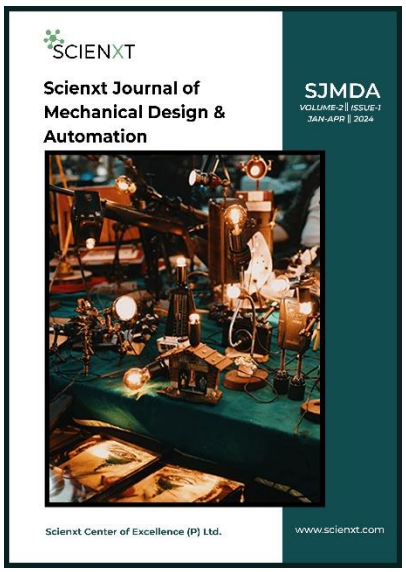

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"Solar-powered refrigeration innovation: compact, compressor-free cooling solution for remote environments"

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Abstract:

In Today's world global warming is being increasing year by year. There are many reasons like pollution, deforestation, water contamination, etc. In coming year, this project consists of peltier module, heat sink, charge controller, solar panel battery, micro-controller kit, wooden box etc. in this project peltier module is used where at one gets cooled and another side become hot and rejects heat to the environment with the help of fans for producing cooling effect this means that cooling is done without use of greenhouse gaseous.

Keywords:

Cooling fan, medicine refrigerator, solar plates, peltier etc.

1. Introduction:

Electrical generation is the leading cause of the industrial air pollution in the country. Most of our electricity comes from coal, nuclear and other non-renewable power plants. To producing energy from these resources takes a sever toll on our environment, polluting our air, land. Renewable energy sources can be used to produce electricity with fewer environment impacts. It is possible to make electricity from renewable energy sources without producing CO2. Renewable energy is the energy derived from natural resources that replenish themselves over a period of time without depleting the earth's resources. These resources also have the benefits of being abundant, available in some capacity nearly everywhere, and they cause little, if any environment damage. Energy from the sun, wind and thermal energy stored in the Earth's crust are examples. For comparison, Fossils fuels such as oil, coal, and natural gas are not renewable, Since their quantity is finite once we have extracted them they will cease to be available for use as an economically-viable energy source. While they are produced through natural processes, these processes are too slow to replenish these fuels as quickly as humans use them, so these resources will run out sooner or later. So this thesis project is intended at the development of a solar based compressor free mini fridge. This fridge will be suitable for cooling purposes meant for small objects and will have a relatively small chilling time as compared to normal refrigeration systems. Also for the backup, this fridge will be attached to a dynamo based charging system which will maintain the smooth operation of fridge in case of non-availability of solar power. In most of the rural areas of our country, the electric supply is either sporadically available or not available at all. The most sever effect of this problem is on the primary Health care Centers. Due to no electricity, most of the PHC'S do not maintain adequate supply of medicines and equipment which need to be kept in a cold environment. So in case of any emergency, the patient is to be referred either to the town or city hospital which results in loss of precious time and may prove fatal for the patient. Large areas of many developing countries have no grid electricity. This is a serious challenge that threatens the working of PHC centre. The main alternatives to electrically powered refrigerators available for many years- kerosene and gas-driven refrigerators are plagued by problems with gas supply interruptions, low efficiency, poor temperature control, and frequent maintenance needs. There are currently no kerosene-or gas-driven refrigerators that qualify under the minimum standards established by the World Health Organization (WHO) performance, quality, and safety (PQS) system

2. Working of the project:

2.1. Fridge:

1. The fridge is provided power supply form a 12 volt DC 7.5 amperes battery.
2. To start the fridge, the switch on the fridge is turned on.
3. When the switch is turned on, a led starts glowing indicating that the fridge is now online.
4. Now two Peltier thermoelectric devices which are insulated from the cooling side and arranges in the fridge generates cooling effect on inner side and heat is dissipated on outer side.
5. On the heat side of the peltier unit, a heat sink along with the fan works to dissipate the heat from the peltier unit in the outer environment.
6. The Peltier thermoelectric Device will be so arranged in a box with proper insulation system and heat sink so that efficient cooling takes place at all the time.
7. To turn off the fried, switch can be turned off. Then the glowing led will also stop glowing indicating no power for the fridge.

2.2. Battery charging:

The batteries used in the fridge are charged from the solar panels using a charge controller rated 12volts, 10 amps. The battery is connected to the charge. Controllers which get supply from the solar panels and feeds it to the battery.

