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SOLAR COOKER

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Abstract- Induction cooking is often considered one of the most efficient cooking technologies. With this technology, up to 90% of the energy consumed is transferred to the food, compared to about 74% for traditional electric systems and 40% for gas. This technology has become popular in Europe, but its adoption in the US has been less enthusiastic. Several market barriers exist for this technology, including high first cost, the requirement of magnetic cookware, and lower perceived reliability. This paper presents findings from a technical assessment of induction cooking performed by the Electric Power Research Institute (EPRI) for the California Energy Commission (CEC). This assessment evaluated the cooking efficiency of induction technology and estimated its energy savings potential. Total cost of ownership is considered, as well as market barriers and non-energy benefits offered by induction cooking technology.

The findings of this study demonstrate that induction cooking is not always more efficient that conventional electric (resistive) technology. The energy savings potential of induction cooking is found to be greatest when used with small cookware. The impact of these findings on standard test procedures is discussed, and recommendations for improvement are suggested. Finally, a prototype cooker design is presented, with a discussion of the limitations of current designs that prevents their operation with non-magnetic cookware.

Keywords- *Electrical Power Research Institute, Prototype, California Energy Commission, Market Barriers, etc.*

I INTRODUCTION

The continuous exhaustion of conventional energy sources and their environmental impacts have created an interest in choosing renewable energy sources such as solar photovoltaic, solar-thermal, and wind energy, producer gas and biomass sources to power induction heating system. The need for the optimum utilization of water and energy resources has become a vital issue during the last decade, and it will become more essential in the future. The availability of renewable energy sources such as solar photo voltaic, solar thermal, wind, biomass and various hybrid forms of energy sources provides good solutions for energy related problems in India. To meet the energy demands and reduce the environmental impact, the idea of integrating renewable energy sources such as solar photo voltaic, solar thermal, wind, and biomass and hybrid forms of energy with induction heating has been proposed by many researchers around the world. Solar energy is a good and clean source of energy, which can help the world in experiencing the dirty and short of non-renewable resources, such as coal, etc. In case of rural area, cooking is heavily dependent on inefficient biomass based cooking. The main problems include the time that is needed to collect the firewood and other biomass by the people, indoor air pollution induced health hazards and various other environmental concerns. Cooking using electricity is one of the most clean and efficient method of cooking as compared to biomass and other method of cooking. At present only few people in the urban area use solar PV technology for cooking purposes. In their system, solar charged battery in used in conjunction with inverter to run induction cooker. The solar powered induction cooking is technically feasible but the use of inverter has reduced efficiency. Therefore, there is a need to explore the possibility of induction cooking using solar powered DC battery.

The DC system not only increases efficiency but also eliminates large and costly inverter that is required for cooking purpose using existing AC induction cooker. Induction heating is widely used nowadays in domestic appliances because of it cleanness, high efficiency, safety, low cost advanced power semiconductors and high performance. Induction heating is commonly used in industries for melting, hardening and brazing. High efficiency comes with the idea that all the magnetic field created between the coil and the pan is at least 80% transferred to the coil. The cooker presents the quick warming energy saving with high speed cooking with many temperature ranges. Domestic and commercial cookers work in the same principle and the performance is identical. Induction heating is the process of heating electrically ferromagnetic (conductive) materials by a process called electromagnetic induction. One of the many applications of induction heating is cooking.

II LITERATURE SURVEY

Cooking is one of the important human activities. As of 2012, residential energy consumption in Nepal is 80% of the total energy consumption, out of which 60% energy is used for cooking applications. In urban residential sector cooking is dominated by LPG and in rural residential sector cooking is dominated by biomass. Over dependence on LPG and biomass can be reduced by switching to more clean and efficient fuel: electricity. Hydro power development in Nepal is too slow paced and therefore, there is a need to develop solar electricity so as to ensure the energy mix and increase the energy security of the nation. The efficiency of the AC based existing induction cooker was measured and found to be 85.56%. The functional circuit diagram of the existing induction cooker was simulated in Multisim and efficiency was calculated to be 87%. A solar electricity based DC induction cooker using quasi resonant topology has been designed and simulated. Circuit simulators like Multisim and Proteus were used for the simulation. The simulated system is battery operated with 24 V DC as system voltage and is micro controller based for control operation. It runs on 300 Ah batteries with 500 WP solar photovoltaic panels. The system operates with the input power range from 46.4 W to 1500 W correspondingly drawing input current in the range from 1.93 A to 62.5 A. The output power is in the range from 40.8 W to 1310 W with an average efficiency of 90.10%. The performance parameters of the designed induction cooker show that the system is technically possible to construct. [1]

