Solar Based Induction Heating Application

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Abstract: Large amount of solar energy available in nature. Combining that solar energy for induction heat generation. Induction heating (IH) technology is widely used for domestic appliances. Advantages of induction heating are its high efficiency, cleanness and fast heating process. Varying magnetic field generates current to heat up pot for cooking purpose. Half bridge series resonant topology used for induction heating.

Keywords: Solar plate, half bridge resonant topology, embedded system with user interface.

I.INTRODUCTION

Most serious problem observed today is increasing cost of cooking gas. Alternate method used is electricity. But the increasing the price of electricity and the availability of large amount of electricity forces us to think on another alternative. Large amount of solar energy is available which we can use for cooking but solar energy is not available for 24 hours so that it is not used for night time. There is need to store that energy in the battery. This stored energy can be used to generate electricity for induction heating application. Induction heating system gives high efficiency for cooking purpose. Solar energy is combined to give future solution for cooking technology. Solar based induction heating system have high initial cost, it is cost effective system over a long term. Induction heating system used to produce very high temperature for melting steel, for that it requires high frequency current for generation of eddy current. Two methods are used generally to produce high frequency current that are hard switching and soft switching technique. Disadvantage of hard switching is its higher power frequency in the LC circuit. Using power MOSFET this problem is solved. Soft switching is used to reduce those switching losses.

II. LITERATURE SURVEY

There are two types of electric heating, resistance heating and induction heating. There are two advantages of resistance heating. First one is low cost and second one is easy maintains but there is one disadvantage is its low efficiency. Another method is induction heating, in this method inverter topology supplies high frequency current to the induction coil by producing alternate magnetic field. Alternate magnetic field is applied to a ferromagnetic pan to produce eddy current and hysteresis, which is used to heat up the pan. Domestic induction hobs have high efficiency and energy saving [1].Because of increasing efficiency and reducing switching loss generally class E resonant inverter is used, in which IGBT is used to reduce cost. To design and implement prototype of low powered and cost effective micro-inverter which is designed for rural area where solar module is used to run AC loads along with DC loads [2].During cooking process to increase the efficiency and the energy saving an induction hob has been focused to provide maximum power to the pot in more efficient way [3].Pulse width modulation technique is used to control temperature of induction cooker.

The heating efficiency of induction cooker is greater comparing to the gas burner. The electricity required for induction cooker can be generated from solar and wind energies. To charge battery from solar panel the maximum
Power point tracking algorithm [4] is used. Half bridge resonant topology is generally used because of its simplicity and its cost effectiveness. Resonant tank consist of pan, induction coil and capacitor. Inverter designed for maximum efficiency and it minimizes switching losses. Generally MOSFET and IGBTs are used as power switching components.

III.EXISTING SYSTEM

The primary input to the system is solar energy coming from the sun; it is received by the array of photovoltaic cell and further converted into electric energy. System block diagram is shown in Fig3.1.This electric energy is utilised to charge the rechargeable lead acid battery bank. The charging of the battery must be monitor and control to avoid the overcharging and to indicate the low voltage condition of the battery for that charge control unit is necessary. Pulse width modulation technology is used in solar charge control unit. The stored electric energy is in the DC voltage form is further converted into high frequency(kHz) AC voltage to generate electromagnetic field in the induction coil which generate the heat. MOSFET is used as switching device for generating the AC voltage. Temperature of the generated heat is control by the pulse width modulated signal given to the gate of MOSFET through the controller. Increment and decrement keys are used to control the temperature of the induction cooker. Solar voltage and current is displayed on LCD display.

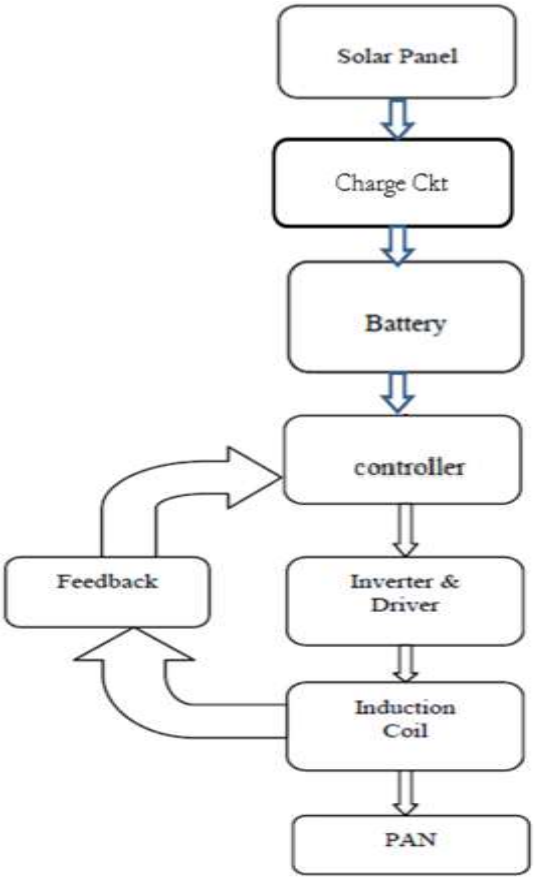


Fig1. System block diagram

Fig.1 shows flow of design in which solar panel absorb radiation of sun through array of photovoltaic cell and this radiation converted into electricity called photovoltaic effect. This energy stored into battery, but there is need of charge circuit to calculate current and voltage of solar panel and display that all parameters on LCD display. Inverter used to convert DC to AC for induction load. Driver circuit used to control temperature of induction coil.

