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Smart Eco-Friendly Solar Cooker

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Abstract - The invention "SMART ECO-FRIENDLY SOLAR COOKER" is basically a solar cooker with some automation.

As we all know solar cooker is a device which can cook food from solar energy. Solar cooker is essential because In current scenario the major issue on our earth is pollution and shortcoming of traditional fuel. To overcome from these problems solar cooker is an ideal solution to revolutionize in cooking sector. As food is our basic need and cooking food requires traditional fuels which can harm our environment cooking from solar energy is a great way to preserve our fuels as well as environment.
If we talk about India in rural areas most of the people use wood and cow dung cakes for cooking which can affect their health that leads to major diseases. So, cooking by the use of solar cooker can be beneficial for them in terms of health and economical stability.
In areas like Rajasthan the solar cooker can be used extensively because of their weather.
So, use of solar cooker in current scenario is very important for us and our mother earth.
The invention aims to the effective use of solar energy for cooking by a solar cooker to preserve traditional fuels as well as overcome from limitations of traditional solar cooker.

1.Introduction

The "SMART ECO-FRIENDLY SOLAR COOKER" is our project which aims to make a solar cooker more efficient and smart in terms of user friendliness as well as our project also aims to overcome from the limitation of traditional solar cooker.
We have implemented such system in this project that it can easily overcome from these limitations. The working of our project is similar to a traditional solar cooker but at every stage we have implemented such techniques which make this project more versatile and dynamic than the traditional solar cooker.
We have make a box type solar cooker which consist of a reflector when the sun rays falls in the reflector it gets reflected and fall on the glass slab which is on the top of the cooking chamber when light fall on this slab and enters into the cooking chamber the food which is kept in that chamber gets start cooking. Now, for night we have made an induction which takes power from a DC battery for cooking the food without sunlight. The battery gets charged up from the solar tracking system in the day time which ultimately removes our dependence from traditional fuel by which we can preserve our resources as well as prevent our environment from getting harmed. It also helps in improving the efficiency of solar cooker. In the day time when food is getting cooked by a solar cooker mostly there is a problem of over cooking which is resolved in our project we have introduced a system by which user can set the time for which the food has to be cooked . After that time alarm starts ringing and sheet come in between the reflector and the glass slab which stop the reflection of light by which over cooking get prevented.
These are the reasons why our solar cooker is said to be smart solar cooker. It overcomes from many limitations of traditional solar cooker and also gives smooth working experience to the user. It is also very much important for our environment and it is also an alternative of traditional fuels which are used in cooking. It also encourage the use of renewable energy and make awareness about the use of solar powered devices.

2. Literature Survey

The increasing demand for sustainable energy solutions has led to the evolution of solar-based cooking technologies as viable alternatives to conventional cooking systems. Over the years, researchers and innovators have worked on various solar cooker models, aiming to reduce dependence on fossil fuels and mitigate environmental degradation.

Conventional Solar Cooker Models:
Initial models such as box-type and parabolic solar cookers were designed with a focus on simplicity and affordability. While these systems offered fuel-free cooking, they were largely dependent on weather conditions and lacked control features. These limitations made them less practical for widespread adoption, especially in regions with fluctuating sunlight.

Energy Efficiency Improvements:
Subsequent developments focused on improving heat retention and sunlight capture. Some models incorporated double-glazing, insulation materials, and reflector optimization. These enhancements improved thermal

efficiency but still required manual alignment and constant user attention, limiting convenience.

Automation and Tracking Innovations:

Recent studies explored the integration of solar tracking mechanisms to improve energy absorption throughout the day. Dual-axis tracking systems have shown a significant increase in cooking efficiency by keeping the cooker aligned with the sun's position. Additionally, the introduction of microcontrollers and sensors enabled basic automation such as automatic lid closing, cooking alerts, and thermal cut-offs.

Energy Storage Integration:

To overcome the challenge of sunlight variability, thermal energy storage solutions such as phase-change materials (PCMs) and insulated chambers have been used. These systems store heat during peak sunlight hours and release it during low-light or evening hours, ensuring cooking can continue beyond daylight availability.

Smart Connectivity and IoT Applications:

With the advancement of IoT technologies, researchers began integrating mobile connectivity and remote monitoring systems into solar cookers. These smart features allow users to control temperature settings, monitor cooking progress, and receive notifications, enhancing usability and safety.

Environmental and Social Impact:

Studies consistently highlight the benefits of solar cookers in reducing carbon emissions, lowering cooking costs, and improving indoor air quality. They are especially relevant in rural and energy-deprived areas, where access to clean fuel is limited.

