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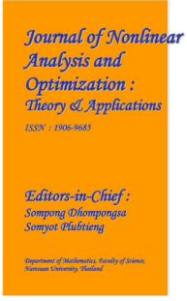

SOLAR AND WIND-POWERED REFRIGERATOR AND OVEN: SUSTAINABLE ENERGY SOLUTIONS

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ABSTRACT

Using a thermo electric plate, the project's primary goal is to build a solar and wind-powered refrigerator cum oven. Solar and wind power, which are abundant and cheap, may be used to fuel this endeavour. The cost of this undertaking won't break the freezer. The solar panels and wind turbines in this project are used to recharge a Lead Acid Battery (12V, 1.2 Amp hours), which is then used to power a pelteir thermoelectric device that can provide either a cooling or warming effect, depending on the user's preference. Since this is going in a refrigerator, we need simply the cold setting. The battery is linked to a peltier thermoelectric device, which produces a cooling effect. PIC Microcontroller is being used to show the voltage. The polarity of the peltier plate may be switched by relay and a selection switch.

exhaust fan PIC microcontroller solar wind LCD battery Thermo electric plate relay

1. Introduction.

Thermoelectric heating (or cooling) technology has received renewed interest recently due to its distinct features compared to conventional technologies, such as vapour-compression and electric heating (or cooling) systems.

Thermoelectric (TE) modules are solidstate heat pumps (or refrigerators in case of cooling) that utilize the Peltier effect between the junctions of two semiconductors. The TE modules require a DC power supply so that the current flows through the TE module in order to cause heat to be transferred from one side of the TE module to other, thus creating a hot and cold side.

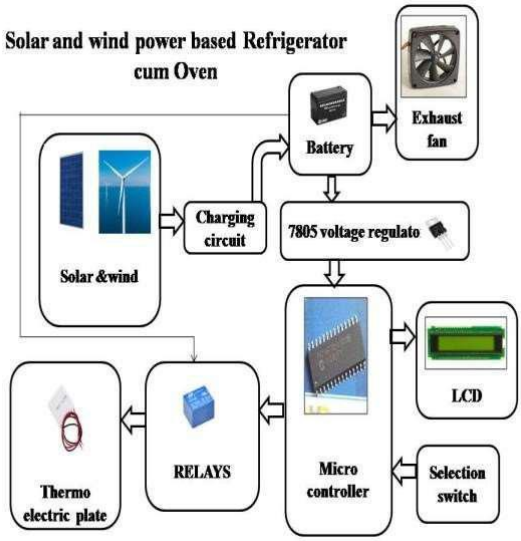
The model could be helpful for analyzing the drive requirement of TECs and loading effect of TEGs. Another important application of proposed model is when the performance of the TEM needs to be analyzed under specific conditions such as heat leakage, non-ideal thermal insulation etc. Using the model can analyzed not only existing modules, but also specify an optimal module for a specific problem. The present model is compatible with PSPICE or other electric circuit simulators for DC, AC, and TRANSIENT simulation types and will thus be an excellent tool for solving problems of temperature control. In this project we are using renewable energies such as solar, wind and the generated energy is stored into the rechargeable battery though charging circuit. This battery power is uses for peltier plate. Peltier modules contain two external ceramic plates separated by semiconductor pellets. One of the plates absorbs heat (becomes cooler) and the other plate dissipates heat (becomes hotter) when a current is passed through the semiconductor pellets.

2. LITERATURE SURVEY

Jincan Chena et al.,[1]:-According to non equilibrium thermodynamics ,cycle models of single stage and two stage semiconductor thermoelectric refrigeration were experimentally investigated. By using the three important Parameters which governs performance of thermoelectric refrigerator i.e. coefficient of performance (COP), the rate of refrigeration, and the power input, development of general expressions performances of the two stage thermoelectric refrigeration system took placed. It was concluded that performance of thermoelectric refrigerator depends on temperature ratio of heat sink to cooled space. When this ratio is small, the maximum value of COP of a two stage Thermoelectric refrigeration system is larger than COP of a single stage thermoelectric refrigeration system; however maximum rate of refrigeration is smaller than that of a single stage thermoelectric refrigeration system. Hence it is convenient to use single stage thermoelectric refrigerator when ratio is small. When temperature ratio is large two stage thermoelectric refrigerators is observed to be superior to single stage by both parameters i.e. maximum value of COP and maximum rate of refrigeration.

