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IOT Based Solar Hybrid Dryer

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ABSTRACT -This dissertation focuses on the design of an indirect solar dryer control system that is simple to use, low-cost, and self-contained. Small farmers who don't have the financial flow to invest in new drying technologies but require basic and modest machinery to compete in the present market for nuts are the target audience for this model.

A sun dryer is a closed system for drying agricultural goods. A hybrid forced and natural convection solar dryer is built and tested in this project to minimise the time necessary to dry various food products such as grapes, tomatoes, and red chilies. Water makes up roughly 85 to 90% of the grapes.Grape is chosen as the principal test sample because it has a higher moisture content than other food items. The major goal of this research is to assist farmers in reducing food waste and drying grapes in the shortest amount of time feasible. The PCM tank is a unique design that includes fins for improved heat absorption and dissipation.Solar panels are also utilised to capture solar energy and convert it into electricity, which is then stored in batteries and used at night to power the blowers and IR (thermal) lights. Various sensors are installed within the cabin to monitor and regulate various situations such as the LCD Display, NodeMCU8266, Temperature sensor, Humidity sensor, heating road, and a drying chamber.

Keywords –LCD Display, NodeMCU8266

I. INTRODUCTION

Drying is one of the ways for preserving food for longer periods of time. For numerous years, the sun's heat combined with the wind has been utilised to dry food for preservation. Drying is the oldest method of preserving agricultural products, and it is a time-consuming and energy-intensive process.The use of alternative renewable energy resources has become more important as a result of rising fossil fuel prices and scarcity. Using renewable energy sources such as solar energy to dry agricultural goods is environmentally friendly and has a lower environmental effect. Solar dryers of various sorts have been created, produced, and tested in various tropical and subtropical locations. Natural convection solar dryers and forced convection solar dryers are the two main types of solar dryers. The airflow in natural convection solar dryers is created by buoyancy induced airflow, whereas the airflow in forced convection solar dryers is created by a fan powered by electricity/solar module or fossil fuelSolar thermal technology is quickly gaining traction as an energy-saving strategy in agriculture. Because it is plentiful, limitless, and non-polluting, it is chosen above other alternative energy sources such as wind and shale.Solar thermal technology is fast gaining momentum in agriculture as an energy-saving solution. It is preferred above other alternative energy sources such as wind and shale because it is abundant, unlimited, and non-polluting.

Although India is one of the world's largest producers of many fruits and vegetables, there is still a significant gap between per capita demand and supply due to massive waste during post-harvest storage and handling, a lack of temperature-controlled vehicles, and the lack of cold storage facilities in various parts of the country. To prevent waste, food goods are dried in a dryer, which extends their shelf life by eliminating moisture. The sun provides an enormous quantity of energy to the Earth in the form of radiation, which may be used to efficiently dry food goods.

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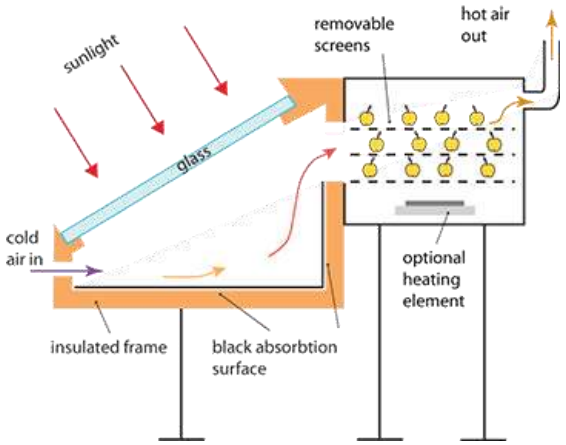

Fig- Solar Hybrid Dryer

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II. LITERATURE SURVEY

[1] Litkouhi, Lee and Craig: Crop drying is the most energy consuming process in all processes on the farm. The purpose of drying is to remove moisture from the agricultural produce so that it can be processed safely and stored for increased periods of time. Crops are also dried before storage or, during storage, by forced circulation of air, to prevent spontaneous combustion by inhibiting fermentation. It is estimated that 20% of the world‘s grain production is lost after harvest because of inefficient handling and poor implementation of post- harvest technology, says Hartman‘s (1991). Grains and seeds are normally harvested at a moisture level between 18% and 40% depending on the nature of crop.

