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SOLAR REFRIGERATOR

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ABSTRACT

A solar-powered refrigerator is a refrigerator which runs on electricity provided by solar energy. This system consists of embedded system, Solar panel, Charger, Battery Display, Embedded system, ADC, Temperature sensor, Driver, Peltier Module, Temperature controlled module and Keypad. The solar panel is used to convert the heat energy into electrical energy and it is given to the charger, the charger is controlled by the embedded system and the output of the charger is given to Battery. Again the Battery voltage is given to the ADC.The temperature sensor is used to measure the temperature of the chamber and the output of the temperature sensor is given to ADC. The Embedded system is programmed like that when it receives the signal from the keypad it checks the temperature of the chamber and activates the Driver. The Driver is used to drive the Peltier module. Peltier is a Module which Generate voltage when there is a different temperature on each side. Conversely, when a voltage is applied to it, it creates a temperature difference. So by using the Peltier module we can cool and heat the chamber. The keypad is used to set the Temperature value to the chamber and at the same time the Display used in this system to display the process carried out in the system.

Key words:

Solar panel, Peltier module, chamber, Embedded system

INTRODUCTION

The solar refrigerator comprises of all the traditional components like the compressor, condenser, expansion valve and the evaporator or the freezer. The power is supplied not by the domestic electrical supply system, but from the solar panel.

There is environmental concern regarding conventional refrigeration technologies including contribution to ozone layer depletion and global warming. Refrigerators which contain ozone depleting and global warming substances such as chlorofluorocarbons (CFCs), in their insulation foam or their refrigerant cycle, are the most harmful. After CFCs were banned in the 1980s, they were replaced with substances such as hydro chlorofluorocarbons (HCFCs), which are ozone-depleting substances and hydro fluorocarbons (HFCs). Both are environmentally destructive as potential global warming chemicals. If a conventional refrigerator is inefficient or used inefficiently, it will also contribute more to global warming than a highly efficient refrigerator. The use of solar energy to power refrigeration strives to minimize the negative impacts refrigerators have on the environment

Traditionally solar-powered refrigerators and vaccine coolers use a combination of solar panels and lead batteries to store energy for cloudy days and at night in the absence of sunlight to keep their contents cool. These fridges are expensive and require heavy lead-acid batteries which tend to deteriorate, especially in hot climates, or are misused for other purposes. In addition, the batteries require maintenance, must be replaced approximately

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every three years, and must be disposed of as hazardous wastes possibly resulting in lead pollution. These problems and the resulting higher costs have been an obstacle for the use of solar powered refrigerators in developing areas.

In the mid-1990s NASA JSC began work on a solar powered refrigerator that used phase change material rather than battery to store "thermal energy" rather than "chemical energy." The resulting technology has been commercialized and is being used for storing food products and vaccines.

Solar energy is the ultimate source of energy from millions of years and it is a renewable energy. This energy consists of radiant light and heat energy from the sun. Out of all energy emitted by the sun only a small fraction of energy is absorbed by the earth. Just this tiny fraction of the sun's energy that hits the earth is enough to meet all our power needs. Using present solar techniques some of the solar energy reaching the earth is utilized for generating electricity etc.….

II. LITERATURE REVIEW

Solar energy based temperature controlled chamber is presented in "solar refrigerator for vaccines in rural areas". This technique is primarily concentrated in the medical area. Using the Peltier module the temperature controlled chamber is utilized for the dual purposes i.e. cooling and warming. As the temperature controlled chamber is compact and easy to carry the vaccines to rural regions, it is mainly designed. This organization concentrates on solar energy in order to avert the environmental contamination. The existing system outlines the implementation of cooling and heating in an exclusive unit. The conflict between the existing and projected system is, both chilling and heating takes place in the individual unit.

A solar energy semiconductor cooling box is implemented by Shun Chen, Jun Zuo and Dan Xie (2010). The cooling box is compact and easy to carry, can be made a special refrigeration unit which is smaller according to user needs. The characteristics of the cooling box are its simple use and maintenance, safe performance, decentralized power supply, convenient energy storage, no environmental pollution, and so on. This paper states that when compared to normal mechanical refrigeration, the semiconductor refrigeration system does not require pumps, compressors and other moving parts and so there will not be any noise .It does not require refrigeration so it will not produce environmental pollution. In order to achieve the purpose of cooling, solar cells generate electricity to drive the semiconductor cooling devices. These results clearly indicate that the control charging circuit through PWM, allows solar panels to reach maximum efficiency and improve the efficiency of the system charge. The working principle that was used in this system is a mainly photovoltaic effect and the Peltier effect.

