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PORTABLE SOLAR COOLER AND HEATER

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Abstract - *The aim of this paper is to develop a portable cooling and heating device in compact size using solar energy. In present day life many new electronic gadgets are introduced in the market. Cooler boxes and food warmer are available in the market to cool and hot the food, but these devices are not portable and are powered with home supply. The Proposed device is portable in nature. Solar power is used as a power source and rechargeable batteries are used to store the energy. This system may be used at any remote location when people are going out. It is very easy to carry while travelling and emergency purposes. This system is implemented with Peltier Module.*

1. INTRODUCTION

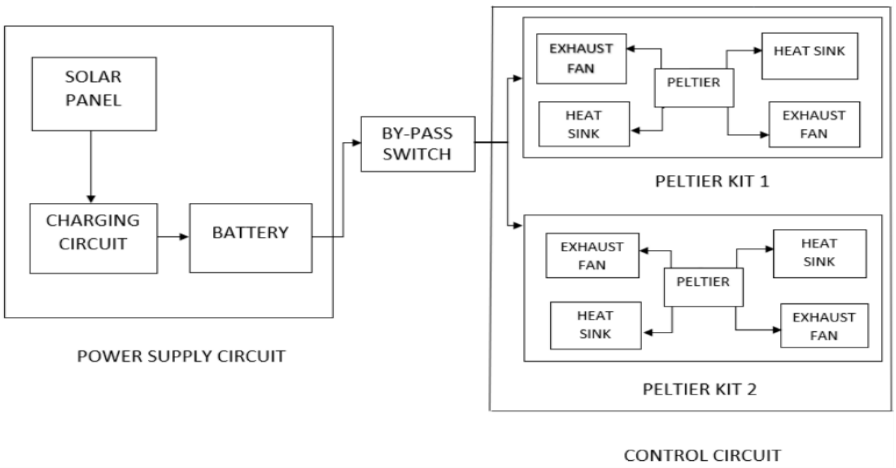
Portable cooling and heating system has the advantages of easily carrying to any place. The limitation of electrical Power to the system is over come by providing alternate supply system from solar panel. The reliability of power supply is maintained with the help of batteries. Lithium ion cells are now-a- days compact in nature with less weight. The overall system may be handy and easily portable. The system can be used with dual power sources that is home supply as well as from solar panel.

2. EXISTING SYSTEM

The refrigerators and electric heaters, electric ovens are available as standalone units and used widely for cooling and heating purpose. The existing refrigerators take more power consumption and space due to complex design which includes compressors, refrigerants, condenser and supportive components for cooling. Because of these complex design components, the refrigerator is not portable, environmentally unfriendly and dangerous if not disposed in a proper manner. The presence of chlorofluorocarbon (CFC) content in the refrigerant cause damage to the environment .This material should be recycled otherwise the CFCs can leak into the atmosphere and this material is suspected to be the cause of depletion of the earth's ozone layer.

The existing electrical heating system consists of bulk inductive coils, thermostats and voltage regulators. The inductive coils are heavy in weight and occupying more space. Heat is transmitted in these systems by conduction, convection and radiation. Providing thermal insulation to the heating system is also a challenging task. They are not handy and often develop faults which leads to shorter life and more maintenance.

