

## Design a Solar and Pedaling powered Rickshaw

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### ABSTRACT

The Indian subcontinent is a place where three wheeler rickshaws are driven by human power for transportation system. As a result, large portion of energy are wasted by human being through pedaling. Since pedaling is one kind of kinetic energy, so it can be converted into electric energy by using dynamo which produce 6 W electricity. As sun & pedal are the source of energy, so these energy can be stored into the battery which is used to supply power to the motor to drive the rickshaw automatically. The implementation of this system would be beneficial and efficient, because these are not only depending on the availability of sun.

Keywords: Solar panel, Dynamo, Battery, DC Motor.

### 1. Introduction

The “Rickshaw” is a common vehicle in Indian subcontinent. Due to its popularity, it has become a symbol of Bangladesh and especially for its design and arts. These vehicles are small and narrow allowing easy maneuverability in congested Asian metropolises. Bangladesh is home of more than a millions of rickshaws [1, 2]. Most of the Rickshaw of Bangladesh is human-powered vehicle for hire, usually with two seats for carrying passengers in addition to a driver seat. This non-motorized form of public transport is basically a three wheeler vehicle capable of carrying two passengers excluding the driver, or a pay-load of 150-200 kg [3].

Rickshaw is an eco-friendly vehicle considering environmental pollution. Most of the transport vehicles in Bangladesh are petrol and diesel-powered and these are responsible for air and noise pollution. There are presently nearly half a millions of petrol-powered motorbikes and thousands of petrol or diesel-powered three wheelers [4].

Recently electric rickshaws are being introduced which do not contains any pedal arrangement. So its driving speed is totally dependent on the charge of battery which diminishes gradually on use [5]. But in these electric rickshaws require high motor and battery capacities having charging and economical problem. Electric hybrid rickshaw combines the advantages of the pedal and electric auto rickshaws in single arrangements which are tried out without changing the main structure of existing rickshaw. The hybrid system improves battery operation time [6].

Electric rickshaws first introduced on a commercial basis in 2004 from china and marketed it in 2008. The government of Bangladesh banned import and assembly of electric vehicles because of power crisis. Each EMR (Electric Motorized Rickshaw) consumes at best five watts of electricity during off-peak hours to recharge the batteries and 50,000 Rickshaws consume at best 25 MW [7].

For the power crisis of Bangladesh, it will be convenient to use alternative power source in electric rickshaws.

Alternative energy solutions convened a great deal of consideration in the last decade due to the need of sustainable and environmental friendly energy sources. The aim of this paper is to propose a new type of Hybrid “Green” Rickshaw that operates in an environment friendly way. A solar system and a dynamo system have introduced in this rickshaw considering economical aspect.

### 2. Obstacles to the development of rickshaw

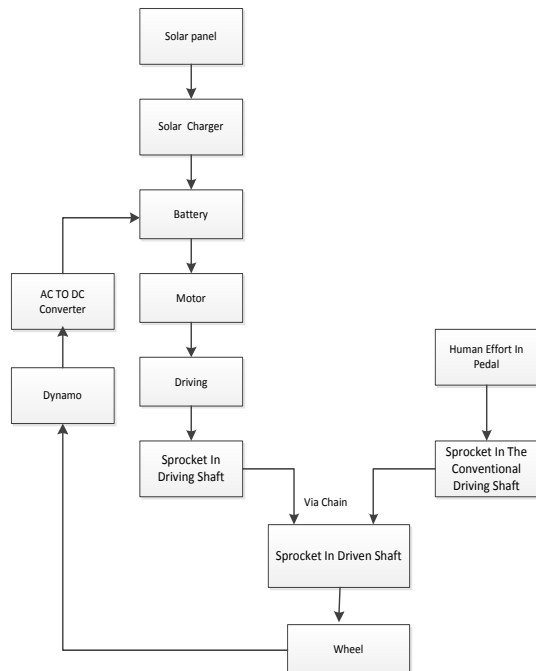
Electric rickshaw becomes popular vehicle. So many research works have been analyzed and many recommendations were proposed for improvement of rickshaw. But no notable change has been implemented in this vehicle in our country [2, 5, and 7]. There are many causes behind this situation which is related to some prevailing socio-economic barriers. There are no significant changes in the existing rickshaw-design. It has been carried out up to road level in the last few decades due to

- Rickshaw owners are not interested to purchase improved rickshaws as well as to modify their own rickshaws for financial problem.
- No organizers are coming forward to motivate the buyers for new ones.
- Mass production is not available in market.
- Lack of government legislation to maintain a standard specification.
- High price of electricity and electrical equipments.