III. PROPOSED SYSTEM

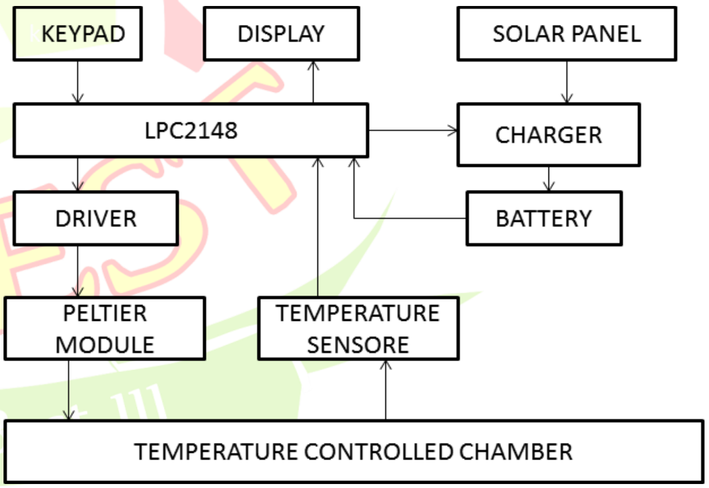

Figure.1 Over all block diagram of proposed system

SOLAR PANEL

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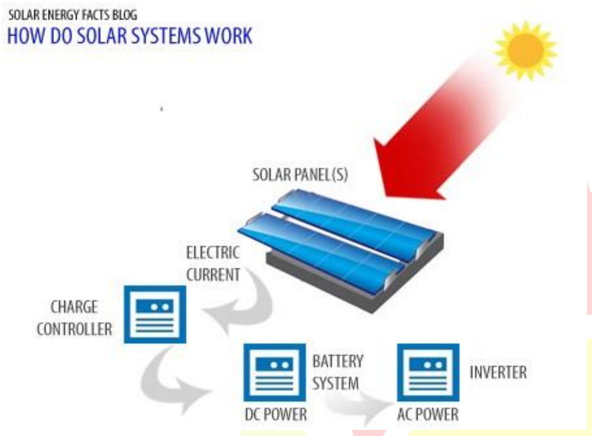

Figure.2 flow diagram for solar panel process

Solar panel designed to absorb the sun's rays as a source of energy for generating electricity or heating. the more solar energy can be converted to electricity by the solar panel .a solar panel works by allowing photons, or particles of light, to knock electrons free from atoms, generating a flow of electricity. Solar panels actually comprise many, smaller units called photovoltaic cells. the solar panels function via the photoelectric effect whereby certain materials create an electric current when the sun shines on them. The solar panels themselves are made up of silicon crystals where each half is doped with a different dopant to produce a semiconductor. When the sun hits the surface of the solar panel it provides the energy needed for the semiconductor to produce a direct current (DC)

Solar panels are comprised of several individual solar cells. Each of these cells uses light to make electrons move. These solar cells function similarly to large semiconductors and utilize a large-area p-n junction diode. When the solar cells are exposed to sunlight, the p-n junction diodes convert the energy from sunlight into usable electrical energy. The energy generated from photons striking the surface of the solar panel allows electrons to be knocked out of their orbits and released, and electric fields in the solar cells pull these free electrons in a directional current, from which metal contacts in the solar cell can generate electricity. the more total electrical output the solar panel can produce. The conversion of sunlight to usable electrical energy has been dubbed the Photovoltaic Effect. The photovoltaic effect arises from the properties of the p-n junction diode, as such there are no moving parts in a solar panel. Solar Insolation is a measure of how much solar radiation a given solar panel or surface receives Other factors that affect the output of solar panels are weather conditions, shade caused by obstructions to direct sunlight, and the angle and position at which the solar panel is installed. Solar panel efficiency can be optimized by using dynamic mounts that follow the position of the sun in the sky and rotate the solar panel to get the maximum amount of direct exposure during the day as possible

PELTIER MODULE

Thermoelectrics is the science and technology associated with thermoelectric converters, that is, the generation of electrical power by the Seebeck effect and refrigeration by the Peltier effect, Thomson effect

The Seebeck effect is a phenomenon in which a temperature difference between two dissimilar electrical conductors or semiconductors produces a voltage difference between the two substances.

Thomson effect is related to the emf that develops between two parts of the single metal when they are at different temperature. Thus Thomson effect is the absorption or evolution of heat along a conductor when current passes through it when one end of the conductor is hot and another is cold

The Peltier effect is a temperature difference created by applying a voltage between two electrodes connected to a sample of semiconductor material. This phenomenon can be useful when it is necessary to transfer heat from one medium to another on a small scale. In a Peltier-effect device, the electrodes are typically made of a metal with excellent electrical conductivity.