Nowadays Induction heating applications are quickly gaining popularity. Induction Heating technology not only offers the advantage of having a better efficiency conversion compared to the other standard technologies, but also offers safety, cleanliness, and compact size, high reliability, low running cost and non-acoustic noise. Induction cooking system utilizes electricity for the generation of heat, in this study solar energy is used as a source of power for the induction heating. Combining solar energy with induction heating technique is the efficient solution for the induction heating and cooking application. This paper reviews a solar based DC induction heating and cooking using different topologies like voltage source inverters of full bridge series resonant inverter, half bridge series resonant inverter, and quasi resonant topology and the resonant converter topology. This study has established a baseline for further research in the area of solar based induction heating and cooking. [2]

About 80 % of total energy consumption in Nepal is being consumed in the residential sector and about 60 % of total residential energy application includes cooking application. At present, in urban area, there is heavy dependence on liquefied petroleum gas for cooking purpose whereas in rural area, there is heavy dependence on biomass. Clearly, there is a need to switch towards clean and efficient fuel:

electricity. Load shedding problem has been a reason preventing Nepalese people to switch towards electricity based cooking. Even though at present (2017), Nepal Electricity Authority's has been able to reduce load shedding for residential consumers; there is still a condition of inadequate supply of electricity if all of the consumers will switch towards electricity for cooking purpose. The experimental and simulation efficiency of conventional AC based induction cooker has been found to be 85.56% and 87% respectively. DC powered induction cooker has been designed and simulated. The simulation efficiency of which has been measured to be 90.10%. The hardware realization of the design is malfunctioning in real time testing making a need of power electronic component with the capacity to pass very high current, as high as 80 A at low voltage, as low as 12 V. [3]

Induction Heating (IH) systems using electromagnetic induction are developed in many industrial applications in Myanmar. Many industries have benefited from this new breakthrough by implementing induction heating for melting, hardening, and heating. Induction heating cooker is based on high frequency induction heating, electrical and electronic technologies. From the electronic point of view, induction heating cooker is composed of four parts. They are rectifier, filter, high frequency inverter, and resonant load. The purpose of this research is mainly objected to develop an induction heating cooker. The rectifier module is considered as full-bridge rectifier. The second portion of the system is a capacitive filter. The ripple components are minimized by this filter. The third is a high frequency converter to convert the constant DC to high frequency AC by switching the devices alternately. In this research, (he Insulated Gate Bipolar Transistor (IGBT) will be used as a power source, and can be driven by the pidse signals from the pulse transformer circuit. In the resonant load, the power consumption is about 500W. Construction and testing has been carried out. The merits of this research work is that IH cookers can be developed because of having less energy consumption, safe, efficient, quick heating, and having efficiency of 90% or more. [4]

Cooking is the major necessity for people all over the world. It accounts for a major share of energy consumption in developing countries. Therefore, solar cookers are commonly used in the domestic sector in these countries. The advantages of the use of solar cookers would result in the reduction of the release of CO2 in the environment. Cooking is the most important energy consuming operation in the domestic sector, as energy for cooking accounts for 50% of the total primary energy consumption. According to Indian government survey, over 77% of rural households in the country were estimated to depend on firewood and chips for cooking. Over 7% used dung cake and only 9% used LPG. In urban areas, LPG was the primary source of energy in nearly 62% of households. Hence, replacing the traditional cooking methods by solar energy can be considered as an alternative for meeting the energy crisis. This paper presents a short review on different types of solar cookers. [5]

III PROBLEM STATEMENT

During Cloudy day or during night the energy cannot be produced, so battery backup is required. Now a day we use 1500w to 2000w shegadi are used in house hold application but they do not work on available in market inverter so our challenge that to design that type of inverter.