[2] Schneiderman and Nashman: These must be dried to a level of 7% to 11% depending on application and market need. Once a cereal crop is harvested, it may have to be stored for a period of time before it can be marketed or used as feed. The length of time a cereal can be safely stored will depend on the condition it was harvested and the type of storage facility being utilized. Grains stored at low temperature and moisture contents can be kept in storage for longer period of time before its quality will deteriorate. Some of the cereals which are normally stored include maize, rice, beans. Solar drying may be classified into direct and indirect solar dryer. In direct solar dryers the air heater contains the grains and solar energy which passes through a transparent cover and is absorbed by the grains.

[3] Taylor et al: Essentially, the heat required for drying is provided by radiation to the upper layers and subsequent conduction into the grain bed. However, in indirect dryers, solar energy is collected in a separate solar collector (air heater) and the heated air then passes through the grain bed, while in the mixed mode type of dryer, the heated air from a separate solar collector is passed through a grain bed, and at the same time, the drying cabinet absorbs solar energy directly through the transparent walls or the roof. Energy is important for the existence and development of human kind and is a key issue in international politics, the economy, military preparedness, and diplomacy. To reduce the impact of conventional energy sources on the environment, much attention should be paid to the development of new energy and renewable energy resources.

[4] Betke, Haritaoglu and Davis: Solar energy, which is environment friendly, is

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renewable and can serve as a sustainable energy source. Hence, it will certainly become an important part of the future energy structure with the increasingly drying up of the terrestrial fossil fuel. However, the lower energy density and seasonal doing with geographical dependence are the major challenges in identifying suitable applications using solar energy as the heat source. Consequently, exploring high efficiency solar energy concentration technology is necessary and realistic. Solar energy is free, environmentally clean, and therefore is recognized as one of the most promising alternative energy recourses options. In near future, the large-scale introduction of solar energy systems, directly converting solar radiation into heat, can be looked forward.

[5] Kelber: However, solar energy is intermittent by its nature; there is no sun at night. Its total available value is seasonal and is dependent on the meteorological conditions of the location. Unreliability is the biggest retarding factor for extensive solar energy utilization. Of course, reliability of solar energy can be increased by storing its portion when it is in excess of the load and using the stored energy whenever needed. Solar drying is a potential decentralized thermal application of solar energy particularly in developing countries. However, so far, there has been very little field penetration of solar drying technology. In theInitial phase of dissemination, identification of suitable areas for using solar dryers would be extremely helpful towards their market penetration.

III. METHODOLOGY

Above A control system for an indirect solar dryer will be developed. The prototype works on the same principle as the Twelve Trades dryer described in the previous chapter: natural air circulation. The first component is the collector, which converts solar energy into heat; the second part is the drying chamber, which contains the product to be dried; and the third part is the drying chamber, which holds the product to be dried.;The chimney, which assists in the natural flow of moist air, is the third component. The drying process is divided into three parts: The air enters the collector, which heats up; owing to natural convection, the temperature of the collector rises, and the heated air rises to the drying chamber;In the second stage, heated air enters the drying chamber through the front aperture attached to the collector to dry the product, following which already heated air enters and is pushed to descend, collecting moisture from the food. The air is denser, and it falls into the tunnel beneath the shelves and trays, which are connected to the chimney.Due to the decrease in the hydraulic diameter of the air channel, the colder and humid air chooses to climb via the tunnel linked to the chimney in the final step. The chimney is painted black to absorb more heat and help in drawing, resulting in a depression at the top of the chimney that allows moist air to easily flow.The air temperature entering the drying chamber must be regulated to maximise the drying process, and there is a valve between the collector and the drying chamber. There is also an air flow management valve at the end of the chimney; it is important to seal the chamber and control the air flow required for optimal drying.

IV. PRE-REQUISITES

NodeMCU 8266

The NodeMCU platform is an open source IoT platform that is free to use. It includes software for Espressif Systems' ESP8266 Wi-Fi SoC as well as hardware for the ESP-12 module. The term "NodeMCU" refers to the firmware rather than the development kits by default. The firmware uses the Lua programming language.It is based on the eLua project and was built with the Espressif Non-OS SDK for ESP8266. Lua-cjson and spiffs are two open source applications that are utilised. The Expressif ESP8622 Wi-Fi SoC interactive firmware, as well as an open source hardware board that, unlike the $3 ESP8266 Wi-Fi modules, has a CP2102 TTL to USB chip for programming and debugging and is breadboard-friendly,and can be powered simply through its micro USB connection.