X.C. Xuan ETal., [2]: In this paper Two stage thermoelectric refrigerator was investigated with two design configurations. Two configurations were pyramid style and cuboids style as shown in respective figures. In pyramid style configuration top side is being coldest as current is unidirectional. In cuboid style configuration current can be alternated causing top and bottom side to be switched between heating and cooling mode. To obtain optimization methods other multi stage designs can be used. The point of maximum cooling capacity and maximum COP both were taken into consideration while investigation for optimization for the two stage TE coolers. It was concluded that value lies between 2.53 for both parameters that is optimum limit of ratio of number of Thermo electric modules of two stages in pyramid style TE cooler and optimum limit of ratio of electric current between stages of cuboid style TE cooler. Maximum temperature difference of pyramid style cooler is greater than single stage cooler.

3. Implementation:



In this project LCD, relay, selection switch is connected to the Micro controller. The micro controller displays the status on LCD. Thermo electric plate works with peltier effect, on applying DC, the array of pellet having positive and negative charge carriers absorb heat energy from one substrate and eventually release it to the substrate at opposite side. In this process, cold surface appeared due to absorption of heat energy. This absorbed heat energy is being released to the opposite surface, becomes hot. Exhaust fan is attached to the system to spread the cooling to the surroundings. We are connecting peltier plate through

relays. And we are using selection switch for changing the supply polarities of the peltier plate through relay so the system works cooling and heat means refrigerator cum oven.

4. Related Work:

The brief introduction of different modules used in this project is discussed below:

PIC Microcontroller:

This powerful (200 nanosecond instruction execution) yet easy-to-program (only 35 single word instructions) CMOS FLASHbased 8-bit microcontroller packs Microchip's powerful PIC® architecture into an 28-pin package and is upwards compatible with the PIC16C5X, PIC12CXXX and PIC16C7X devices. The PIC16F872 features 64 bytes of EEPROM data memory, self programming, an ICD, 5 channels of 10-bit Analog-to-Digital (A/D) converter, 2 additional timers, a capture/compare/PWM functions and the synchronous serial port can be configured as either 3-wire Serial Peripheral Interface (SPI™) or the 2-wire Inter-Integrated Circuit (I²C™) bus. All of these features make it ideal for more advanced level A/D applications in automotive, industrial, appliances and consumer applications.

Solar panel:

Fig:solar panel

Photons in sunlight hit the solar panel and are absorbed by semi conducting materials, such as silicon. Electrons (negatively charged) are knocked loose from their atoms, allowing them to flow through the material to produce electricity. Due to the special composition of solar cells, only allow the electrons to move in a single direction.

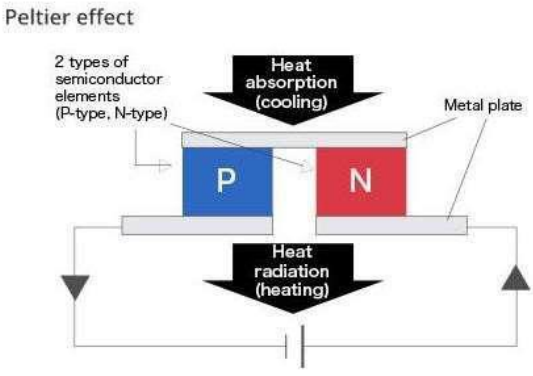
The complementary positive charges that are also created (like bubbles) are called holes and flow in the direction opposite of the electrons in a silicon solar panel. An array of solar panels converts solar energy into a usable amount of direct current (DC) electricity.

Wind:

Wind power or wind energy describes the process by which the wind is used to generate mechanical power or electricity. Wind turbines convert the kinetic energy in the wind into mechanical power.

