

REVIEW ARTICLE



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## DEVELOPMENT OF CONCEPTUAL MODEL OF CROSS TRAINER FOR WATER PUMPING AND BATTERY CHARGING

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### ABSTRACT



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In this project work an effort has been made to development of conceptual model of water pumping and battery charging cross trainer which is user friendly, easy to do exercise, save & stores the energy of the users muscle efforts. When the human operates the lever and the pedal, the Centrifugal Pump is actuated and the water is pumped from ground sump to the tank. At the same time the attached dynamo (i.e., is mounted near the V-belt) operates and the mechanical energy is converted in to electrical energy, the generated electrical energy is stored in battery with the help of wires. The stored electrical energy is used when we are needed.

**Key words:** Centrifugal, Dynamo.

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### INTRODUCTION

The body fitness equipment's had major roll in routine life of city populates. Body fitness equipment's burns the fat and helps stay fit. There is high demand & use of body fitness equipment's due to lack of adequate space to work out. In present scenario of fitness industry, lot of research & development is carried out to bring fitness technology to door steps. There are incredible verity of instruments is available in market with verity of features. Cross trainer is also such a fitness devise used to burn body calories, by means of pedalling the dummy wheel & brake arrangement, which is linked to the hand leavers. By this, it could highlight that work out with Cross trainer has certain disadvantages, such as loss of human muscle power. Cross trainers will convert the muscle power in to break power (BHP) which is slinked to friction brake drum. So to overcome these barriers, cross trainer are need to be employed for use full work. There are few solutions to operating cross trainers for useful work, such as water pumping and electricity generator. But there are no such satisfactory solutions with a low cost installation. The engineering solution is to adopt mechanically operate cross trainer for water pumping at an affordable cost and maximum flexibility with minimum maintenance.

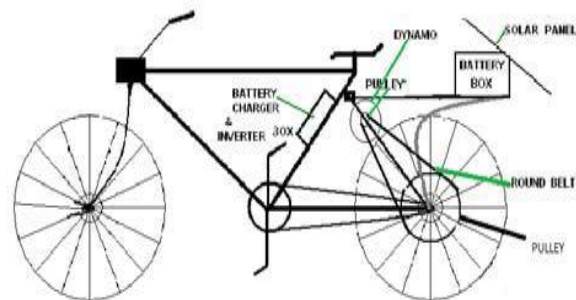
Man invented most of the things for his comfort and convenience. Electricity is one of them. Now a day, the production of electricity is from hydraulic power plant, thermal power plant, wind power plant etc.. In the hydraulic power plant, the kinetic energy of water is used to run turbine and convert into mechanical

energy and again into electrical energy by connecting generator. In the thermal power plant, the kinetic energy of pressurized steam is used to rotate the turbine and generate electricity. In wind power plant, the kinetic energy of wind is converted into electricity. In the human power generator, it works on the principle of convert muscular or physical energy of human being into the electrical energy by means of applying pulley arrangement. The pulley arrangement converts the efforts which is applied by human being into the rotating motion which is used to generate electricity and this electricity will be used as a preliminary requirement of electricity and also use of solar energy by means of solar cell for generation of electricity for use in stationary and mobile condition and also use of AC appliances by use of inverter. [1]

The dynamo in the bicycle uses rotating coils of wire and magnetic fields to convert mechanical rotation into a pulsing direct electric current through Faraday's law of induction. A dynamo machine consists of a stationary structure, called the stator, which provides a constant magnetic field, and a set of rotating windings called the armature which turn within that field. The rotation of the rotor within the magnetic field causes the field to push on the electrons in the metal, creating an electric current in the wire. On small machines the constant magnetic field may be provided by one or more permanent magnets; larger machines have the constant magnetic field provided by one or more electromagnets, which are usually called field coils. Thus, by the above mechanism dynamo charges the battery.

#### LITERATURE SURVEY

Mrs.Manisha.S.Lande et al., [1] "OPTIMUM UTILIZATION OF A BICYCLE" Department of Mechanical Engineering, Priyadarshini College of Engineering.



BICYCLE GENERATOR USING HUMAN AND SOLAR ENERGY AS FUEL

Figure 1, Bicycle generator using human and solar energy as fuel

In 21st century the world is going towards a new era of invention. Every rising day comes with new invention or discovery. But all this is for what? Just to enhance the life of human being and to improve the living standard of human. The basic thought behind all this is that everyone is working for getting more and more comfort in this life. Now a day, our country and human life is mostly affected by load shedding. This is all from the shortage of electricity due to break down of power plant several times. So the production of electricity is affected. Therefore it is not possible to supply electricity as per requirement. It has badly affected the daily human life. Thus taking this point of view a human power generator should be designed that can work according to the human comfort requirement. Different type of generator is available in market, but they are not economical for common people. By keeping this point, the human power generator is useful for production or generation of electricity to fulfill our preliminary requirement of electricity in daily life by use of dynamo and solar panel for its use in stationary and mobile condition.