### 3. Proposed Methodology

In this system sun is the main source of energy which provides power through solar panel to store this power in the battery for riding the rickshaw. A dynamo is used in the rickshaw’s front wheel which can provide power. This power will be stored in an additional battery of 6v. This 6v battery will supply power to the rickshaws horn for giving signal to other people. It also supplies power to the rickshaw’s light at night for safe movement. This

system needs two kinds of equipment where one is mechanical and other is electrical equipment.



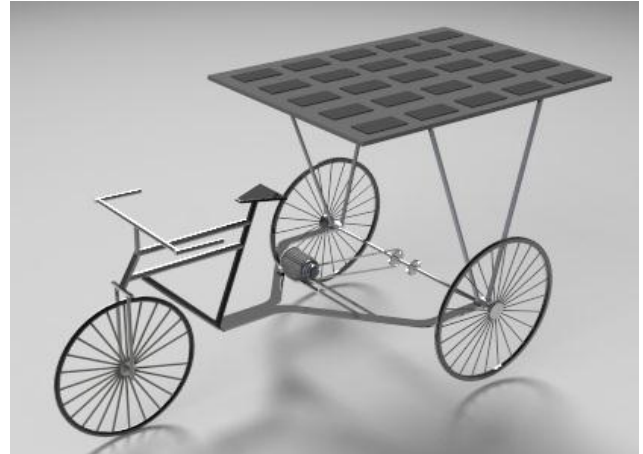
**Fig.1** Block diagram of power transmission

### 3.1 Mechanical equipments

The mechanical equipments used in rickshaw are

1. Mechanical shaft.
2. Chain sprocket.
3. Mild steel pipe.
4. Mild steel bar.

In this system the frame of rickshaw will carry all the loads. An electric dc motor is used in this mechanism. Two additional mild steel bars are used to support the motor. The mild steel bar provides a better support for the motor and an additional chain sprocket is assembling with the motor in this mechanism. It transmits power from the motor to the shaft. A solar panel is assemble in the upper portion of rickshaw with the help of two mild steel pipe which mounted vertically and joined with the lower portion of the frame of rickshaw. The mild steel pipe has no connection with the hood of rickshaw. The hood can easily move.



**Fig.2** SolidWorks design for the fabrication of Mechanical equipments.

### 3.2 Electrical equipments

The main electrical equipments those are used in this system are discussed below-

- **Solar Panel:** A solar panel is a set of solar photovoltaic (PV) modules electrically connected and mounted on a supporting structure. A PV module is a packaged, connected assembly of solar cells. Solar panels can be used as a component of a larger photovoltaic system to generate and supply electricity in commercial and residential applications. A panel is designed to absorb the sun's rays as a source of energy for generating electricity or heating. In this system 4 pieces 40W solar panel is used which can easily recharge the battery.
- **Motor:** The DC motor helps to convert electrical energy into mechanical energy. It is used in majority of household applications and electronic devices and it is also widely used in electric rickshaw. In this system 48V 500W brushless DC motor is used.



**Fig.3** 48V 500W Dc motor

- **Battery:** A dry cell battery is an electrochemical device that produces voltage

and delivers electrical current. The battery is the primary “source” of electrical energy used in vehicles today. In this system 1 piece of 6V 14Ah battery and 4 piece of 12V 30Ah Super Start Dry Charged NS40ZL JIS standard batteries are used.



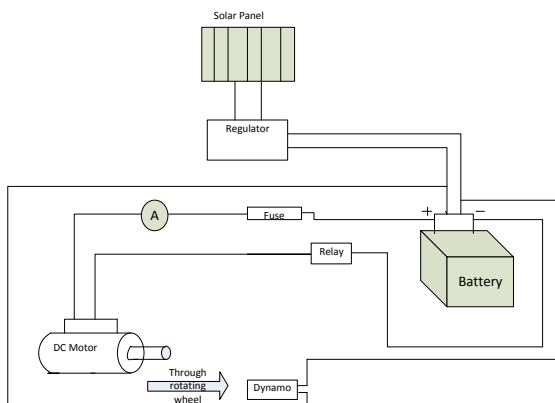
**Fig.4** Battery

- **Dynamo:** It is a device which changes energy of movement into electrical energy. It turns mechanical energy from the rickshaw’s movement into electricity that can be used to power the rickshaw’s battery. In this system one piece of 12V 6W dynamo is used to store power in a 6V 14Ah battery.