Humidity Sensor

A humidity sensor detects, measures, and reports both moisture and air temperature (or hygrometer). The ratio of moisture in the air to the maximum quantity of moisture at a particular air temperature is known as relative humidity. Relative humidity is important when it comes to seeking comfort.Humidity sensors measure the amount of moisture in the air by detecting changes in electrical currents or temperature.
Capacitive
Resistive
Thermal

Temperature Sensor

A temperature sensor is a device that employs an electrical signal to give temperature measurement in a readable form, often a thermocouple or a resistance temperature detector. The most basic form of temperature metre is a

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thermometer, which is used to detect how hot or cold something is.

Heating Rod

Room heaters are portable or wall-mounted heaters that are used to heat a small room. The majority of room heaters are either gas or electric. Room heaters are useful equipment that offer focused and targeted heat, which is ideal for individuals who are elderly, unwell, or have limited movement in a room.

LCD Display

The acronym for "liquid crystal display" is "Liquid Crystal Display." Liquid crystal display (LCD) is a flat panel display technology that is often used in TVs and computer monitors. It may also be found on the displays of mobile devices such as laptops, tablets, and smartphones.

LCD displays are not only aesthetically unique from bulkier CRT monitors, but they also operate in a different manner. Instead of shooting electrons at a glass panel, an LCD has a backlight that illuminates individual pixels in a rectangular grid. Each pixel has a red, green, and blue RGB sub-pixel that may be turned on or off.When all of a pixel's sub-pixels are turned off, it appears dark. When all of the sub-pixels are turned on to 100%, it appears white. By varying the quantities of red, green, and blue light, you can create millions of different colour combinations.

Solar Cells

A solar cell, also known as a photovoltaic cell, is an electrical device that converts light energy directly into electricity via the photovoltaic effect, a physical and chemical phenomenon. Simply said, a solar panel creates energy by allowing photons, or light particles, to dislodge electrons from atoms. Solar panels are made up of photovoltaic cells, which are the smallest components(The word "photovoltaic" simply refers to the conversion of sunlight into electricity.) Solar cells are made from silicon boules. These are polycrystalline structures having the atomic structure of a single crystal.

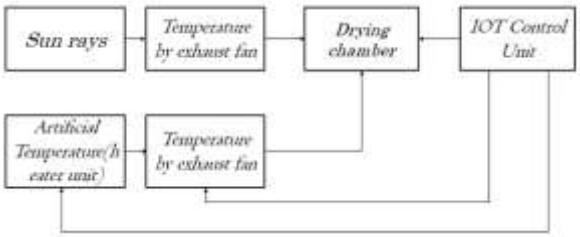

Fig. Flow Diagram

V. EXPERIMENTAL RESULTS AND DISCUSSION

Fig- Reading of Display

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Fig. Reading of Cell Display

VI. CONCLUSION

1. The device may be used to keep agricultural products in good condition.
2. The product has the potential to increase the income of the rural population.
3. Rural areas may see a rise in entrepreneurship options.
4. Product drying time is reduced, and it is suited for all types of environments.

For comparing the drying efficiency of various driers, the reliance of drying on product parameters remains an issue. The author provided a thorough examination of the numerous designs, construction details, and operating principles of a wide range of solar-energy drying systems that have been successfully implemented.Passive or natural-circulation solar-energy dryers and active or 24 forced-convection solar-energy dryers are the two major categories of solar energy dryers (often called hybrid solar dryers).Integral or direct mode solar dryers, dispersed or indirect-mode solar dryers can be divided into three sub-groups, which differ primarily in structural layout. This diagram shows how various solar dryer designs may be categorised systematically based on their working temperature ranges, heating sources and heating modes, operational modes, and structural modes.Though it is widely accepted that correctly constructed forced-convection (active) solar dryers are more effective and controlled than natural-circulation (passive) models. This chapter also includes several simple-to-build and simple-to-operate dryers that may be used in small-scale industries. Low-cost drying systems like this may be quickly implemented in rural regions to decrease spoilage, enhance product quality, and improve overall processing cleanliness.

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