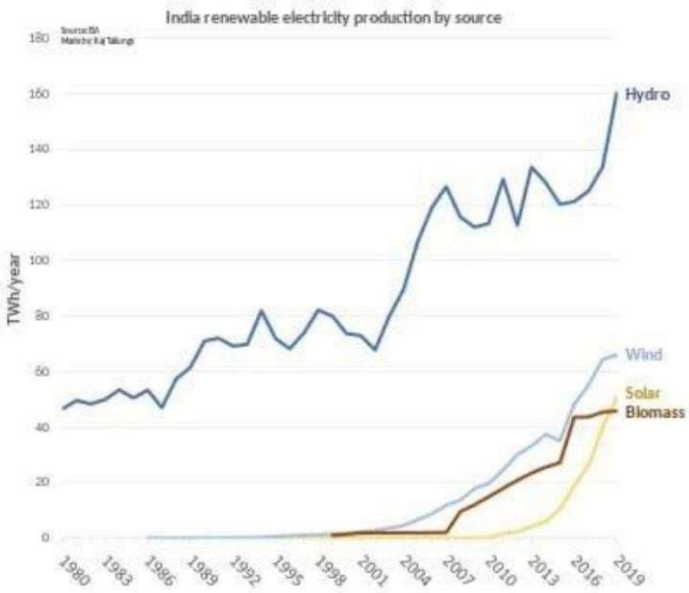
Keywords: Green Energy, Renewable Energy, Human-Generated Power, Community Energy**.**

1. Introduction

The main aim of any country is to provide a sustainable and advancement, improve access to energy, providing of electricity and other essential needs to communities. By a 10-year action plan designed by the Ministry of Power (MoP) to bring electricity across the country, NEP [3] hasalso developed a further program to ensure that energy is provided to citizens at a reasonable cost.In 2013–2014, India imported 171 million tonnes of coal; in 2014–2015, 215 million tonnes; in 2015–2016, 207 million tonnes; in 2016–2017, 195 million tonnes; and in 2017–2018, 213 million tonnes. This is according to a report from the Center for Monitoring Indian Economy.

With the help of the appliances whereby energy conversion is its only working principle, user/operator can also provide our house, electrical/electronic appliances a secondary form of electricity production, thereby reducing the overall primary electricity consumption. Now, if we look at broader scenario regarding power generation, 100 Watts of power is generated by just pedaling a bicycle. In this manner, if a bicycle is being pedaled for a month, it would be producing a total power generation of 30 kW of energy which is more than sufficient. By the usage of the appliance, we are able to continuously convert the type of energy which is rather not utilized frequently and is wasted. So, our work falls where we are converting the utilizable mechanical energy to electrical energy. In this project we are providing the conversion not just by

a single method but with three methods. The primary application of the inputs would simply be for drawing out the energy and providing for battery charge of power banks or mobile devices,car appliances etc.



(Fig 1) Statistics of Renewable Electricity Production in India

Apart from all this, fitness is one of the major concerns of people in today's date. Thus, the given idea also focuses on well-being and physical health of its user. Application like these would definitely provide a way to people in order to improve their physical health and hence produce the electric energy by performing mechanical exercises (mechanical work). The mechanical energy in our project is provided by pulley method, tai chi wheel, bicycle (primary source). 4 Although present scale of the product is small, but with the increase in scale and size of the project, it is highly expected that the device can be simultaneously used by more than three users at a time for different purpose thus providing an essential part in saving energy and reduce the recent increase in electricity cost. Moreover, on a different scenario, we are imposing such devices in gyms so that more people are attracted towards fitness which is totally the need of the hour. Keeping the Fit India Movement started in the year 2019 by our Honorable Prime Ministerto encourage indigenous sports, to make fitness reach every school, college/university, panchayat/village, etc., to create a platform for citizens of India to share information, drive awareness and encourage sharing of personal fitness stories. According to WHO, global prevalence of obesity has almost tripled in last 40 year, India ranks 3rd in Global Obesity Index, which is a scenario of worry and health-emergency. The reason of the team to go with the project was to provide a secondary form of energy not just for urban sectors but also for rural sectors. With the help of this project, it is also expected to provide a need to rural sectors where electric load-shading are frequent. Though the project won't be providing on a large scale such as providing electricity to the house but it surely can provide an allowance in charging up of their small electric appliances.

2. Work done

Our objective of this equipment is to charge an electronic device by using mechanical energy. Here, in this equipment we are using gym equipment as a source of mechanical energy and after conversion the electronic device that we are using here is a phone to get charged. To charge the phone it is a preceding procedure to rotate the motor of the dynamometer first which in turn will charge the batteries and then the phone will get charged. The dynamometer is attached to the gym equipment and when the dynamo will rotate it will generate energy. The rotation of dynamo can be in clockwise or in anti-clockwise direction. It will generate pulsating signal which contain dual polarity. But the charger unit needs single polarity supply to charge the phone. So to achieve single polarity supply we have used bridge rectifier which converts dual polarity supply into single polarity supply This bridge rectifier contains four diodes which are arranged in a particular manner so that it converts AC supply to DC supply and regardless of the polarity of the ACsupply this rectifier converts into same polarity DC supply. Now this single polarity supply will get transferred to the charge controller unit which will further charge the battery. This charge controller controls and regulates an excess charge supplied to the batteries and maintain it form getting overcharged. The charge controller unit is also Load is connected to the mobile charger which is the USB charger, which gives 12V power supply and a voltmeter is connected to 41 measure voltage across it.

