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ROOM HEATING BY ENERGY TRANSFER AND ITS PERFORMANCE

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Abstract

In this research, a room heater by solar panel is designed, fabricated and its performance is assessed in the perspective of an emerging/developing country with a huge energy demand like Bangladesh. The winter season (mid-November–mid-February) of the country characterizes by low temperatures, cool air blowing from the west or northwest, clear sky and meager rainfall. Minimum temperature in the extreme northwest in late December and early January sometimes reaches 3^0 C and day length is about 10 h. The shortness of winter days can be compensated by reducing the heat loss during long nights. The heater by solar panel will be constructed to prevent as much heat loss as possible. In other words, the heating of air will be accomplished by maximizing light gain and minimizing heat loss. It is expected that the fabricated room heater by solar panel will work efficiently. The maximum room temperature is 45^0C. The experimental outlet temperatures have been compared with that of theoretical values. Due to the uses of low-cost and simple technology, it would affordable in all aspects, visualization of cost, operation and maintenance by the typical people of Bangladesh.

Keywords: *solar power, photovoltaic cells**,** solar energy.*

1. Introduction

People have become increasingly concerned about the rapid depletion and uncertainty in the cost of fossil fuels. There is some fear about the possible environmental and safety risks associated with fossil fuels, such as global warming, greenhouse effect, sea level rise, climatic change and acid rain precipitation. These concerns have focused worldwide attention on the potential of harnessing the Sun’s power in new and varied forms to meet society’s growing energy needs and for saving conventional energy. Although the Sun has been a major energy source throughout the ages, technological advances in several fields of science and engineering now make it possible to accelerate the use of solar energy to meet the world’s expanding energy requirement [1]. Despite the efforts of various government institutions, universities, NGOs and international development organizations, renewable energy technologies are yet to make a substantial contribution for betterment of the quality of life in the developing countries. To find a wider acceptance, it is very important to make sure that renewable energy solutions are accessible, affordable and appropriate [2].

2. Solar Energy:

About half the incoming solar energy reaches the Earth's surface.
The Earth receives 174 pet watts (PW) of incoming solar radiation (insulation) at the upper atmosphere. Approximately 30% is reflected back to space while the rest is absorbed by clouds, oceans and land masses. The spectrum of solar light at the Earth's surface is mostly spread across the visible and near-infrared ranges with a small part in the near-ultraviolet [3]. Solar energy has much greater present and future potential because it produces large quantities of energy at low cost with minimal impact on the environment i.e. it satisfies three "E's" (energy, economy and ecology) [4]. Solar lights that charge during the day and light up at dusk are a common sight along walkways.
Although daylight saving time is promoted as a way to use sunlight to save energy, recent research has been limited and reports contradictory results: several studies report savings, but just as many suggest no effect or even a net loss, particularly when gasoline consumption is taken into account. Electricity use is greatly affected by geography, climate and economics, making it hard to generalize from single studies [5].

3. Project Setup:

A solar panel which is used to absorb the direct solar energy, connected with an energy storage device (a battery 12volt & 17 amps). The solar panel produces electricity, stored in the battery. A charge controller is then connected to the battery to control the flow of electricity. A heating device is connected with the charge controller by which we can heat our desired space. This is the whole process of my project that I have to be done.

Fig: Project setup

4. Procedure for Data Collection:

Inside and outside temperatures were measured by placing a thermometer at inside and outside of the room respectively. The other necessary data were collected with the help of different references such as book, internet, and thesis paper and so on.

4.1. Calculation:

Efficiency of solar panel:
We have:

Solar power P =20 watt
Solar area A =630×290 mm^2
= (0.63×0.29) mm^2
=0.1827 m^2

Let,

Irradiation, G =4. 2 kWh/m^2/day
Input power =4. 2×0.1827 kW/day
=0. 76734 kW/day
=767. 34 kWh/day

Let,

Sunshine be 7 hr/day
7 hrs give =767.34 wh
1 hr give $=\frac{767.34}{7}$ watt
=109.62 watt

So efficiency,

$$\eta = \frac{20}{109.62} \times 100$$
=18.24%

. **Time needs to charge the battery:**

(1) Calculate the Ampere per hour of the charger: 20 watts/18 volts=1.11 amp
(2) Calculate the division: 12 Ah/1.11 amp=10. 8 hr
(3) Add 10%: 0.1

So time needs to charge the battery= 11 hr

Battery backup time:

We have: Ah= (7.5+4.5) Ah
=12 Ah
V_t =18 volt
25 watt bulb

So,

$$Wh = Ah \times V_t$$
$$= 12 \times 18$$
$$= 216 \text{ Wh}$$
$$\text{Or, } h = \frac{216}{25} \text{ hr}$$
$$= 8.64 \text{ hr} = 8 \text{ hr } 38 \text{ min}$$

4.2. DATA COLLECTION & DISCUSSION:

Day 1:

Time	Room temp(^{0}C)	Ambient temp(^{0}C)	Temp difference(^{0}C)
5.00 pm	30	29	1
5.15 pm	31	29	2
5.30 pm	32	29	3
5.45 pm	33	29	4
6.00 pm	33.5	29	4.5
6.15 pm	34	28.5	5.5
6.30 pm	34.5	28	6.5
6.45 pm	35	28	7
7.00 pm	36	28.5	7.5
7.15 pm	37	29	8
7.30 pm	38	29	9
7.45 pm	38.75	28	10.75
8.00 pm	39	28	11
8.15 pm	39	27	12
8.30 pm	39	27	12
8.45 pm	39.5	27	12.5
9.00 pm	40	27.5	12.5
9.15 pm	40	27.5	12.5
9.30 pm	40	28	12
9.45 pm	41	27	14
10.00 pm	41	28.5	12.5
10.15 pm	41	27	14
10.30 pm	41.5	27	14.5
10.45 pm	41.5	27	14.5
11.00 pm	42	27	15
11.15 pm	42	27	15
11.30 pm	42	27	15
11.45 pm	42	27	15
12.00 pm	42	27	15

Table 4.1: Data Of Day 1

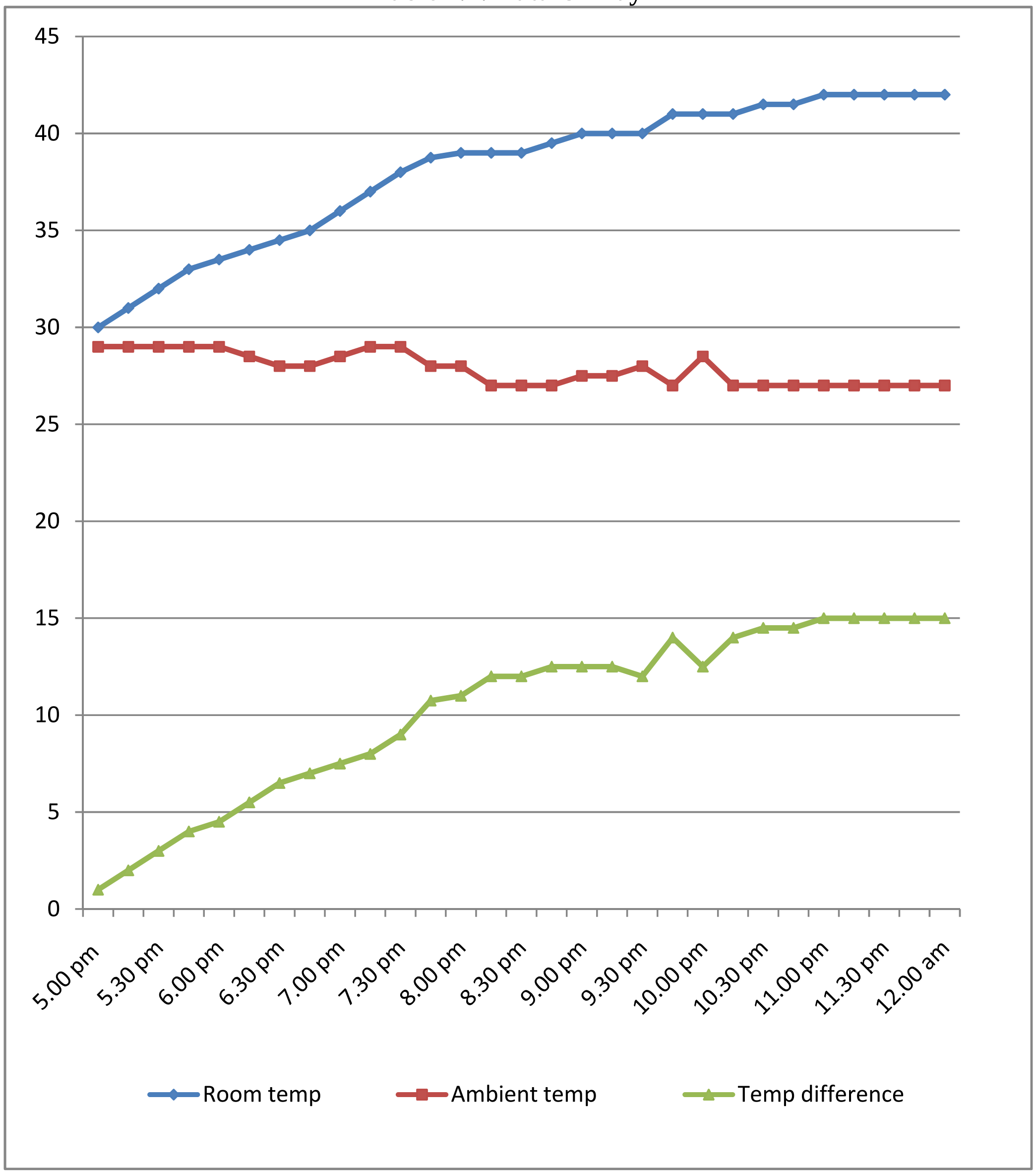

Fig4.1: Graph of day 1

From the graph we can see that, room temperature increases as time passes. Time is chosen from 5pm-12pm.to collects the data. From 5pm to 12pm temperature decreases slowly. Though the ambient temperature decreases slowly room temperature increases. Because in this experiment we have used the power of the battery not the direct solar power. If we used the direct solar power than the room temperature decreased with decreasing ambient temperature. Moreover the battery gives us a constant rate of power. So the room temperature increases in spite decreasing of ambient temperature