In this project solar, wind energies are stored into the rechargeable battery to operate the Refrigerator cum Oven.

THERMOELECTRIC PLATE:



PRINCIPLES OF OPERATION

The Peltier effect is named after Jean Charles Athanase Peltier who discovered it by accident while investigating electricity. In the eventful experiment, Peltier joined a copper and a bismuth wires together and connected them to each other, then to a battery. When he switched the battery on, one of the junctions of the two wires got hot, while the other junction got cold.

An LCD is an electronic display module which uses liquid crystal to produce a visible image. The 16×2 LCD display is a very basic module commonly used in DIYs and circuits. The 16×2 translates o a display 16 characters per line in 2 such lines.

Exhaust fan:

One of the most common devices attached to a micro controller is an LCD display.

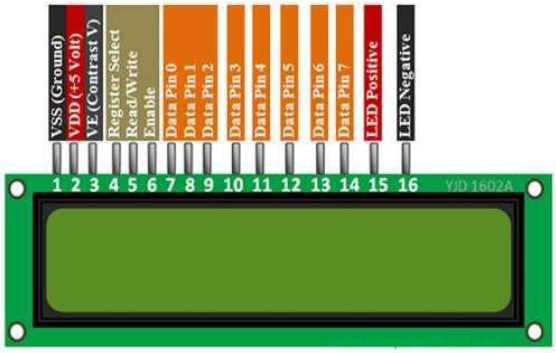
DC 12V cooling fan uses a motor to turn its blades, which function to pull air out of the space. We can fix this fan peltier plate heat side so the fan pulls the air out.

Relay:

Relay is an electromagnetic switch. It consists of a coil of wire surrounding a soft iron core, an iron yoke, which provides a low reluctance path for magnetic flux, a movable iron armature, and a set, or sets, of contacts; two in the relay pictured. The armature is hinged to the yoke and mechanically linked to a moving contact or contacts.

When an electric current is passed through the coil, the resulting magnetic field attracts the armature and the consequent movement of the movable contact or contacts either makes or breaks a connection with a fixed contact.

We are connecting peltier plate through relays. And we are using selection switch for changing the supply polarities of the peltier plate through relay.



The Peltier effect is the heat exchange that results when electricity is passed across a junction of two conductors, and is a close relative of the Seebeck effect (effectively the same phenomenon in reverse, used in thermocouples used to measure temperature), and the Thomson effect (generation of electricity along a conductor with a temperature gradient). Sparing ourselves the maths, conduction electrons have different energies in different materials, and so when they are forced to move from one conductor to another, they either gain or lose energy. This difference is either released as heat, or absorbed from the surroundings.

When two conductors are arranged in a circuit, they form a heat pump, able to move heat from one junction to the other. Unfortunately, though, it's not always this simple, as the Peltier effect is always up against the Joule effect – the 'frictional' heating that results from electrons bouncing off the atoms. In most systems, this swamps the Peltier effect, and means that all that you get is a bit more heating at one junction, and a bit less heating at the other. Nonetheless, the Peltier effect has a lot of technological potential. It is very reliable, and since it has no moving parts, it rarely needs maintenance while being mobile.

LCD:

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We would like to thank all the authors of different research papers referred during writing this paper. It was very knowledge gaining and helpful for the further research to be done in future.

Conclusion:

The TE devices can act as coolers, heat pumps, power generators, or thermal energy sensors and are used in almost all the fields such as military, aerospace, instrument, biology, medicine, industrial or commercial products. The major challenge faced in TE cooling is lower COP especially in large capacity systems. However, as the energy costs are elevating and environmental regulations regarding the manufacture and release of CFCs have become more firm with time. TE chilling of beverage can be done at the farm level to inhibit any enzymatic or microbial change in quality of the beverage. Research in `the field of thermoelectricity and experimentation with different materials is required to improve the COP of the TE cooler. In the coming years thermoelectricity has a lot of potential to create energy saving and effective solutions for the industry and commercially as well. This system able to use the solar and wind energies to operate the refrigerator and oven which is economically free sources.

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