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The semiconductor material between the electrodes creates two junctions between dissimilar materials, which, in turn, creates a pair of thermocouple voltage is applied to the electrodes to force electrical current through the semiconductor, thermal energy flows in the direction of the charge carriers.

Working of peltier module

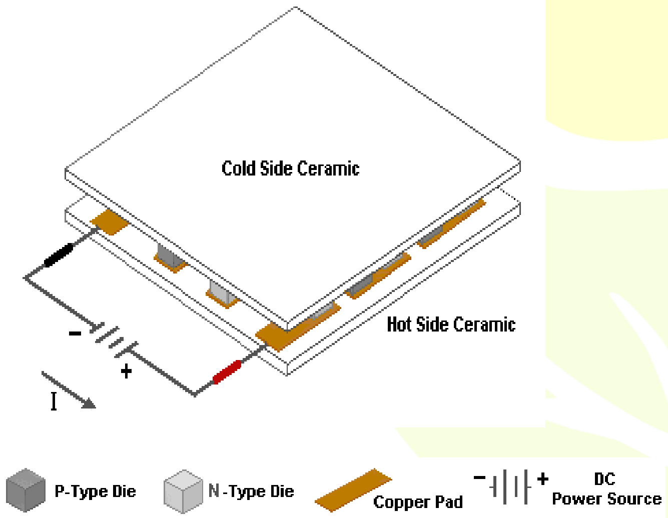

Figure 3. Structure of peltier module

A typical thermoelectric module is composed of two ceramic substrates that serve as a foundation and electrical insulation for P-type and N-type Bismuth Telluride dice that are connected electrically in series and thermally in parallel between the ceramics. The ceramics also serve as insulation between the modules internal electrical elements and a heat sink that must be in contact with the hot side as well as an object against the cold side surface. An electrically conductive material, usually copper pads attached to the ceramics, maintain electrical connections inside the module. Solder is most commonly used at the connection joints to enhance the electrical connections and hold the module together.

Most modules have and even number of P-type and N-type dice and one of each sharing an electrical interconnection is known as, "a couple." The above module would be described as an 11-couple module.

While both P-type and N-type materials are alloys of Bismuth and Tellurium, both have different free electron densities at the same temperature. P-type dice are composed of material having a deficiency of electrons while N-type has an excess of electrons. As current (Amperage) flows up and down through the module it attempts to establish a new equilibrium within the materials. The current treats the P-type material as a hot junction needing to be cooled and the N-type as a cold junction needing to be heated. Since the material is actually at the same temperature, the result is that the hot side becomes hotter while the cold side becomes colder. The direction of the current will determine if a particular die will cool down or heat up. In short, reversing the polarity will switch the hot and cold sides.

Leads to the modules are attached to pads on the hot side ceramic. If the module is sealed you can determine the hot side without applying power. With the module on a flat surface, point the leads toward you with the positive lead, usually in red wire insulation, on the right. The bottom surface will be the hot side.

Material researchers are investigating the use of other materials to improve the efficiency of thermoelectric modules but Bismuth Telluride remains the most economical material for cooling modules used in ambient temperature applications. However, at low temperature (around minus 110 degrees Celsius) this material stops becoming a semiconductor and performance is severely diminished. Typically, the highest temperature that modules can operate is the melting point of the solder inside, usually + 150 or 200 °C (302 or 392° F).

Some Bismuth Telluride based modules for power generation applications are fabricated with high melting temperature solder or without solder entirely. Some of these may be used at temperatures up to +400°C.

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TEMPERATURE SENSOR

LM35 is a precision IC temperature sensor (in C). With LM35, temperature can be measured more accurately than with a thermistor . The operating temperature range is from -55°C to 150°C. The output voltage varies by 10mV in response to every C rise/fall in ambient temperature, i.e., its scale factor is 0.01V/ oC. it give the readings in centigrade since its output voltage is linearly proportional to temperature. It uses the fact that as temperature increases, the voltage across diode increases at known rate.

The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 device does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C.Lower cost is assured by trimming and calibration at the wafer level.

POWER SUPPLY

The LPC2148 supports two reduced power modes: Idle mode and Power-down mode.In Idle mode, execution of instructions is suspended until either a reset or interrupt occurs. Peripheral functions continue operation during Idle mode and may generate interrupts to cause the processor to resume execution. Idle mode eliminates power used by the processor itself, memory systems and related controllers, and internal buses.