IV. HARDWARE IMPLEMENTATION

Hardware Implementation: Hardware of system consists of ARM7 controller. Hardware implementation is shown in Fig.2.Temperature sensor output, battery voltage and solar panel voltage are input to the controller.To display temperature of induction cooker 16*2 LCD is used. output devices are fan, Buzzer and MOSFET they are controlled through controller. Proteus software used to simulate interfacing of solar panel with ADC. Solar panel output is maximum in sunny condition and this ideal condition considered for charging of battery.

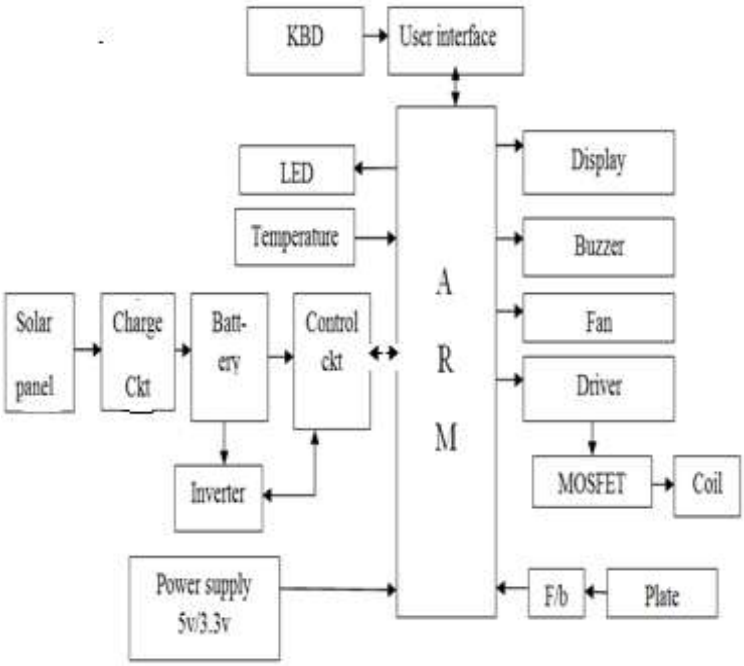


Fig. 2: Hardware implementation

Solar panel is selected such that it has more voltage than the load Here we have used 40W of solar plate to charge battery at constant voltage and current. 12V, 26Ah of battery used to store electrical energy. LCD display used to show current, voltage of both battery and solar plate. 620W of DC to AC inverter is used.

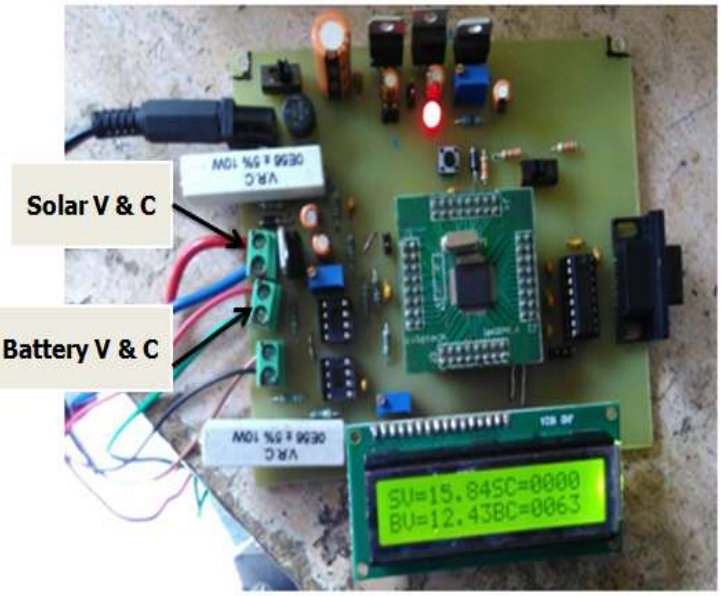
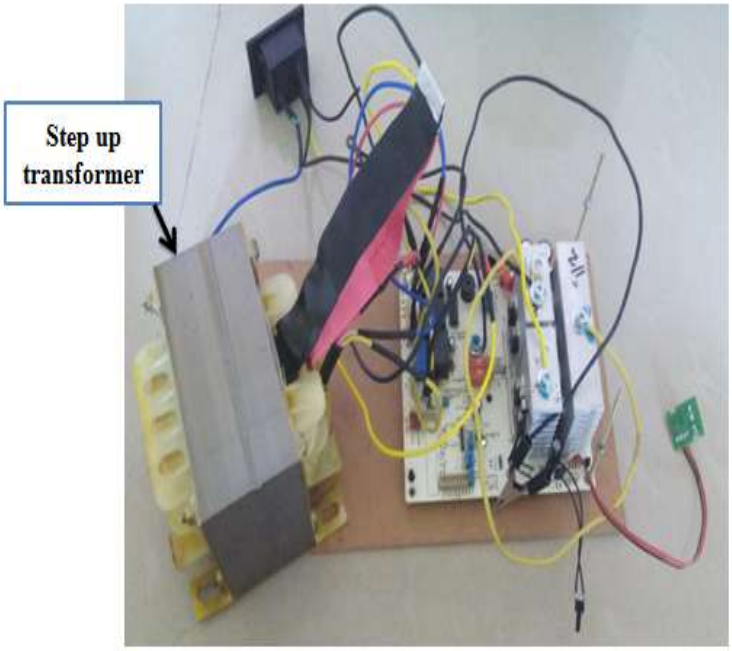


