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Power Generation using Gym Equipment (Lat Pull Down)

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Abstract - *The renewable sources are becoming essential in today's world. The conventional sources like natural oil, coal, petrol all are at the edge of depletion. Overpopulation, Delay in Commissioning of Power Plants, Wastage of Energy, Sometimes bottlenecks at oil refineries and port facilities restrict fuel supply. Hence new techniques are being employed for energy harvesting. These all techniques have high capital cost and equipment can be complex. Hence low power harvesting will be beneficial for small appliances.*

The trend of exercising in gym is increasing among people. We studied about which machine is being used often. The Lat Pull Down Machine is used by many users and that's why we decided to adapt this machine mechanism.

The basic concept of our project is to convert mechanical energy into electrical energy. The mechanical energy is produced by the Lat Pull Down machine when operated by user. The exercise equipment, in this case a Lat pull down will be attached to a generator. This creates a dc voltage which will be fed into a circuit and then sent to a battery where it can be stored for future use. The form of ambient energy source was the waste mechanical energy from fitness exercise equipment which was converted to electrical energy and stored in battery banks for use in the system. An appropriate energy harvesting and storage system was built and demonstrated to investigate reliability of the fitness equipment as an ambient energy source. This report will introduce the project and present all applicable information regarding the design, development, and the final product.

***Key Words*:**

Gym Equipment, Mechanical system, Gear ratio, Dynamo, Electrical power

1. INTRODUCTION

Human kinetic energy can be extracted and transferred to small scale power applications in several different ways such as pedaling bicycles and hand-crank tools. In this research an energy harvesting system using human kinetic energy was presented. For this purpose, the Lat pull down were investigated for potential waste mechanical energy capture [2]. By converting mechanical energy to electrical energy, not only does the display get powered but also different applications such as a small radio, or digital embedded heartbeat sensor can also be powered. The amount of electrical power that can be produced by the generator is determined by the energy available to pull the Lat down. The stronger the human power, the more electrical power which can be generated and stored. The power output of the generator unit was directly proportional to 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 for a stable AC output. If an average person is expected to produce sustainable 100-150 watts, charging a battery or capacitor with an average 50mA current is enough to power a low power electronic device [3]. The following work investigated the feasibility of an energy harvesting device that generates energy from a Lat pull down machine as an ambient energy source during a workout routine of a person.

In this paper pulley is directly connected to mechanical arrangement which consist of chain and sprocket, freewheel, flywheel. This mechanical arrangement is directly connected to shaft which is connected to the rotor of the dynamo. This rotor contains a magnet which when turned produce rotating magnetic field (emf) which in turn produces electromotive force. The rotor is surrounded by stator which is nothing only a stationary case, which contains the wound copper coils or windings. When the moving magnetic field passes through these wound copper coil or windings, they generate electricity [5]. On controlling the speed at which the rotor is turned, a steady flow of electricity is produced in the core windings. These windings of the rotor are connected to the electrical circuit by transmission lines. When weight is pulled up it causes rotating motion of the pulley which is transferred to output shaft. Hence the energy is generated and can be stored in batteries or any other equipment. The input for producing energy is the dead weight motion to a DC motor for electrical power generation.

2. Working mechanism of the setup

The mechanism of the Lat pull down machine consist of the rope and pulley arrangement which deal with the rotation of the pulley in both direction is seen. The operator when exercising on the machine pulls the bar attached to the rope which rotates the pulley and the free weight fixed (one DOF vertical) reciprocates. This project focuses on conversion of the rotational movement of the pulley into electrical energy.

The rotation of the pulley can be both anti-clock wise and clockwise so the free wheel mechanism (ratcheting) is mounted on the transmission shaft. The transmission shaft has mounting such as chain & sprocket, flywheel on it. The transmission shaft is intermediate between the pulley and generation shaft. This shaft transmits the rotational motion the generation shaft with the help of large sprocket mounted on it.

The generation shaft gets rotational motion by the smaller sprocket. Gear ratio of 2.4 is desired for the large and small sprocket. Hence the high speed rpm will be available at the corresponding shaft. This generation shaft has the electrical generator or dynamo assembly. The dynamo converts the mechanical power into the electrical power with principle of Faraday's law of electromagnetic induction. Thus the electric power is obtained by the Lat pull down machine. This electric power can be stored or used to power small appliances in the application area.

2.1 Electrical equipment configuration

The output energy will be in form of DC type and we can use the energy to charge the battery. The charging circuit can be implemented in the setup to charge the battery.

3. Testing and Verification

The setup was tested with parameters like output voltage and currents obtained at the output shaft on which dynamo (electrical generator) is mount. The shaft speed were measure with the tachometer. Hence we can establish enough data to verify the usable output by the setup with different persons operating the machine for specific amount of time

Table -1: Shaft Speeds

Persons operating the machine	Shafts Speed in RPM		
	Input	Intermediate	Output
1	88	255	636.4
2	91.5	257	685.5
3	84	247	639.5
4	89	258	642.2
	Avg: 88.125	254.25	650.9

Table -2: Output Voltages (Avg 12.17V)

Persons operating the machine	Output Voltage (in Volts)	
	Maximum	Minimum
1	14.9	8.39
2	15.6	9.4
3	16.9	10.3
4	16.4	10.2

Table -3: Output current (Avg 0.3455A)

Persons operating the machine	Output Current (in Ampere)	
	Maximum	Minimum
1	0.43	0.20
2	0.47	0.24
3	0.49	0.25
4	0.46	0.22

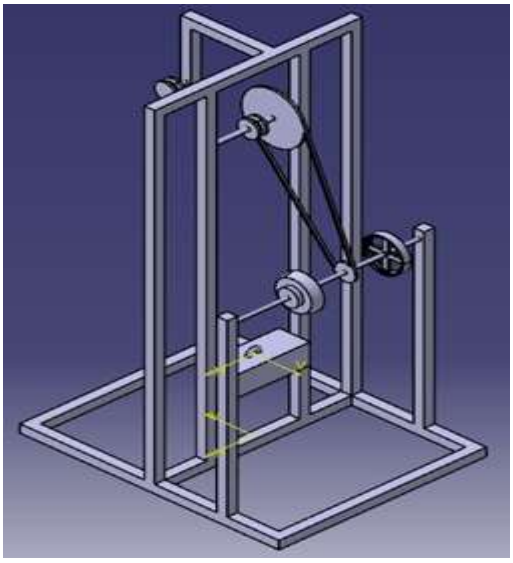

Fig -1: Isometric view of proposed setup

Fig -2: Actual fabricated setup

4. RESULTS

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.

5. ADVANTAGES

1. Benefits of using Lat Pull Down Machine
2. Use of the our machine will help in the energy storage for particular gym
3. Ample amount of electrical energy will be stored in the battery which will help in providing supply to the equipment and appliances in the gym
4. This machine is generally most used therefore the frequency of generation of electricity will be high

6. CONCLUSION

Thus in this paper we adapted the electrical power generation process in the gym machine which is mostly used. The use of pulley and free wheel makes the single stroke of gym machine causes the electrical output up to 12V which can be used for many electrical components. The output electrical energy can be stored in battery if needed. The verification of the constructed system is done by measuring output by multimeter.

7. FUTURE SCOPE

The fitness is important factor in modern life and young generations are interested for the exercises. Implementation of such provisions in gym machines will be surely a help in renewable energy field. The alternate source of energy will reduce the overall energy cost of such particular organization.

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