IV OBJECTIVES

- The main objective of this project is to reduce the use of conventional energy consumption.
- The maximum renewable energy should be in use for cooking purpose.

V PROPOSED SYSTEM

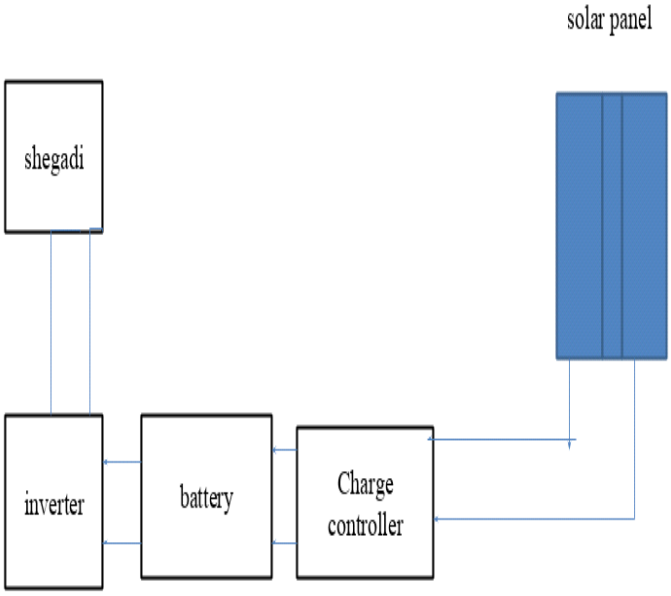


Figure 1: Block Diagram of Solar cooker

With the help of Arduino Uno we are going to measured temperature, voltage and current of shegadi. Induction cooking heats a cooking vessel by electrical induction, instead of by thermal conduction from a flame, or an electrical heating element. The cooking vessel must be made of or contain a ferromagnetic metal such as cast iron or stainless steel. Heat is coming from within the pan, making this method of cooking a lot more efficient. You therefore need to ensure that your pans are suitable to use on an induction hob. Copper or aluminum pans would not work unless they have additional layers added onto the bottom that are magnetic. The best way to check if your pans are viable is to see if a magnet will stick to the bottom of the pan. An induction hob contains a coil of copper wire underneath the ceramic plate, and when a cooking pot is placed on top an alternating electric current is passed through it. The resulting oscillating magnetic field induces a magnetic flux, producing an eddy current in the ferrous pot, which acts like the secondary winding of a transformer. The eddy current flowing through the resistance of the pot heats it. To find out what an eddy current is, see below. Energy transfer with induction hobs is around 84 percent compared to around 74 percent for gas or ceramic electric so there are good energy savings. Safety is an important aspect too – there is no naked flame so fire is extremely unlikely.

A pan of water will boil in nearly half the time that it would on a normal gas hob. An induction hob will also ensure the longevity of your pans because they have more contact with the heat below, and the current is running all the way through the pan. This will stop your pan from developing hot spots which in turn, will burn or scorch food.

Solar Panel:

Solar panel coverts the sunlight into electricity, sunlight was collect either directly by using photovoltaic or indirectly using concentrated of solar energy.

Figure 2: Solar Panel

A solar cell works on the principle of photo-voltaic principle, the photo-voltaic solar energy conversion is one of the most attractive non-conventional energy sources of proven reliability from the micro to the Megawatt level.