Identified Research Gap:

Despite individual progress in solar tracking, thermal storage, and smart control systems, there remains a lack of unified models that combine all these technologies into a single, user-friendly, and cost-efficient solution. This research aims to bridge that gap by proposing a smart, eco-friendly solar cooker with integrated tracking, automation, storage, and remote control features.

food. The induction oven is powered by a DC battery which is further charged by solar tracking system for increasing the efficiency. By this the reliability on traditional fuels for cooking in night and in cloudy days can be eliminated.

Also we have used the timers with an alarm for the user so the user can manually set the time for which he/she want to cook food after the time the alarm start ringing which let the user know that food is ready and he/she can prevent it from over cooking.

At last we also have made a solution for preventing the food from over cooking by the use of IOT, when the alarms ring a blank sheet will come across the reflector and the glass slab which cuts the reflection of sunlight so the cooking can be stopped automatically.

II. **Detailed description of the invention with accompanying drawings:** we have made a prototype of solar cooker with additional new features. The model is made up of cardboard and instead of using mirror for the reflector we used aluminum foil for reflection.

All the components used with their specification and areas of application are listed below:

I. Cardboard - Approx 500mm- For making the body.
II. Aluminum foil- Half a roll- For making reflectors.
III. Thermocol- 4 pcs.
IV. Black paper- 2 charts.
V. Glass slab-1 - Top of the cooker.
VI. Aluminum plate-1- For conduction of heat.
VII. Servo motor-3- For solar tracking system and over cooking preventing system.
VIII. Arduino UNO-2- For solar tracking system and over cooking preventing system.
IX. Temperature meter-1- For temperature detection.
X. Solar panel-1- For solar tracking system.
XI. LDR sensor-2- For solar tracking system.
XII. Copper wire coil- For making induction.
XIII. Battery (12v)-1- For solar tracking system.

3.Methodology

I. As we all know about the solar cooker and their working our project "SMART ECO-FRIENDLY SOLAR COOKER" aims to overcome from the limitation of traditional solar cooker for making it more user friendly and efficient.

We introduced two major systems in solar cooker which make it more efficient.

- SOLAR TRACKING SYSTEM
- INDUCTION OVEN

Apart from these we had connected temperature meter for getting real time temperature of cooking chamber. We have made an induction chamber in which our induction oven is placed which can be used in night for cooking the

