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SMART SOLAR DEHYDRATOR

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Abstract
This project's primary goal is to use Arduino and the Internet of Things to construct a solar-powered smart dehydrator system. The system used to preserve food using solar energy through a charging circuit, solar energy is stored in the battery and used to power the project. Through an insulated tube, the heat from the sun is transferred to the heating chamber. Due to this procedure, the heating chamber will become heated, preventing bacterial growth and removing moisture from the meal. It aids in the longer-term preservation of food goods. The Arduino microcontroller is the primary controlling component of the entire system. The Arduino microcontroller receives input from temperature sensors, an exhaust fan with a relay, an esp8266 Wi-Fi module, and an LCD display. The inside and outside temperatures of the heating chamber are measured using temperature sensors. The sensor data is continuously read by the Arduino controller and shown on the LCD. When the temperature rises above 45 degrees, Arduino will use a relay to turn off the exhaust fan. Additionally, the user can operate the exhaust fan from a mobile device using the Blynk app and WI-FI. Here, the relay acts as a switch to turn on and off the fan.

I. INTRODUCTION

A. Aim

The main aim of this project is to build a solar based smart dehydrator system using IoT and Arduino. The device used for preservation of food products using solar energy.

It is impossible to overstate the value of dried foods. Any country's kitchens and grocery shops will attest to the variety and utilisation of dried foods. The variety of meals is astounding. The world consumes vast amounts of nuts, fish, meat, spices, vegetables, fruits, dried grains, and beverages like coffee and tea.

Drying could be necessary for a variety of reasons. In order to prolong the life of the fresh crop, water is first and most frequently eliminated. To create a cuisine that closely resembles the fresh crop, the dried product is later rehydrated before consumption. An example of this drying use is dried vegetables.

Second, a crop might need to be dried in order to be processed further. For instance, numerous grains are dried before being crushed into flour. In order to create a new product that is distinctly different from its original form, fresh crops are occasionally dried. Sultanas, a dried version of grapes, are one illustration of this use of drying.

Food drying is anticipated to become more significant. By 2025, more than eight billion people are expected to live on the planet (Cliquet and Thienpont, 1995). To fulfil the expanding demand, food production

Many other things need to be dried in addition to those meant for human consumption. These include both inorganic products like paint and organic crops like rubber and wood. The significance of drying in people's lives is emphasised by each of the aforementioned arguments. However, drying is the industrial operation that uses the most energy, according to Mujumdar (1990). One litre of water evaporation consumes about 2.4 MJ. However, drying is the industrial operation that uses the most energy, according to Mujumdar (1990). One litre of water evaporation consumes about 2.4 MJ.

Around 100 litres of oil are needed to dehydrate one metric tonne of most fruits in a typical dehydrator to the proper moisture content for long-term preservation. Many countries, especially emerging ones, struggle with an energy shortage. Even in areas with an abundance of conventional energy, there is pressure to consume fewer fossil fuels.

B. Problem statement

One of the oldest solar energy techniques is drying, which involves exposing the things being dried, such as meat, fish, vegetables, and fruits, directly to the sun. This method has a lot of drawbacks, including spoiled goods from weather-related factors such as fungus, animal attack, bug infestation, dust, rain, and wind. When a product dries quickly, especially in direct sunshine, the moisture inside cannot fully evaporate before the surface of the object hardens, lowering the quality of the dried product.

The sustainable solar dryer used in this study was created to address this issue, will adopt the ergonomic standards, and will result in a product of higher quality.

C. Objective

- To increase the efficiency.
- Continuous chamber in/out temperature monitoring system
- Visible alerts using LCD display.
- Emergency Control using blynkapp.
- Temperature based exhaust fan control system.
- Design a solar based dehydrator system.
- To reduce the drying time of farmer or worker.
- To preserve product for long period of time.

D. TYPES OF DRYING METHOD

The two types of solar dryers are passive and active mode. Direct and indirect types can further be separated into passive dryers.

The temperature of the box dryer is raised by reflecting radiations. In an indirect solar dryer, hot air in the dryer chamber is heated using a collecter or preheater instead of sunlight directly hitting the article being dried.