Fig.3: Battery charging circuit

Charging current = Solar panel wattage / Solar panel voltage. Here, charging current=40 / 17.6 = 2.27A. Time taken for charging = 26Ah / 2.27A = 11.45hours. Power dissipation: Here solar panel has 40Watts.
Power going into battery = 13.5*2.27=30.645watts.Thus 9.355Watt of power going into regulator. All that parameters are taken into account before charging a battery. LM317 voltage regulator internally has temperature limiting circuit. As the solar panel provides constant current, it acts as a current limiter. Therefore the circuit does not need any current limiting. In this circuit capacitor protects from the static discharge. Diode protects from the reverse polarity. And voltage regulator IC provides voltage and current regulation. Fig4. Shows the DC to AC inverter, 620 Watt of inverter used to convert direct electricity into alternating current. Step up transformer used to convert 12V DC into high frequency 230V AC.



Fg4.DC to AC inverter

A transformer transforms the input voltage into a variable magnetic field. The magnetic field generates a voltage in the secondary winding and the voltage ratio between primary and secondary is equal to the ratio of the number of turns. Transformer makes the output voltage bigger than the input voltage this is step up transformer. Number of turns of secondary winding is large than primary winding.

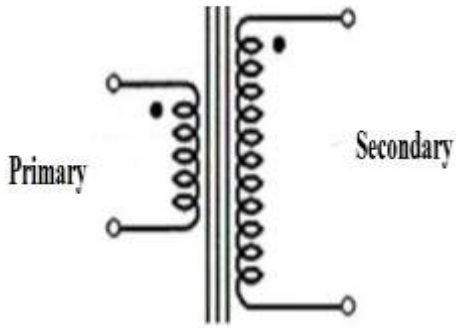


Fig.5.Step up transformer winding.

We can work out the transformer output voltage if we know the input voltage and number of turns (coil) on the secondary coils.
Vp =Potential difference (voltage) input on the primary coil.
Vs =Potential difference (voltage) output on the secondary coil.
Np =number of turns (coil) of wire on the primary coil.
Ns =number of turns (coil) of wire on the secondary coil.
Ip =Current in the primary coil.
Is = Current in the secondary coil.
Vp/Vs = Np/Ns and Vp*Ip=Vs*Is

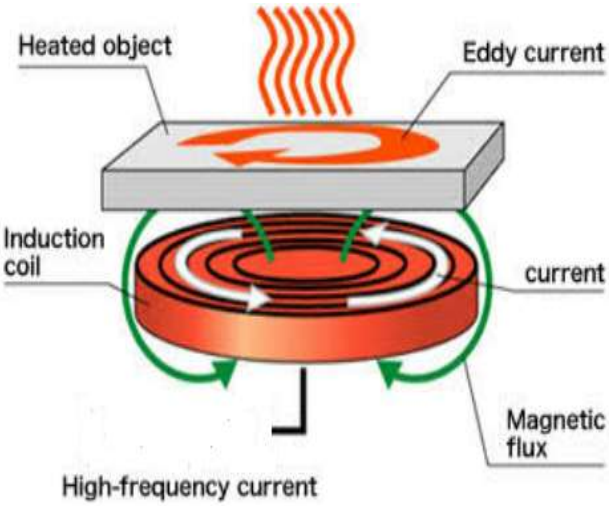


Fig.6 Induction working

In above figure high frequency current is passed through the induction coil it will generate electromagnetic flux around the coil and that will generate eddy current. When object (PAN) is placed close to this field it will generate heat into the pot because of its low resistance.

V. ADVANTAGES AND APPLICATION

Proposed System has greater efficiency. System can be used during day as well as night time and can be used in rainy season by using electrical charging option. Main advantage of domestic induction heating technology is the reduced heating times and cleanness. Efficient and quick heating. Safe heating as there is no flame. Both DC and AC energy is generated.Used in industrial applications,Cooking application. Energy saved in battery used in various applications. Induction used in industrial application like melting still.

VI. CONCLUSION

The proposed system can be used day as well as night time. It is used for heating applications like water heating for industrial purpose. This system is cost effective solution over gas and electricity when used at long time. This system has one time investment of money and solar energy is pollution free source of energy.

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