3. Observations:

For evaluating the performance of our mini compressor-less solar fridge we tested it using a Fluke multimeter - 287 and data is recorded. Afterwards graph. Was prepared for the same by taking the data from the multimeter.

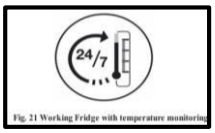

Fig. 21 Working Fridge with temperature monitoring

As shown in the above figure, it can be observed that the refrigerator is operational as led is glowing. Also in the background the multimeter is showing the temperature inside the refrigerator simultaneously in the real time. The following observations were recorded using the multimeter.

Reading	Sample	Start time	Duration	Max time	Max	Average	Min time	Min	Description	Stop time
1	30.9	26:02.4	0:12.8	26:02.4	30.9	30.05	26:05.4	29.7	Stable	26:15.2
2	29.6	26:02.4	00:07.1	26:02.4	29.6	28.9	26:08.4	28.07	Stable	26:10.0
3	28.3	26:02.4	00:08.07	26:02.4	28.3	27.8	26:03.4	28.4	Stable	26:05.0
4	27.1	26:02.4	00:18.9	26:02.4	27.1	26.5	26:04.4	27.2	Stable	26:06.0
5	26.0	26:02.4	04:39.9	26:02.4	26.0	26.1	26:03.4	26.1	Stable	26:05.0
6	24.9	31:29.8	00:08.7	31:29.8	24.9	24.4	31:30.8	25.0	Stable	31:30.0
7	23.9	31:29.8	00:17.3	31:29.8	23.9	23.5	32:30.8	24.0	Stable	32:31.1
8	22.9	31:29.8	00:45.7	31:29.8	22.9	22.4	33:30.8	23.0	Stable	33:31.0
9	21.9	31:29.8	01:02.2	31:29.8	21.9	21.7	33:31.8	22.0	Stable	35:10.8
10	20.9	31:29.8	00:17.3	31:29.8	20.9	20.4	34:30.8	21.0	Stable	39:30.5
11	19.9	31:29.8	00:28.6	31:29.8	19.9	19.4	31:31.8	20.0	Stable	40:31.8
12	18.9	31:29.8	01:29.0	31:29.8	18.9	18.3	35:30.8	19.0	Stable	42:30.0
13	17.8	31:29.8	03:30.7	31:29.8	17.8	17.6	36:30.8	17.9	Stable	42:31.0
14	17.4	31:29.8	00:06.8	31:29.8	17.4	19.3	37:29.8	17.2	Stable	40:31.8
15	17.4	31:29.8	00:17.0	31:29.8	17.4	19.7	38:29.8	18.9	Stable	42:30.0
16	17.3	31:29.8	00:44.9	31:29.8	17.3	18.5	38:21.8	19.0	Stable	40:31.8
17	17.1	40:37.9	00:24.5	40:37.9	17.1	18.0	40:35.9	18.0	Stable	42:30.0
18	17.0	40:37.9	03:48.8	40:37.9	17.0	17.5	40:36.9	17.9	Stable	42:31.0
19	16.9	44:51.2	03:17.1	44:51.2	16.9	16.9	44:49.2	17.0	Stable	44:34.5
20	16.9	48:08.3	00:00.0						Logging stop	46:31.5

Table1 Readings Table

As shown in the Table, from the readings given following observations can be made:

Starting temperature 30.9

Starting time 26 minute 2 seconds

O final stable temperature 16.9

Final time 48 minute 8 seconds

In the above, the temperature corresponds to the value taken inside the fridge using the temperature sensor of the Multimeter. Also from the table it is clear about the start logging instance and stop logging instance of the Multimeter.

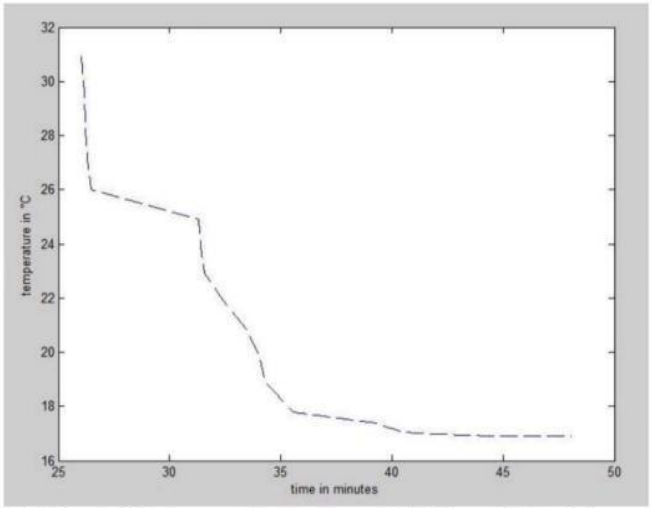

Fig.22 graph between Temperature V/s Time in Real time

Figure. 22: graph temperature V/s time in real time

From the above data it can be seen that the temperature variation is from 31 °C to 16.9 °C in 22 minutes giving us the temperature difference between surrounding and the box inside equal to 15 °C.