Natural convection, which is what passive dryers are, occurs when there are changes in fluid density brought on by temperature gradients. They are easily buildable with cheap, locally obtainable materials. This is a quick and affordable way to store food for an extended period of time

- Indirect solar drying in active mode
- Mixed-mode Solar drying

- Indirect solar drying in Passive mode
- Direct Solar Dryring in Passive Mode
- Open Sun Drying

E. Advantages

- To create a food drying solar dryer system.
- To boost effectiveness.
- To speed up a worker's or farmer's drying process.
- To keep the stuff fresh for a long time.
- Using solar power without cost.
- Use the blynk app to work from anywhere in the world.
- In general, this solar dryer has reduced the amount of space needed to spread the product out to dry, reduced labor-intensive time, increased process efficiency, and protected the environment.

F. Disadvantages

When it's cloudy outside, we can't use the sun's energy.

G. Applications

- Drying of agricultural crops.
- Fruits and vegetables are dehydrated in the food processing sectors.
- Drying of fish and meat.
- Dairy businesses that make milk powder.
- Seasoning of lumber and wood.
- textile businesses that dry textile materials

II. LITERATURE SURVEY

Dried goods are used widely around the world, and drying is a significant human activity, especially when it comes to crops. Moisture removal is frequently required for both organic and inorganic materials for the purposes of processing, quality improvement, and preservation. The most often used technologies are mechanical dehydration powered by fossil fuels and sun drying. Direct, indirect, and mixed modes are the three basic types of solar dryers; however, these divisions can be further broken down based on the type of an additional energy source. However, in actual use, certain solar dryer models and heat transfer fluid, the direction and source of the flow, the presence of thermal storage, have proven to be more practical than others. The technical performance of solar dryers can be assessed in a variety of ways, but practical and economic concerns will frequently be more crucial in evaluating their acceptability. [1]

The drying of thick layers of grains is demonstrated in this research using the design process for the "GJ-ABAQUE" polyvalent modular dryers' partial solar heating system. The utilisation of graphs or polynomial correlations serves as the basis for this methodology. We just need one graphic to represent the fraction of the monthly heating need supplied by solar energy as a function of two dimensionless factors in the real-world scenario where the drying air is not recycled. The latter suggests using information about the collector surface, monthly radiation averages, and projections of drying loads. [2]

For the simultaneous production of hot air and hot water required for the processing of vanilla, we investigate three potential solar-added system configurations. The monthly solar fraction and two dimensional less parameters that are given in terms of the system's physical characteristics have been found to be correlated. In addition to contrasting the various solar systems from a techno-economic perspective, we have presented correlations for the ideal system that directly link the mass of the product to be dried with the area of the solar collector.[3]

Logs make up a sizable amount of the wood exported from emerging nations. These nations emphasise improved domestic processing of logs into timber or other finished goods to support their economic growth. Manufacturing that produces value-added goods has been hampered by improper or inadequate timber drying. Solar kilns might provide inexpensive drying capacity. This study examined the viability of small- to medium-sized businesses in developing nations using solar energy to enhance timber drying. A review of the literature highlights the success or failure of particular design elements, building techniques, and solar dryer applications while attesting to the promise of solar drying. Feasibility studies found that solar drying is feasible if a dryer satisfies cost and output standards. There were two dryer designs put forth: a greenhouse type and an external collector type. A material and energy balance analysis was used to evaluate their production capacity and construction costs. [4]

A rapidly expanding sector of the food business, fresh and processed vegetables play a significant role in the international trade and economies of many nations. Numerous studies have shown how important vegetables are for human health since they fill our diets with bioactive phytochemicals, minerals, vitamins fibre, and other nutrients. Vegetables are primarily produced on a regional and seasonal basis and are botanically and organoleptically different. Due to their high perishability, research into more effective and superior preservation techniques has been on-going alongside advancements in postharvest handling, processing, and quality enhancements. This guidebook is divided into six parts that evaluate and debate significant developments in vegetables. It has 37 chapters written by more than 50 writers from Asia, Australia, Europe, America, North and the Middle East. [5]