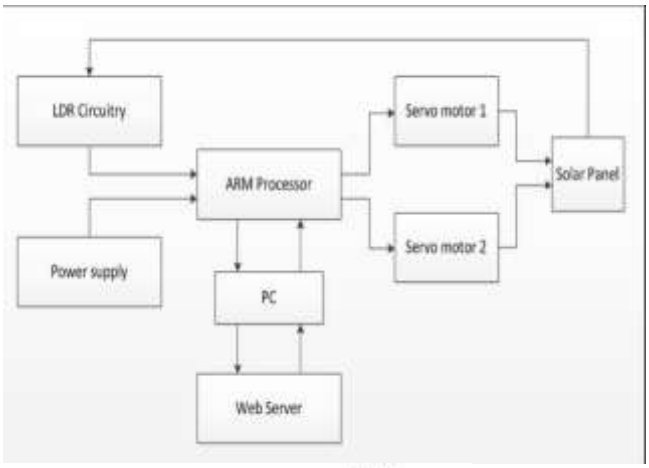

Fig 1: Block diagram

4. Working Model Images

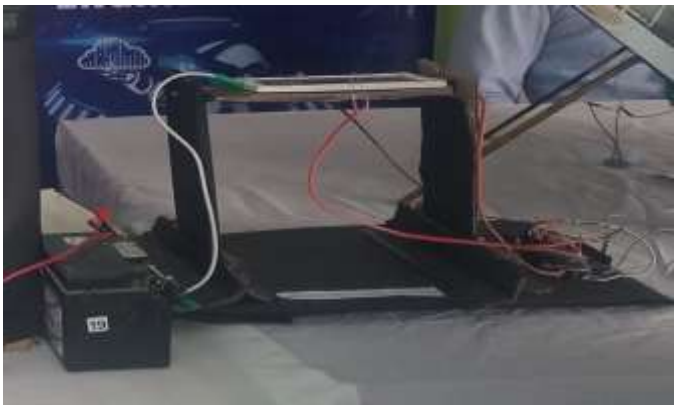

Fig 2: Solar tracking system

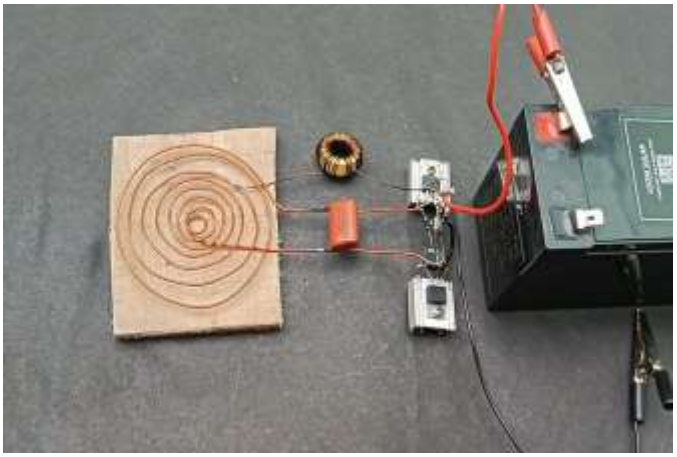

Fig 3: Induction oven

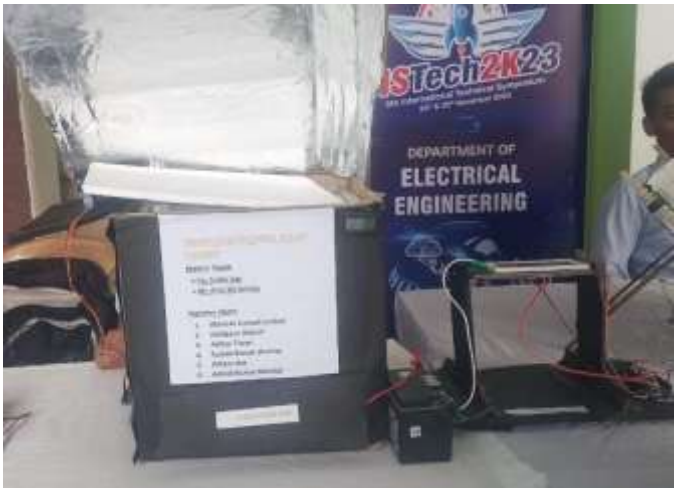

Fig 4: Smart solar cooker

5. Claim:

I. The biggest limitation of traditional solar cooker is that cooking in night and in cloudy days or rainy season is not possible but this problem is resolved in our smart solar cooker. We have made a DC powered induction cooktop which can be used in night and in cloudy weather.

II. Another limitation of traditional solar cooker is that they are not much efficient but we introduced solar tracking system which will follow the sunlight in the day time by which a battery gets charged from which our induction can work. So that the user can cook when sunlight is not present which ultimately increases the efficiency of the solar cooker.
III. Also, there is another limitation of tradition solar cooker is that the food gets over cooked in them. For over coming from this problem we have created a system with a blank sheet, timer and alarm that is the user can set a time manually for which the food get cooked after that the alarm rings and the blank sheet come across the glass slab by which the reflection of sunlight from reflector cannot enter into the cooking chamber which ultimately stop over cooking.

6. Advantages over the prior art

I. It can be used in night as well as in cloudy days.
II. It is more efficient than traditional solar cooker.
III. It can prevent food from over cooking.
IV. It has also the features of timer and alarm.
V. It is more user friendly than traditional solar cooker.
VI. Cooking time can be reduced by this solar cooker.
VII. It is more economically suitable because by the use of solar tracking system the electricity cost can be minimized.
VIII. It is self sustainable means not depend upon other resources like it can be used during power cuts.

7. Conclusion and Future scope

The development of the Smart Eco-Friendly Solar Cooker demonstrates a practical and innovative approach to addressing modern-day cooking needs using clean energy. By effectively utilizing solar power, the system reduces dependency on conventional fuels while offering a reliable cooking method that aligns with sustainability goals. The integration of features like solar tracking, battery storage, and induction-based cooking ensures operational flexibility, even in varying weather conditions. This solution not only minimizes environmental impact but also provides an efficient and cost-effective alternative, particularly for regions facing energy shortages or unreliable power supply.

The Smart Solar Cooker has significant potential for enhancement and broader application. Future advancements may include:

I. **Enhanced Automation:** Incorporating smart sensors and AI can optimize cooking performance based on food type and sunlight availability.
II. **Mobile App Expansion:** More interactive features can be added for recipe suggestions, energy tracking, and remote troubleshooting.
III. **Grid Integration:** The system can be adapted to feed excess solar energy into small-scale community microgrids.
IV. **Weather Adaptability:** Improvements in insulation and hybrid power inputs (solar + electric backup) can allow seamless operation in all seasons.
V. **Mass Adoption:** With support from government initiatives and eco-conscious organizations, this technology can be deployed widely in rural, remote, or emergency-prone areas to promote clean, smoke-free cooking practices.

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