3.1. Battery Charging:

From this charge controller, a single battery of the above rating charges in approximately 40 minutes. So the two batteries are charged in 1 hour 20 minutes.

3.2. Electrical measurements:

The fridge is kept operational for the time period of 20 minutes for the readings and the observations. Regarding the electrical readings of the current, voltage and power being drawn following observations were made: by the fridge, a Multimeter is used for measuring all the quantities. From the readings, following observations were made:

Voltage Supply (V): 12 Volt DC

Voltage across peltier unit (V): 6 Volts DC.

Current drawn from the battery (1): 2.2 Amps

Power of one peltier unit (P): V?xI=6x2.2= 13.2 Watts

Total power of fridge: P, x2= 13.2x2=26.4 watts

So from the above readings, it can be concluded that this fridge total power: input is 26.4 watts. As one battery is of 84 watts, this fridge can works for continuous 3.2 hours when the battery is fully charged.

The cost analysis for this thesis project is as follows, all the components along with the miscellaneous cost are included in the total cost of this fridge.

Table. 2: Cost table

S.no.	***Name of the material/Equipment***	***Cost***
1	Peltier unit (x2)	700
2	Batteries(x2)	2000
3	Solar panel (100watts)	7000
4	Cooling fans(x2)	150
5	Heat sink(x2)	250

6	Solar charge controller	700
7	Insulation material	250
8	Box building material	150
9	Wiring material	150
10	Digital thermometer	200
Total		11,550

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10	Digital Thermometer	200
	Total	11,550

Table 2. Cost Table

As shown in the above table, the total cost of the project is Rs. 11550. In this total cost, solar panels accounts for the major portions while the overall individual cost of the fridge is Rs. 3500.In the mass production of the fridge, the overall cost of the fridge will be reduced substantially making it cheap and economical for the user. Also with the same solar panels, multiple units of the fridge can be attached making it more cost effective in nature.

4. Results:

The aim of the development of the fridge is to provide efficient and effective cooling in the designated locations and places. As observed from the data above, this fridge is capable of maintaining an inner temperature of 16.5 °C after 20 minutes of continuous power supply and is maintaining it at a constant rate, Also when the battery will be fully charged, Fridge will remain operational for the time period of 3.2 hours after which the battery will be discharged and the temperature inside the fridge will increase at a very slow rate due to the insulation

provided. On the basis of the above data it can be said that the above fridge can be easily used for the small chilling operations where cooling is required in a small time.

This system is provided with a solar panel charge controller which can be easily I used to charge the battery from the solar panels. In addition the battery charger which runs on normal 220 volt ac supply is provided which can be used to charge the batteries.

5. Conclusion and future scope:

Solar power nowadays is playing a major role in meeting the energy requirements of our country. It is being developed at a very fast rate and its applications in many areas are being explored. The fridge is intended at exploring the same and provides an efficient and economical solution to the areas where there is no electricity and cooling is required.

This project main objective was to develop a mini compressor less solar fridge and this has been successfully done. The applications of this fridge are very wide and it can be used in various places for variety of operations. Also the main purpose for which this fridge is made is being fulfilled as the space inside the fridge is sufficient enough to cool appropriate amount of medicines and injections needed at the primary health care centres in the villages where there is sporadic or no power supply.

Though this fridge is working satisfactorily to its full capacity, still many changes and improvements can be done in this fridge to make it more users friendly and sophisticated in nature. This measures and changes, if implemented. Can play an important role in the future models to be developed. Some of these measures and changes are:

Number of peltier units can be increased to further decrease the temperature inside the fridge. Same fridge can be used for heating purpose if we also insulate the other side i.e. heating side of the fridge within the box. To increase the volume of the fridge maintaining the same temperature inside the fridge, number of peltier units and heat sink has to be increased.

PID controllers can be used for making it a temperature controlled fridge. This fridge can also be equipped with a LCD display and digital temperature sensor so that the temperature inside the fridge can be monitored.

In this project, this fridge is made up of Thermocol and aluminium foils. Wooden material can be used to make this fridge mores study in constructions. Wood will also act as an additional insulator for the. Cooling compartment.

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