III. PROPSOED METHOD

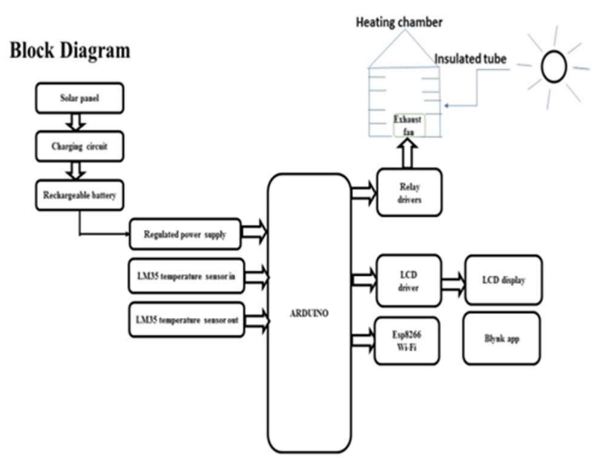


Fig. Block Diagram

The main blocks of this project are:

- Solar panel.
- Charging circuit.
- Rechargeable battery.
- Regulated power supply.
- Arduino UNO.
- Esp8266 Wi-Fi module.
- LCD display.
- Heat chamber.
- Insulated tube.
- LM35 temperature sensors.
- Exhaust Fan with relay.

Through a charging circuit, solar energy is stored in the battery and used to power the project. Through an insulated tube, the heat from the sun is transferred to the heating chamber. Due to this procedure, the heating chamber will become heated, preventing bacterial growth and removing moisture from the meal. It aids in the longer-term preservation of food goods.

The Arduino microcontroller is the primary controlling component of the entire system. The Arduino microcontroller receives input from temperature sensors, an exhaust fan with a relay, an esp8266 Wi-Fi module, and an LCD display. To measure the temperature inside and outside the heating chamber, temperature sensors are utilised. Data from sensors is continuously read by the Arduino controller.

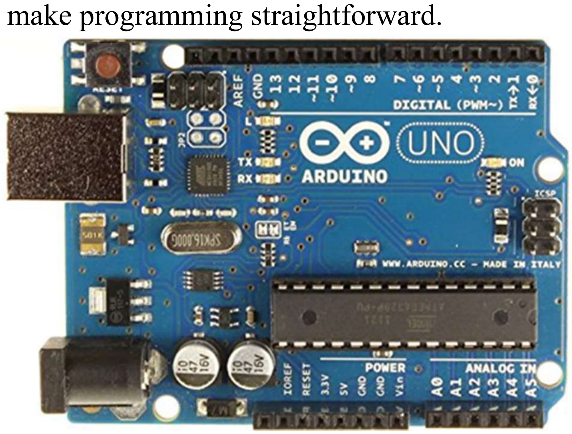
The sensor data is continuously read by the Arduino controller and shown on the LCD. When the temperature rises above 45 degrees, Arduino will use a relay to turn off the exhaust fan. Additionally, the user can operate the exhaust fan from a mobile device using the Blynk app and WI-FI. Here, the relay acts as a switch to turn on and off the fan.

IV. HARDWARE DESCRIPTION

A. Micro controller

An ATmega328 from the AVR family serves as the microcontroller board for the Arduino Uno. There are 14 digital input/output pins, a 16 MHz ceramic resonator, and 6 analogue pins.

The gadget uses a power jack, a reset button, and a USB connector. The multiple libraries that support its applications make programming straightforward.



B. REGULATED POWER SUPPLY

A power supply is an electrical energy source. The expression is most usually used in connection with electrical energy sources, followed by mechanical ones, and then other sources.

C. LED

A light source built on semiconductors is known as an LED. LEDs produced dull red light when they were first presented as a useful electrical component in 1962, but more current types now output light that is bright over the visible, ultraviolet, and infrared spectrums. This picture shows an LED's internal components.

D. LM35 temperature sensor

Precise integrated-circuit temperature sensors of the LM35 sensor family have an output voltage that is linearly proportional to the temperature in Celsius. Temperature sensors are used to measure the heat generated during a fire.

E. ESP8266 WI-FI

Any microcontroller can connect to your Wi-Fi network with, a self-contained SOC, ESP8266 Wi-Fi Module with an integrated TCP/IP protocol stack. The ESP8266 is capable of hosting an application or assigning another application processor to handle all Wi-Fi networking tasks.