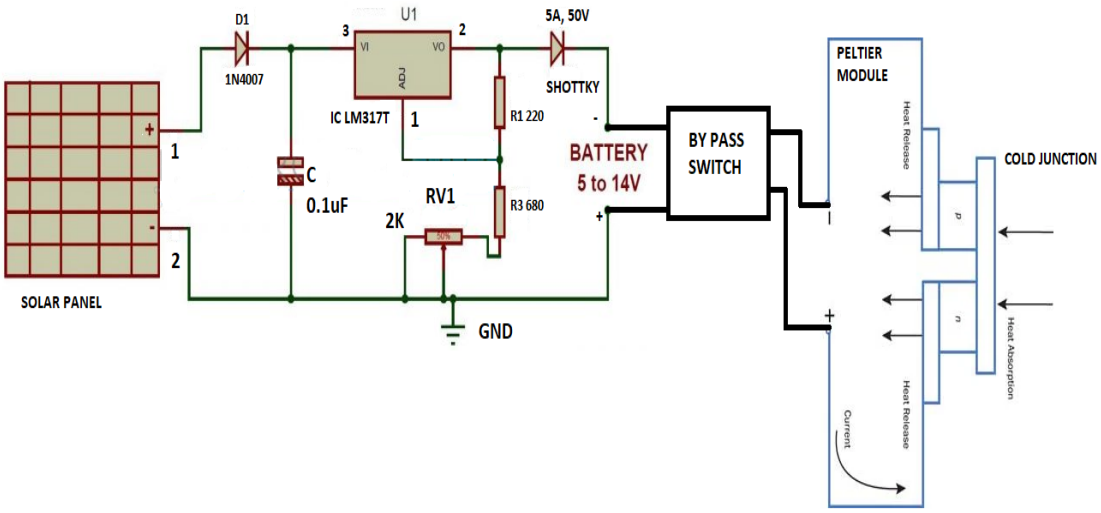
BLOCK DIAGRAM OF PROPOSED SYSTEM



The proposed system is an integrated one and portable in nature. It is lighter in weight, smaller in size and effective for both cooling and heating process. The block diagram consists of power supply circuit and control circuit. The power supply circuit consist of solar panel, charging circuit and battery. The bypass switch is used to select the cooling and heating operation

required in the chamber. The control circuit includes two Peltier kits. Both are used for cooling and heating process. Peltier modules are made of two dissimilar semiconductor materials. They are placed as thermally in parallel and electrically in series and they are joined by thermal plates to allow heat or to flow from one side to another. When an emf is applied to it, the cold side pumps the heat and transfer it to the hot side. By reversing the current, the Peltier plate make the hot side as cold and vice versa. A thermoelectric cooler (TEC) consists of thermocouples connected electrically in series and sandwiched between two Alumina ceramic plates.

OVER ALL CIRCUIT DIAGRAM



3. HARDWARE DESCRIPTION

3.1 PELTIER - This module act as a heat pump. The surface where heat energy is absorbed will be cold, and the opposite surface where heat energy is released becomes hot. The following ratings of Peltier Module is used in this prototype system

Maximum voltage = 12 V; Maximum current = 6 A; Peltier model = Tec1-12706; (Tmax) = 68 °C.;

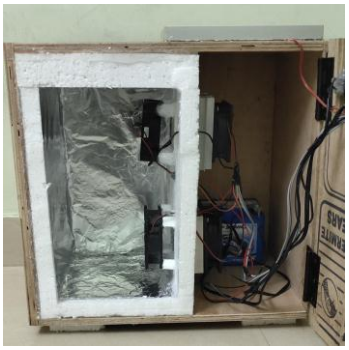
No of memory sticks = 5; The brand used is Robocraze.

3.2 SOLAR PANEL - Most solar cells are a few square centimeters in area and protected from the environment by a thin coating of glass or transparent plastic. A solar module generally consists of 36 interconnected cells laminated to glass within an aluminum frame. In turn, one of these modules may be wired and framed together to form a solar panel. The ratings of solar panel used here is

Nominal output voltage – 12 V ; Number of cells - 36 ; Open Circuit Voltage (Voc) – 22 V
Max Power Volts (Vmp) - 18 V.

3.3 CHARGING CIRCUIT- The circuit used for solar energy to charge a 12 V, 4.5 Ah rechargeable battery. The charger circuit includes voltage and current regulation functioning and over voltage cut-off facilities. The circuit uses a 12 V solar panel and a variable voltage regulator IC LM 317. Transistor T1 and Zener diode Z_D act as a cut off switch when the battery is fully charged. Normally T1 is off and battery starts charging current. When the terminal voltage of the battery rises above 6.8V, Zener conducts and provides base current to T1. It then turns on grounding the output of LM317 and stop charging.

HARDWARE



OUTPUT ANALYSIS (COOLING) OUTPUT ANALYSIS (HEATING)

The above hardware is the prototype model. The output is analyzed for cooling and heating selection inside the compartment. The following Table interprets the time required to achieve the temperature when used as cooler or heater. When the set temperature is achieved inside the compartment, supply to Peltier module is cut off and switched on once the inside compartment temperature is either reduced or increased in the case of cooler or heater.

TABULATION AND RESULT INTERPRETATION

S.NO	Time (in min)	Temperature of Cooling (in °C)	Temperature of Heating (in °C)
1	4	30.01	38.02
2	8	25.2	45.06
3	12	20.35	51.07
4	16	18.02	56.04
5	20	16.7	61.2

4. CONCLUSION

The proposed system is an integrated unit used as a cooler or heater which is portable and handy. Since the base unit is of less weight it can be taken to any remote places. The dual power sources helpful to maintain reliability of heating and cooling. The Peltier module is a semiconductor device which can be easily controlled for required function inside compartment. It replaces conventional compressor, condenser, heating coils. The major advantage of this system is Low maintenance and environment friendly.

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