(Fig 2) Prototype

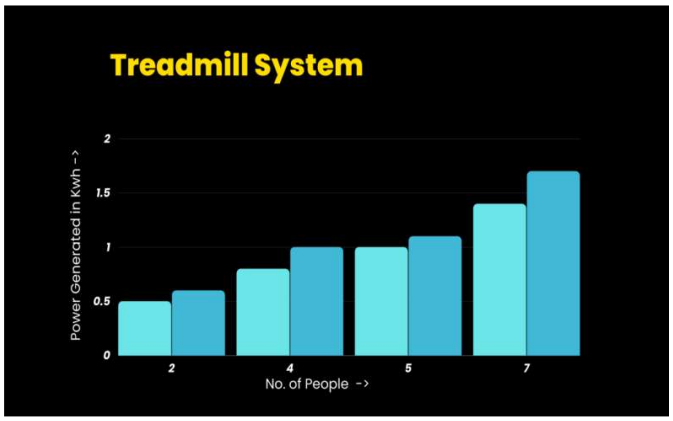
(Fig 3) Charge Controller

3. Results and Discussion

3.1 Result

By doing actual testing of created model on fitness equipments, following data is gathered.

1. Treadmill: -

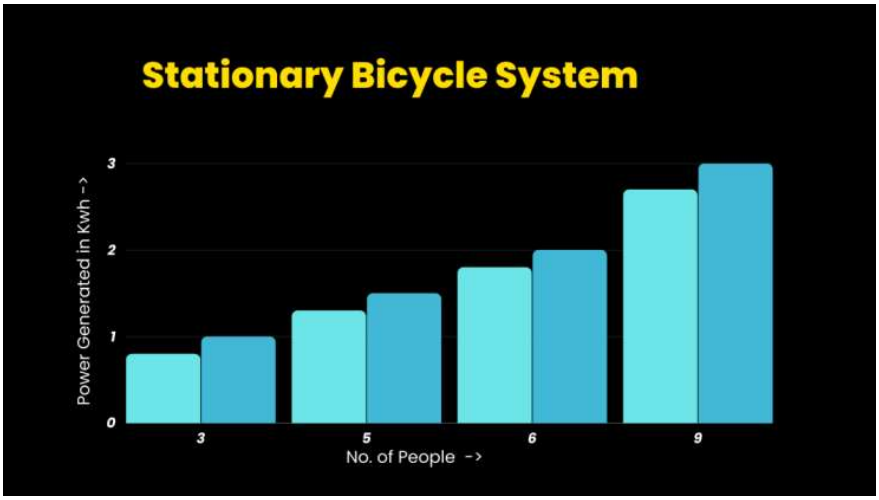


(Fig 4) Treadmill System

Treadmill System It was found out that more power can be generated in the evening period between 7pm to 9pm. The range of power tapped in was from 0.6kwh to 1.7kwh. The average power obtained in our model through these observations was 1.05kwh

SR NO.	TREADMILL(AVAILABLE)	TIME OF THE DAY	NUMBER OF PEOPLE	POWER GENERATED IN Kwh
1.	2	7AM-9AM	4	0.6-0.8kWH
2.	3	4PM-5:30PM	5	1-1.1kWH
3.	2	6PM-7PM	4	0.8-1.0kWH
4.	2	7PM-9PM	7	1.4-1.7kWH

(Fig 5) Treadmill Data

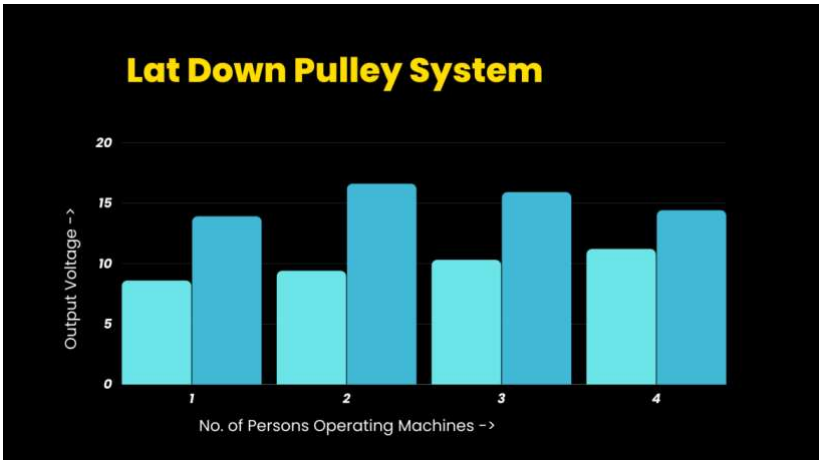


(Fig 6) Stationary Bicycle data

From this table it can be gathered that power output during various phases of a day will be different as individuals prefer to visit at a particular time of day more often. We calculated powergenerated in four different times of the day; first in morning and last in evening. It can be observed that more power can be effectively tapped in the evening. The range of power tapped isbetween from about 1Kwh to 3kwh. The average power gained in this observation was 1.71kwh.