Result

- According to Faraday law of induction, the model works properly.
- The generation of voltage is varied with variation.
- We get constant supply of voltage by using battery and inverter section.
- We can use AC appliances by use of inverter.
- Solar panel is used for charging of battery in stationary condition.
- Pulley arrangement is used to minimize initial torque.
- Round belts are being used because of its high efficiency characteristic.

Rajesh Kannan Megalingam, et al., [15] **“PEDAL POWER GENERATION”** Amrita Vishwa Vidyapeetham University, Amritapuri Campus.

Bicycle is the main mode of transportation for many Indian villagers. Most of these villages are un-electrified. Power generated by pedaling can be converted from mechanical to electrical energy by using either dynamo or alternator. Small powered lighting devices can be charged using dynamo and can be used in the night by students for study purposes. This principle can be extended to power mobiles, iPods, laptops etc. Power can be also generated from the rotation of the wheels of alternator vehicles like bikes and cars, where there is a possibility of generating more power. The generated power can be either used in the same vehicle or can be stored in a battery for powering some other devices. Riding bicycle helps in maintaining a good physic and along with it power can be also generated. This paper presents methods in generating electricity by pedaling a bicycle. It also explains in detail the method using bottle dynamo to generate power. A detailed analysis of using pedal power is also presented.

#### METHODOLOGY

The device consists of two sprockets and are connected each other by the chain mechanism, at one end of the sprocket pedals are mounted. Centrifugal pump is connected by the V-belt from pulley. When the human pedals, the Centrifugal pump is actuated through the flywheel and the water can be pumped from sump to the tank. (As shown in fig) At the same time the attached dynamo (i.e., is mounted near the V-belt) runs and the mechanical energy is converted in to electrical energy, the generated electrical energy is stored in chargeable battery. The stored electrical energy is used whenever needed.

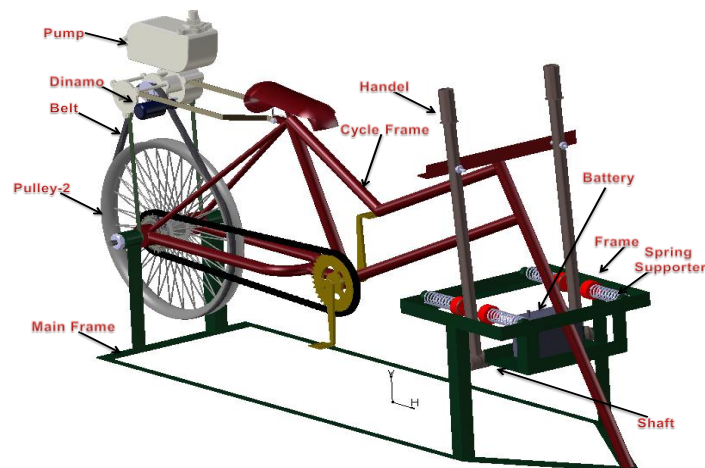


Figure: 2, Developed conceptual model of cross trainer for water pumping and battery charging

As shown in the figure: 2 the frame is designed as per the ergonomic consideration of the bicycle frame. The two sprockets one is bigger and smaller i.e., one is driver and another is driven respectively. At the end of driven sprocket flywheel is mounted as shown in figure: 2.

When human pedals the mechanical energy is transferred to flywheel, here the mechanical energy is converted in to rotational energy(in turn centrifugal force) this rotational energy is transferred to pulley of

centrifugal pump, thus the impeller rotates and the vacuum is created in a volute casting, this vacuum is enough to create section force to pump the water.

As the rotation speed increases the section force is also increases thus the discharge of the water will be varied according to the rotational speed of the impeller.

#### **COMPONENTS INVOLVED**

The different major components which are used in development of system are as follows,

1. Main Frame
2. Chain sprockets-2
3. Cycle Rim-Pulley
4. Flat-Pulley -4
5. V-Belt
6. Dynamo
7. Pump
8. Seat
9. Cycle Frame
10. Chain
11. Battery
12. Spring Supports
13. Battery Frame

#### **SELECTION OF MATERIALS**

Selection of different materials actually depends on the below mentioned parameters.

##### **Properties**

The material selected must possess the necessary properties for the proposed application. The various requirements to be satisfied can be weight, choosing of centrifugal pump, surface finish, rigidity, maintenance, service life, reliability etc. The following four types of principle properties of materials decisively affect their selection

- 1 Physical
- 2 Mechanical
- 3 From manufacturing point of view
- 4 Ergonomical

The various physical properties concerned are size, power consumption.