F. LCD display

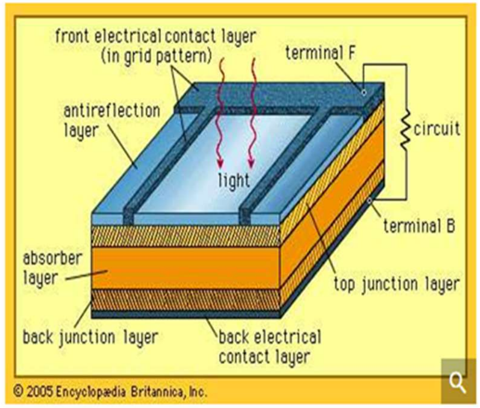
One of the most common add-ons for micro controllers is an LCD monitor. Some of the most popular LCDs connected to the many microcontrollers are 16x2 and 20x2 LCD displays. This indicates that there are, respectively, 16 and 20 characters per line by two lines.

G. Heating chamber

Typically, an indirect drier has a drying chamber and a collector chamber. A separate piece of equipment known as a solar collector gathers solar energy, and it is protected by a transparent glass or plastic cover.

H. SOLAR

Calculators and spacecraft that use solar power are examples of photovoltaic (PV) cells. To produce electricity, they make advantage of the sun. A solar panel, or module, is a frame-mounted assembly of electrically linked solar cells. Larger solar arrays can be created by combining many modules.



V. RESULT

Using Arduino and the Internet of Things, the "Smart Solar Dehydrator" project created a solar-powered smart dehydrator system. the system used to preserve food using solar energy.