**Fig.5** 12V 6W dynamo [8]

### 3.2.1 Electric circuit diagram



**Fig.6** Electrical circuit diagram

### 3.3 Designing set-up

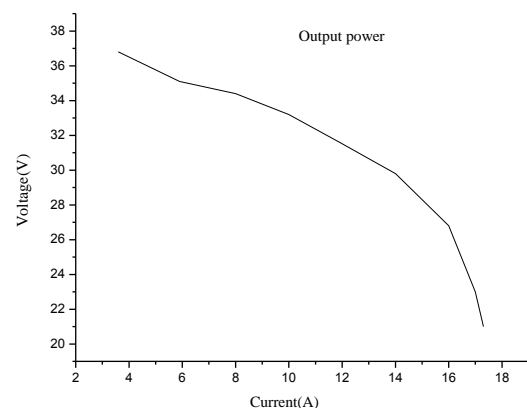
In this system 4 piece of 12V 30Ah Super Start Dry Charged NS40ZL JIS standard battery is used which is located inside the seat box. The battery is located inside the seat box for protecting it from the rain, as the rain water can damage the battery. After giving full charge to the battery it can easily support 4-5 hours with the load of 3 people including the rickshaw puller. The total system controlled by a switch which is located in the rickshaw’s handle. The switch starts the motor for automatic riding. The horn is located in front of the rickshaw and the horn switch is located near the handle. The light is located in the lower portion of the rickshaw’s frame. The additional battery of 6V will supply power to both the light and the horn. The motor is located in the lower portion of rickshaw’s frame with the help of mild steel bar. The mild steel bar gives a strong support as the motor’s weight is very heavy.



**Fig.7** Experimental view

### 3.4 Observation of solar panel

In this system the solar panel was connected in direct sunlight with main electrical circuit and measured the voltage by digital multi-meter. The meter was used to measure the open circuit voltage and the short circuit current. No power was generated when the open circuit voltage and short circuit current was measured.



**Fig.8** Plot of Voltage versus Current of solar panel

The Fig 8 shows an intuitive view of data. The output of this solar panel shows a characteristic behavior of solar panel. The maximum power is generated at the operating point which forms the 'knee' in the curve. The maximum power is produce approximately 428.8 watts.

To measure the load of the solar panels, the power resistor was connected and measured over time to identify the complete output characteristics.

**Table 1:** Measured output values with the power resistance.

| Time    | Ampere (A) | Voltage(V) | Power(W) |
|---------|------------|------------|----------|
| 11.30am | 8          | 34.4       | 275.2    |
| 12.00pm | 10         | 33.2       | 332      |
| 12.30pm | 12         | 31.6       | 379.2    |
| 1.00pm  | 14         | 29.8       | 417.2    |
| 1.30pm  | 16         | 26.8       | 428.8    |
| 2.30pm  | 17         | 23.1       | 392.7    |

#### 4. Advantages and Drawbacks

##### 4.1 Advantages

- To save the electric utility.
- There is no environmental pollution.
- Convenient use of renewable energy.
- Lighting and traffic signal indicators in a rickshaw provides with the dynamo battery.

##### 4.2 Drawbacks

- In this system space is limited for solar panel setting. As solar panel covers comparatively large area on top of the rickshaw's body so it creates a problem.
- The performance of solar cell in not satisfactory in comparison with its price.
- The dynamo provides small amount of energy to the battery.
- Needs more time for charging of a battery due to the change of intensity of suns ray.

#### 5. Discussion

In this system renewable energy is used to reduce the waste of national power. The main purpose of this system is to use solar power through solar panel and to recharge the battery as solar power is available and cost-free. Dynamo is used in rickshaw's wheel to store some energy in an additional battery. The additional battery supplies power to the light and the horn. For this eco-friendly system around 6-7 hours are required to recharge the 48V 30Ah battery by solar power which can be used 4-5 hours. This eco-friendly solar and pedaling powered rickshaw will be more efficient after

the improvement of solar cell, charging system and dynamo mechanism.

#### 6. Future improvement

The model will be more efficient in future if dynamo system will be upgraded to produce power with the help of alternator and other electronic equipment's. Besides, efficiency may be increased by using upgraded solar cells.

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