In Power-down mode, the oscillator is shut down and the chip receives no internal clocks. The processor state and registers, peripheral registers, and internal SRAM values are preserved throughout Power-down mode and the logic levels of chip output pins remain static. The Power-down mode can be terminated and normal operation resumed by either a reset or certain specific interrupts that are able to function without clocks. Since all dynamic operation of the chip is suspended, Power-down mode reduces chip power consumption to nearly zero.

Selecting an external 32 kHz clock instead of the PCLK as a clock-source for the on-chip RTC will enable the microcontroller to have the RTC active during Power-down mode. Power-down current is increased with RTC active. However, it is significantly lower than in idle mode. A Power Control for Peripherals feature allows individual peripherals to be turned off if they are not needed in the application, resulting in additional power savings during active and idle mode.

KEYPAD

This Application Note describes programming techniques implemented on the LPC2148 ARM-based microcontroller for scanning a 4x4 Keyboard matrix usually found in both consumer and industrial applications for numeric data entry.,LPC2148Keyboard interface In this application, a 4x4 matrix keypad requiring eight hot cooling ports for interfacing is used as an example.Rows are connected to Peripheral Input/Output (PIO) pins configured as output. Columns are connected to PIO pins configured as input with interrupts. In this configuration, four pull-up resistors must be added in order to apply a high level on the corresponding input pin. The corresponding hexadecimal value of the pressed key is sent on four LCDs.

EMBEDDED UNIT

LPC2148 MICRO CONTROLLER

LPC2148 is the widely used IC from ARM-7 family. It is manufactured by Philips and it is pre-loaded with many inbuilt peripherals making it more efficient and a reliable option for the beginners as well as high end application developer.

• 8 to 40 kB of on-chip static RAM and 32 to 512 kB of on-chip flash program memory.128 bit wide interface/accelerator enables high speed 60 MHz operation.

• In-System/In-Application Programming (ISP/IAP) via on-chip boot-loader software.Single flash sector or full chip erase in 400 ms and programming of 256 bytes in 1ms.

• Embedded ICE RT and Embedded Trace interfaces offer real-time debugging with theon-chip Real Monitor software and high speed tracing of instruction execution.

• USB 2.0 Full Speed compliant Device Controller with 2 kB of endpoint RAM. In addition, the LPC2146/8 provides 8 kB of on-chip RAM accessible to USB by DMA.

• One or two (**LPC2141/2 vs. LPC2144/6/8**) 10-bit A/D converters provide a total of 6/14analog inputs, with conversion times as low as 2.44 us per channel.

• Single 10-bit D/A converter provides variable analog output.

• Two 32-bit timers/external event counters (with four capture and four compare channels each), PWM unit (six outputs) and watchdog.

• Low power real-time clock with independent power and dedicated 32 kHz clock input.

• Multiple serial interfaces including two UARTs (16C550), two Fast I2C-bus(400 kbit/s), SPI and SSP with buffering and variable data length capabilities.

• Vectored interrupt controller with configurable priorities and vector addresses.

• Up to 45 of 5 V tolerant fast general purpose I/O pins in a tiny LQFP64 package.

• Up to nine edge or level sensitive external interrupt pins available.

• On-chip integrated oscillator operates with an external crystal in range from 1 MHz to30 MHz and with an external oscillator up to 50 MHz.

• Power saving modes include Idle and Power-down.

• Individual enable/disable of peripheral functions as well as peripheral clock scaling foradditional power optimization.

• Processor wake-up from Power-down mode via external interrupt, USB, Brown-OutDetect (BOD) or Real-Time Clock (RTC).

• Single power supply chip with Power-On Reset (POR) and BOD circuits:

– CPU operating voltage range of 3.0 V to 3.6 V (3.3 V ± 10 %) with 5 V tolerant I/O pads.

LCD DISPLAY

A **liquid-crystal display** (**LCD**) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly.[1]

LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

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LCDs are used in a wide range of applications including computer monitors, televisions, instrument panels, aircraft cockpit displays, and signage. They are common in consumer devices such as DVD players, gaming devices, clocks, watches, calculators, and telephones, and have replaced cathode ray tube (CRT) displays in nearly all applications. They are available in a wider range of screen sizes than CRT and plasma displays, and since they do not use phosphors, they do not suffer image burn-in. LCDs are, however, susceptible to image persistence.[2]

The LCD screen is more energy efficient and can be disposed of more safely than a CRT. Its low electrical power consumption enables it to be used in battery-powered electronic equipment. It is an electronically modulated optical device made up of any number of segments controlling a layer of liquid crystals and arrayed in front of a light source (backlight) or reflector to produce images in color or monochrome. Liquid crystals were first discovered in 1888.[3] By 2008, annual sales of televisions with LCD screens exceeded sales of CRT units worldwide, and the CRT became obsolete for most purposes.