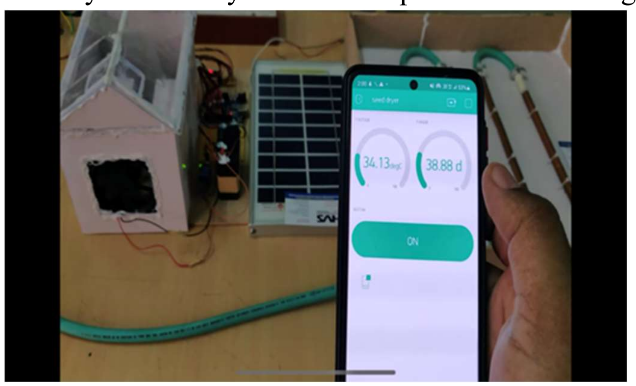


Fig: monitoring in and out temperature in to the blynk app

Fig: total setup of solar seed dryer

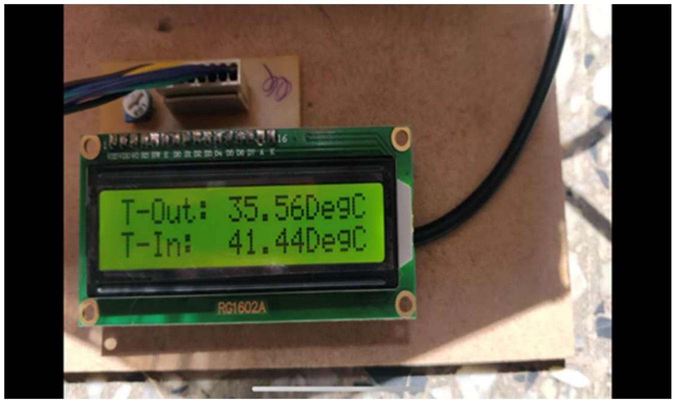


Fig: display the in and out temperature on LCD module

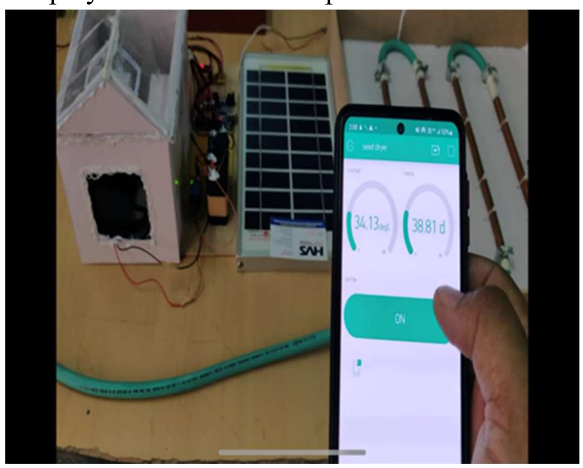


Fig: switch ON the cooling fan from blynkapp

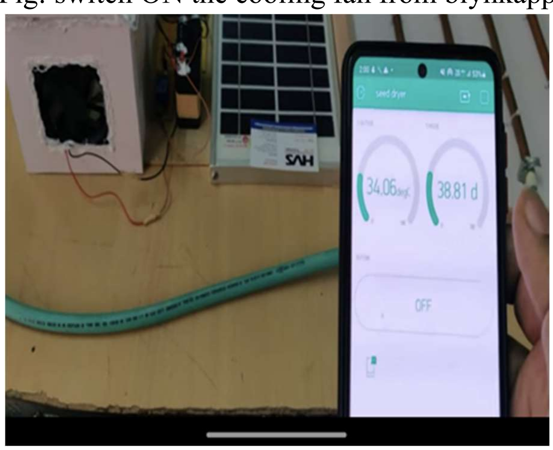


Fig: switch OFF the cooling fan from blynkapp

VI. CONCLUSION

Existing solar fruit dryers can still perform better, especially in terms of speeding up the drying process and perhaps even storing heat energy. If sufficient planning is done, solar radiation can be used to effectively dry agricultural products in our environment. This was proven, and the solar dryer that was built and designed showed enough capacity to dry agricultural products, notably fruit items, to a noticeably lower moisture level. Since it can be utilised extensively for the majority of agricultural fruit crops, this will significantly reduce fruit wastage while also alleviating fruit shortages. In addition to this, solar energy, which is easily accessible in the tropics and is also a clean kind of energy, is needed for its operation. Since it dries fruit products faster, it saves money and time compared to open-air, sun-drying agricultural produce. It also helps the environment. The fruit products are better protected in the solar dryer than in the open sun, which reduces the risk of contamination and pest and insect attack.

REFERENCES

[1] PSA (1995). Comparative test of solar dryers. TDC Serial Report 2/95. Spain: Plataforma Solar de Almeria, in conjunction with Synopsis, Lodeve, France.

[2] Ramamonjisoa, B.O., Gatina, J.C., Chabriat, J.P., Khedari, J. and Daguenet, M. (1994). A graphical design method for a partial solar dryer for corn. Drying Technology, 12(4): 923-936.

[3] Ratobison, R., Zeghmati, B., Reddy, T.A. and Daguenet, M. (1998). Sizing of solar supplemented liquid and air heating systems for treatment of vanilla. Solar Energy, 62(2): 131-138.

[4] Read, W.R., Choda, A. and Cooper, P.I. (1974). A solar timber kiln. Solar Energy, 15: 309-36.

[5] Salunkhe, D.K. and Kadam, S.S. (1998). Handbook of Vegetable Science and Technology: Production, Composition, Storage and Processing. New York: Marcel Dekker. 721 p.

[6] Ampratwum DB, Dorvlo ASS. Evaluation of a solar cabinet dryer as an airheating system. Applied Energy 1998; 59(1): 63–71p.

[7] Sharma SJ, Sharma VK, Ranjana JHA, Ray RA. Evaluation of the performance of a cabinet type solar dryer. Energy Conversion & Management 1990; 30(2): 75–80p.

[8] Minka CJ. Potential improvement to traditional solar crop drying in Cameroon: research and development solar drying in Africa. In: Proceedings of a Workshop held in Dakar; 1986; 11– 22p.

[9] Gbaha P, Andoh HY, Saraka JK, Koua BK, Toure S. Experimental investigation of a solar dryer with natural convective heat flow. Renewable Energy 2007; 32: 1817– 29p.

[10] Singh PP, Singh S, Dhaliwal SS. Multi-shelf domestic solar dryer. Energy Conversion & Management 2006; 47: 1799–815p.

[11] Mursalim, Supratomo, Dewi YS. Drying of cashew nut in shell using solar dryer. Science & Technology 2002; 3(2): 25–33p.

[12] Muhlbauer W, Hofacker W, Muller HM, Thaler M. Die Kaltlufttrockung von Weizen unter energetischem undmikrobiologischem Aspekt. Grundlagender Landtechnik 2013; 31.