SR NO.	STATIONARY BICYCLE	TIME OF THE DAY	NUMBER OF PEOPLE	POWER GENERATED IN Kwh(0.3)
1.	3	7AM-8AM	5	1.3-1.5kWH
2.	4	8AM-9AM	3	0.9kWH
3.	2	4PM-6PM	6	1.8-2.0kWH
4.	6	6PM-9PM	9	2.7-3.0kWH

(Fig 7) Stationary Bicycle data



(Fig 8) Lat down pulley system

On an average we were able to produce 4.2 Watt every hour operating the machine. We calculated the time for which a LED bulb in the gym would be powered by our setup. The LED bulb requires 140 kWh for 1 year that means for 1 hour it requires 15.9 W. As per our testing we were able to generate 4.2 Wh. Thus, the setup can power the LED bulb for 2 Hours if machine is operated for 8 hours in the gym. The power output of the generator unit was directly proportionalto the effort put into it, but the output power of energy harvesting circuit was a fixed voltage to avoid damaging the storage device [1]. The produced DC voltage can also be used for different applications, including AC appliances by using a DC-AC inverter connected to a storage unit fora stable AC output.

Power Operating the Machine	Output Voltage	
	Maximum	Minimum
1	13.9	8.59
2	16.6	9.4
3	15.9	10.3
4	14.4	11.2

(Fig 9) Lat down pulley data

These observations make us privy to fact that the power output from gymnasium equipment's varies in different times of the day and if maximum output needs to be gained then it are necessary to know the average behavior of gym-visiting individuals, especially the heavy weight-lifters. The total power gained from all of these observations which included 7 hrs. Of cycle observation, 1 hour of pulley LAT down machine and 6.5 hours on treadmill was 6.9kwh. This gives an idea of how much energy can be generated if this concept is applied on a broader level by equipping all machines in a particular gym which will simultaneously generate energy and store or revert to main grid on a day-to-day basis.

3.2 Discussion

The average power generated by the machine at normal loading conditions is about 3.2 watts. Average a man can produce a power of approx. 100 watts in a day from a single exercise equipment. 1 day =100 watt, 30days = 30×100 watt = 3 Kilo Watt, With the amount of 3- Kilowatt power 03 Celling Fan can run approx. 08 hours in a day for whole Month. If the charge for electricity is ₹4/- per unit then the monthly electricity bill of 03 celling fan will be 2.4 × 30 = 72 unit/day & `72 × 4 = 288 Rupees So, power generation by a single human on a single exercises machine is saving 288 rupees per month. Also, the generated power can be used to glowlights, charge the phones in gym as well as can run many electrical appliances in home.

4. Conclusions

In this project, a demonstration of converting mechanical work (input) and converting it into consumable power to charge various electronic devices (output) is successfully shown. Several fitness equipments like gym cycles, elliptical cross trainer, cable crossover machine etc can be affixed to the given assembly by the user to utilize dissipated energy. Human movements are an abundant source of clean energy and this energy can be effectively harnessed and stored in form of electrical energy. This provides an alternate source of power for domestic applications and reduces the stress on conventionally produced electricity. In this report we have developed an effective method to this end by utilizing the human powered fitness equipment. In a gym, a five- minute workout (including two breaks of one minute each) can supply more than 15 Wh of

electricity, enough to charge a quarter of a laptop's battery or to power a desk lamp for 3 hours. Rather than providing a financial reward, we are giving the user's a leisure of utilizing their mechanical energy simply either to get their devices charged or to operate any other electric energy powered appliance, also providing a competitive, healthy and fun environment. It providesan effective way to convert and store the rotational energy from fitness equipment's / cycle and then utilize it as per user's time and convenience. The device also has a huge future scope to be applied to various equipment's performing rotational motion. The main motivation of this project was creating a sound awareness towards fitness and maintenance of health. With severe rise in health degrading cases, this project would pave a way towards providing a better lifestyle for the people and community. As the scalability and application of the product increases whereby more way of generating energy would be accessible.

How is it necessary to the society?

This design and implement an innovative exercise equipment to generate electrical power for the house appliances. Energy storage is very necessary and important within renewable energy systems to ensure stability of the system. These models vary in complexity and accuracy and therefore the model chosen must match the application for which it is needed. As the model gets more familiarized in near future by the society, its value as well as its usage has a chance of growing rapidly. Also, the model has great potential towards reducing excessive CO2 emission. This type of model can be used in many places and if it is operated throughout the day by many people, it can create sufficient amount of energy. It will be very helpful for the rural areas. If additional design and study of this concept proves it effective in energy use reduction, localized energy delivery and sustainability education, it would be efficiently answering the three great challenges; source of electrical power, reducing the emission of CO2 to the atmosphere and the issue of obesity.

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