The various Mechanical properties Concerned are discharge of pump, handling load.

The various properties concerned from the manufacturing point of view are,

- 1 Structural frame ability
- 2 Motor ability
- 3 Fly wheel ability
- 4 Motor efficiency

Based on human factor the model is developed.

##### **Manufacturing case:**

Sometimes the based on the power consumption and output discharge of a fluid will affect the manufacturing cost of the pump.

**Quality required:**

This generally affects the manufacturing process and ultimately the material. For example, it would never be desirable to go for casting of a less number of components which can be fabricated much more economically by secondary machining process.

- **Type of pump:**

As secondary main factor the type of pump should also be part of a quality of discharge of the pump, also the type of power utilized.

- **Discharge ability of pump:**

Sometimes high dischargeable with low power consumption can be obtained, but sometimes the discharge will vary with respect to speed of the impeller.

- **Cost:**

As in any case based on the power factor (efficiency of motor) used for the type of application for fluid pumping.

**GEOMETRIC 3D CAD MODELLING**

The CAD models are generated for the concept and the modeling software CATIA V5 R20 is used for the 3D CAD generation.

Following are the 2D models of developed system,

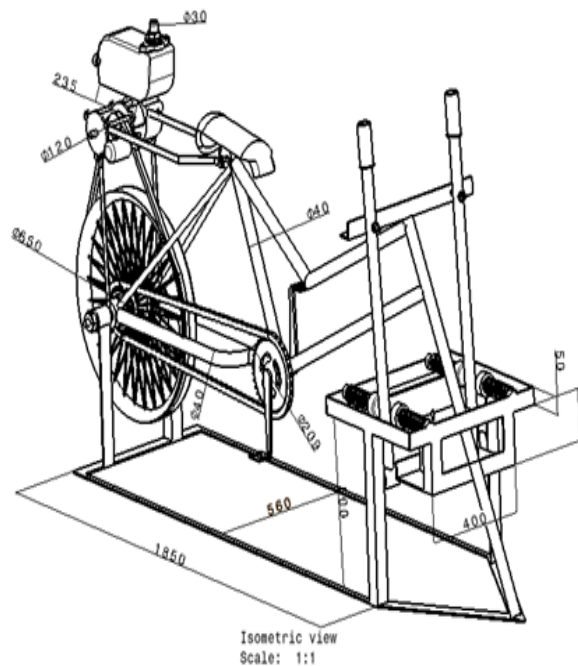


Figure: 3, 2D model of developed system

Centrifugal pump is selected on the basis of following typical factors,

- 1) Minimum speed
- 2) Maximum speed
- 3) Discharge head
- 4) Human power consumed/minute.

**WORKING PRINCIPLE**

When human pedals the mechanical energy is transferred to flywheel, here the mechanical energy is converted in to rotational energy(in turn centrifugal force) this rotational energy is transferred to pulley of centrifugal pump, thus the impeller rotates and the vacuum is created in a volute casting, this vacuume is enough to create section force to pump the water.

As the rotation speed increases the section force is also increases thus the discharge of the water will be varied according to the rotational speed of the impeller.

At the same time the attached dynamo (i.e., is mounted near the V-belt) runs and the mechanical energy is converted in to electrical energy, the generated electrical energy is stored in chargeable battery. The stored electrical energy is used whenever needed.



Figure: 4, Developed fabricated model

**RESULTS**

The equipment can also be used as domestic purpose and also as gym training equipment - Cross trainer. In domestic purpose the discharge may vary due to the individual person’s weight and ability (strength). Thus when compared with trained person having greater ability (strength) to pump the water quickly and charge the battery, in turn depends upon the speed of the cycling. Following results are obtained,

Table: 1

Sl.No.	Speed in RPM	Discharge in $m^3/s$
01	495	0.0068
02	527	0.0095
03	502	0.008
04	480	0.006

Table: 2

Sl.No.	Human weight in Kg	Speed in RPM
01	62	495
02	65	527
03	68	502
04	70	480

**CONCLUSION**

The equipment consists of two sprockets which are connected each other by the chain mechanism mounted at one end of the sprocket pedals. Centrifugal pump is connected by the V-belt from pulley. When the human pedals, the Centrifugal pump is actuated through the flywheel and the water is pumped from sump to the tank. At the same time the dynamo attached (i.e., is mounted near the V-belt) runs and the mechanical energy is converted in to electrical energy. The generated electrical energy is stored in chargeable battery. With the analysis, the Cross trainer model pumps the 1 litre of water up to 10 mtrs with an average time of 6 seconds by the average human being (66kg). Also it generates an average power of 3.4 Volts/min. It is used as physical exercise equipment to maximize the human power utilization.

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