Its advantages are:

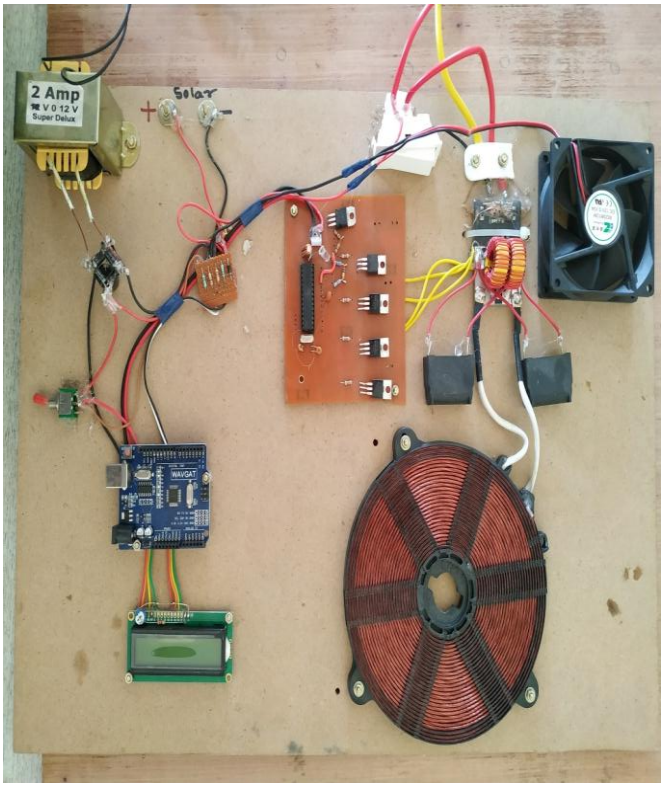
- Direct room temperature conversion of light to electricity through a simple solid state device

- Absence of moving parts
- Ability to function unattended for long periods as evidence
- Modular nature in which desired currents, voltages and power levels can be achieved by more integration
- Maintenance cost is low as they are easy to operate
- They do not create pollution
- They have a long effective life, and
- They are highly reliable

Disadvantages are:

- Distributed nature of solar energy,
- Absence of energy storage. While the first disadvantage can be party overcome by concentration, the second is an inherent disadvantage overcome in PV systems by the use of conventional storage batteries. Efforts are being made worldwide to reduce costs per watt through various technological innovations.

VI RESULT



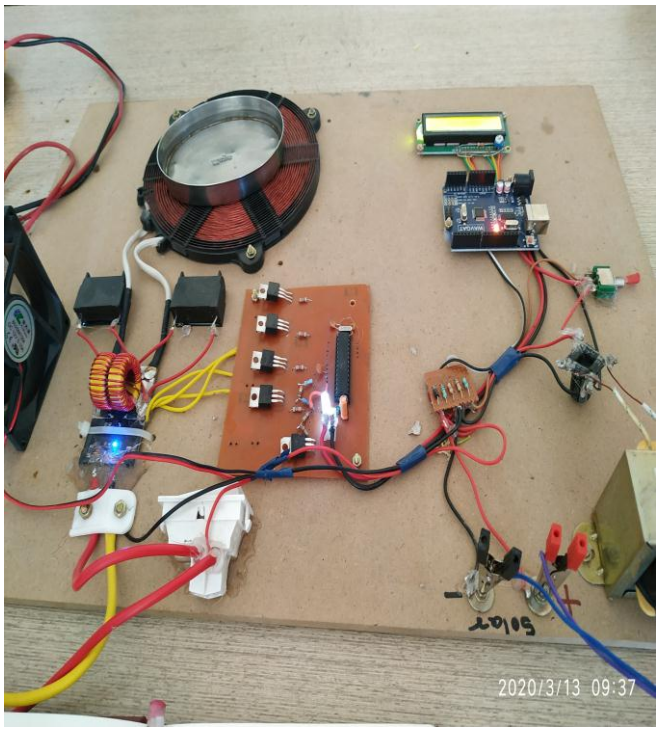


Figure 3: Solar Induction Cooker

VIII CONCLUSION

Cooking solutions are becoming convenient quick and efficient, but ensuring the availability of the same as clean , reliable and affordable remains a humongous task for world leaders and policy makers .The thrust on clean energy scenario is at its peak at present and the need of the hour. The emergence of solar PV cooking can be most viable solution to address cooking needs as it fits well in 5C parameters of convenience, control, cost-effective, clean and compact. Since the solar PV cooking solutions fits well to full fill the cooking needs, both urban as well as in rural areas. If promoted well, it can grow significantly and it will not be far when it becomes one of the most adopted cooking ways.

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