DRIVER

Most embedded hardware requires some type of software initialization and management. The software that directly interfaces with and controls this hardware is called a device driver. All embedded systems that require software have, at the very least, device driver software in their system software layer. Device drivers are the software libraries that initialize the hardware and manage access to the hardware by higher layers of software. Device drivers are the liaison between the hardware and the operating system, middleware, and application layers.

A device driver is a program that manages the system's interaction with a particular piece of hardware. The driver translates between the hardware commands understood by the device and the stylized programming interface used by the kernel. The existence of the driver layer helps to keep UNIX reasonably device-independent. Device drivers are part of the kernel; they are not user processes. However, a driver can be accessed both from within the kernel and from user space.

WORKING OF THE SOLAR REFRIGERATOR

panel it is given to the rechargeable battery to store the current. The role of the battery stores energy when the solar cell converted and to keep the power supply at any time to load. The battery used in solar power generation system has some basic requirements, such as low self-discharge rates, long life, deep discharge ability, charging efficiency, less maintenance or maintenance-free, wide working temperature range and low prices. Battery used in this paper can achieve with the discharge depth of about 80% of the deep discharge maintenance-free battery. It should consider the output voltage and capacity. Its output voltage should match with the controller in the system and its capacity should insure the refrigerator working normally for some time when the system at no sunlight circumstances. The battery most commonly used is the lead acid type, long life, deep cycle batteries are preferred. A capacity to run the refrigerator for five days without sun is recommended.

In embedded unit (Figure 2) the microcontroller LPC2148 is used. The supply is given from the battery to run the entire unit. LPC2148 is the widely used IC from ARM-7 family. It is manufactured by Philips and it is pre-loaded with many inbuilt peripherals making it more efficient and a reliable option for the beginners as well as high end application developer. Embedded system consists of two ports port 0 and port1. With this system in port-0 temperature sensor, LCD display, in port-1 keypad and relay driver is connected. ADC was inbuilt in the controller.

The change in the temperature values is simultaneously displayed on the 16*2 line LCD panel.LCD Display is used for displaying the status of the processing. The LCD doesn't generate light and so light is needed to read the display. Driver circuit is an electrical

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circuit used to power the LCD. The LCD is connected to the port 0 to display the temperature readings. A keypad consists of three buttons. The first and second buttons are used to set the hot and cold condition. The last button is used to set off the condition. The relay driver circuit is enabled certain time duration only, such enable pulse is depended by delay programming of microcontroller, here Darlington circuit has been two transistors made connection of cascade network, if input is set to the base of the first transistor, then that turns on and emitter current of that turn the other one. Hereby the circuit is closed through the coil and second transistors, now the energized coil is controlled the contractors that are changing the normally open to close and normally closed to open connection. The enabled signal is not essential after energizing that coil because the transistor collector current maintains the transistors in the saturated state continuously. The induction effect may affect the indication components and another thing, so the diode is connected across the coil which can prevent the chopping effect the inverse magnitude of magnetic field shorted across from the coil.

SIZE	30*30*30 cm
SUPPLY VOLTAGE	12V DC
POWER CONSUMPTION AT COLD CONDITION	3.3 Amps 40 Watt
POWER CONSUMPTION AT HOT CONDITION	4.6 Amps 56 Watt
CAPACITY FOR COOLING	15°C - 20°C
CAPACITY FOR HEATING	60°C

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain the convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°C over a full −55 to +150°C temperature range. Low cost is assured by trimming and calibration at the wafer level.

The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. The temperature sensor LM35 senses the temperature and convert it into an electrical signal which is applied to the microcontroller through the ADC. The temperature range of the sensor is 1°C to 255°C. A Peltier cooler is used as a thermo-electric generator. When operated as a cooler, a voltage is applied across the device, and as a result, a difference in temperature will build up between the two sides. When operated as a generator, one side of the device is heated to a temperature greater than the other side, and as a result, a difference in voltage will build up between the two sides. The temperature control chamber provides the user with an accurate range of ambient temperature. The user can build this simple circuit and protect any issues with temperature.

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Table.1 Specification of the chamber

CONCLUSION

In this paper, the Peltier module is used for the purpose of heating and cooling.They both heating and cooling are done in the same chamber. The minimum temperature achieved was found to be 20◦c for cooling and the maximum temperature was 60◦c for heating in this experiment. The cost of solar panels is high, so the size of solar panel must be replaced in order to reduce the cost.

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