SOLAR POWERED INDUCTION COOKING SYSTEM

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Introduction

In Modern world we can see induction cooker in many houses, because in induction heating we don't need LPG, however these are powered by AC mains, because of this these heaters cannot be utilized for portable application. Not only that, induction heater draws large amount of current at AC mains. To counter these problems we've proposed a system which can be powered by battery and the battery can be charged by using solar panel, hence saving in electricity bill and utilisation of natural resources helps to environment.

In induction heating efficiency is very high, because induction heating utilizes electromagnetic induction principle, when changing magnetic field links with a metal an emf gets induced in that, here target material act as a short circuited secondary of transformer. Due to high frequency magnetic field huge power loss in target object and here heat gets induced in the target object that's why these heaters are highly efficient. And since resonant converters offers maximum efficiency, the designed system offers best out of it.

Objectives:

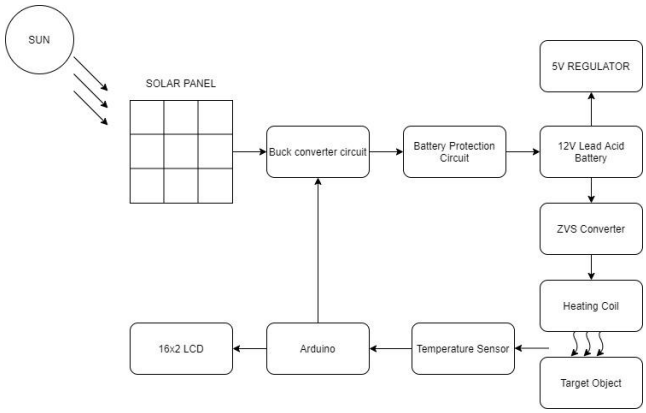
Our main objective is to provide a portable induction cooking system which fulfils following points:

- To give efficient portable heating solution.
- To utilize naturally available energy source.
- To reduce dependency over AC mains and LPG.
- To minimize thermal losses.

Methodology:

The solar power from the sun id converted into electrical power by using solar panel, the generated voltage will have magnitude greater than battery safe charging voltage hence it is first stepped down by using DC/DC buck converter whose duty cycle will

be controlled by arduino, based on feedback voltage arduino maintains constant voltage across battery terminal, battery protection circuit consist of reverse polarity protection and over discharge protection, then the energy gets stored in battery.



The battery feeds energy to ZVS (Zero Voltage Switching) circuit , this is a type of circuit which changes it's state when voltage across it is zero which reduces losses and hence increases efficiency, due to resonance behaviour a sinusoidal HF current will flow in heating coil which creates oscillating magnetic field, this field links with target objects and due to generated eddy currents in them heat will be produced, this heat is measured in arduino and arduino displays temperature in 16x2 LCD. Since all used electronics elements are 5V tolerant a 5V linear regulator is used which reduces battery voltage to 5V.

Components used

- Arduino: Arduino pro mini is a development board with 8 bit microcontroller (ATMEGA328P), here we used this board because it's size and cost also processing power of this chip is enough for this project, here we used this for measuring temperature and to control Duty cycle of Buck converter.
- Solar panel: Solar panel converts infrared rays from sunlight to DC power, this helps to utilize renewable power source, here we've used Four 12V panels.
- DS18B20: It is a digital temperature sensor, which produces 12-bit data which holds the data of temperature, this communicates with arduino by one wire interface method.
- UF4007: UF4007 is a high frequency diode and can handle up to 1A. Here we are using this diode as gate turn of diode. Since the circuit operates at high frequency it is better to use high frequency diode like UF4007.
- 16x2 LCD: These LCDs are ideal for displaying text/characters only, hence these are also called as 'Character LCD'. The display has an LED backlight and can display 32 ASCII characters in four rows with 16 characters on each column. These LCD offers 16 pins including pin connections for backlight, these uses 8 bit data in general but while using Arduino 4 bit data are enough, a suitable value resistor must be used to adjust correct contrast level.

- MOSFET: Here we used IRF540N and R9540, the IRF540N is an N-Channel MOSFET. This MOSFET can drive loads upto 33A and can support peak current upto 33A. It also has a threshold voltage of 4V, which means it can easily driven by low voltages like 5V. Hence it is mostly used with Arduino and other microcontrollers for logic switching. Speed control of motors and Light dimmers are also possible with this Mosfet since it has good switching characteristics.Unlike transistors, MOSFETs are voltage controlled devices. Meaning, they can be turned on or turned off by supplying the required Gate threshold voltage (VGS). IRF540N is an N-channel MOSFET, so the Drain and Source pins will be left open when there is no voltage applied to the gate pin. When a gate voltage is applied these pins gets closed. The R9540N is P-Channel MOSFET here we used this MOSFET to achieve High side switching. Here in order to turn on the MOSFET it's gate should be connected to ground, this is done by using NPN transistor.

Result:

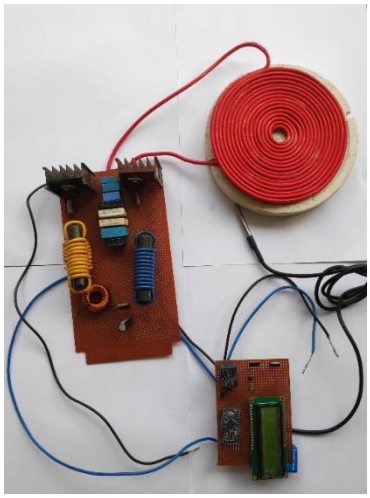


Fig.2 Prototype

The prototype is shown in above picture here we utilised two different boards because the heater board runs at high power and control board works at logic level, hence isolation between two board are necessary. The induction heater works well with steel Scalder as a test object we've used butter and water which was heated efficiently.

Conclusion:

Solar power based induction cooking solution is proposed using resonant converter and tested with various target ingredients.

Future scope

The project can be extended to hybrid model, hence whenever sufficient solar radiation is not available the battery can be charged via AC mains and also we can integrate synchronous DC/DC converter between source and heater board to ensure flexible control.