Again we know that,

$Q_{in}=Q_{absorbed}$

Or, $VIt = mcp\Delta T = \rho v C p \Delta T$

Or, $\Delta T = VIt / \rho v C p$

Or, $\Delta T = \frac{18\times12}{1.2\times10.16\times1.006}$

Or, $\Delta T = 17.89^{0}C$

Here $\Delta T = T_{Room} - T_{ambient}$. So $T_{room} = 17.80C + T_{Ambient}$.
This is the theoretical value & the actual value of the room is determined by a thermometer.
And heat loss,

$$Q = AU\Delta T$$

Or, $Q = 0.3681 \times .48 \times 12$

Or, $Q = 2.2969$ watt

So percentage of heat loss $= \frac{2.2969}{18 \times 12} \times 100$

$= 1.2\%$

The overall efficiency of this process $= \frac{43.35}{52.51} \times 100$

$= 0.8247 \times 100$

$= 82.47\%$

5.1. Theoretical vs. Actual Graph:

Day 1:

Time	Actual temp(^{0}C)	Theoretical temp(^{0}C)
5.00 pm	30	46.89
6.00 pm	33.5	46.89
7.00 pm	36	46.39
8.00 pm	39	45.89
9.00 pm	40	45.39
10.00 pm	41	46.39
11.00 pm	42	44.89
12.00 am	42	44.89

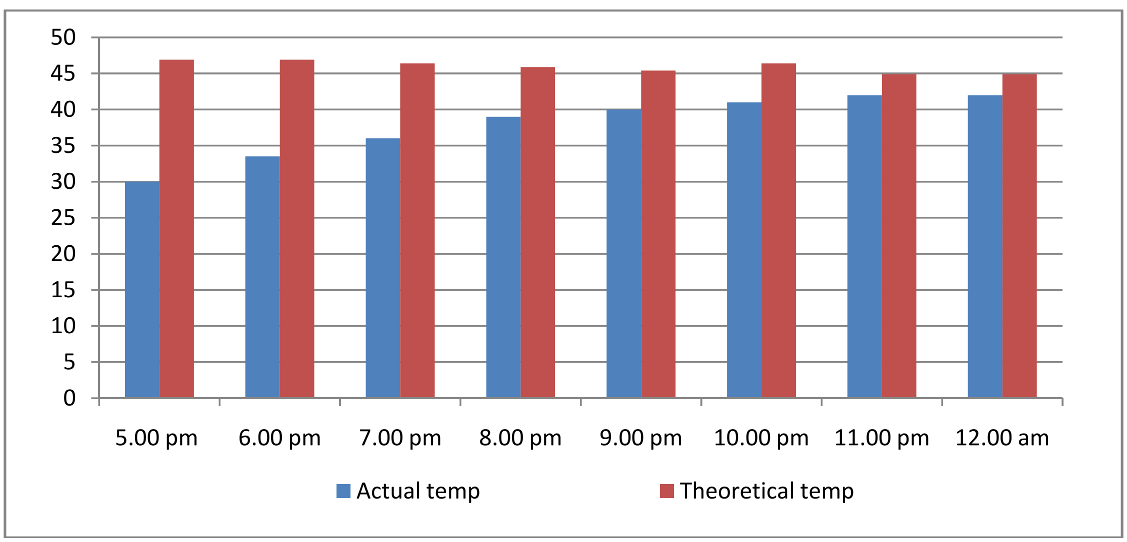

Fig 5.1: Theoretical vs. actual graph 1

From the graph we can see that the difference between the theoretical vs. actual graph of the day. Time is taken from 5-12 pm. At the beginning of the day, difference between the theoretical & actual more than the end of the day. At the end of the day the actual value reaches near to the theoretical value. Here the theoretical value gradually decreases & the actual value gradually increases with respect to time.

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Nomenclature

$\mathbf{Q_{in}}$=Heat inlet
$\mathbf{Q_{absorbed}}$=Heat absorbed
V=Voltage
I=Current
t=Time
m=Mass of the air
$\mathbf{C_p}$=specific heat of air
ΔT=Temperature difference
ρ=Density of air
A=Area of room
V=volume of room
U=Overall coefficient of heat transmission
η=Efficiency

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