IoT based Solar food Drying and Monitoring System

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Abstract - ***This system makes an effort to automate solar dryers and maintain optimal humidity, temperatureand dryer air velocity. IoT technology has shown to be crucial for numerous industries, including manufacturing, transportation, and agriculture. Temperature, humidity, drying time, as well as many other factors, are all measured when solar dryers are put to the test. The primary objective is to automate solar dryers using IoT. To achieve effective and efficient drying results, this systemmay be utilized to remotely monitor and control dryer efficiency, making it easier for users to comprehend the current state of grapes being dried. An Atmega328P microcontroller and three Digital Humidity and Temperature Sensors (DHT22) are used in the dryer using an interface to manage and monitor the solar dryer system . In this drying procedure, where temperature and humidity are regulated as needed, the sensory evaluation of the raisins' quality was quite positive. Using an external fan to dry according to the desired temperature and humidity levels is a superior drying method than other ways since the process is ongoing, there is less risk of contamination. and produces products of a high caliber . The average rating for the raisins produced using various drying techniques in terms of colour and appearance, texture, flavour, and acceptability.***

Keywords: **IoT , Solar , Automation**

I. INTRODUCTION

IoT is transforming our way of life in the modern day, impacting both our behavior and how we go about our daily tasks. IoT is a massive network that includes connected devices. IoT makes it possible to perceive an object through networking infrastructure. These gadgets collect and disseminate information on their usage and the environment in which they are employed. We can sense and manage several factors by using IoT in solar dryers. Future prospects for food item solar drying are bright. If the dried product's quality can bekept up to par with accepted worldwide standards, the global market will be further stimulated.

High-quality capacitive type sensors Based on the capability to identify the physical state of the grapes inside the dryer, sensor performance is utilized. Digital Temperature and Humidity Sensor Module AM2302 (DHT22) sensors were employed in this system for thestudy. This sensor has a wide range of relative humidity and temperature measurement capabilities. The microcontroller Atmega328P is heavily amalgamated. This microcontroller was built to meet the needs of a modern, connected environment. A Wi-Fi networking-based Wi-fi module is used to intelligently monitor and control the drying conditions inside the dryer chamber.

Grapes drying device to track the effectiveness of integrating grapes with IoT, accessible in real-time via a smartphone, preventing grapes from rotting. Compared to the old way of recording data and managing drying conditions, the Internet of things has many benefits. In order to record the relative humidity and temperature at various locations, some researchers choose to use a data logger. We can get a very big number of various variables by employing this IoT technology. Multiple parameter values are available for recording and retrieval every minute. Through various applications that can sense, store, and visualize a wide range of characteristics, the virtual world links real-world objects and allows for remote control. The solar dryer's heat transfer efficiency and moisture removal rate are directly correlated with the hot air's velocity, relative humidity, and temperature.

II. LITERATURE SURVEY

IoT technology has shown to be crucial for numerous industries, including manufacturing, transportation, and agriculture. The goal of this effort is to automate solar dryers and maintain optimal dryer air velocity, humidity, and temperature. Temperature, humidity, drying time, as well as many other factors, are all measured when solar dryers are put to the test. he primary goal is to automate solar dryers using the Internet of Things. This technology may be used to monitor and control dryer performance remotely, making it simpler for users to comprehend the present state of drying bananas and produce effective and efficient drying results. Three DHT22 Digital Temperature and Humidity Sensors, an ESP8266 Node MCU, and a solar dryer are used to monitor and manage the system. The difference in percentage between the temperature measurements for the solar collector show that there are temperature variations between 0.19% and 1.37%, suggesting that the calibration of the devices as well as ambient factors may have contributed to the mistake. The variance in reading for the percentage of the solar collector's humidity ranges from 0.64% to 4.59%, which is significantly higher. Temperature range for banana drying is between 0.32% and 3.11% with a 1-2°C tolerance. Since the humidity is computed from the humidity metre, the percentage error for the readings of humidity in the banana drying chamber is also a little high. According to the difference in readings between the sensor and the humidity metre at 14 o'clock, the humidity displays the highest percentage with 1.41% [1].

In order to dry and humidify the paddy grains in the allotted time, machinery is used. Two alternating batteries, the system's primary energy source, were powered by solar radiation. The microcontroller is programmed to set the desired temperature and humidity level in accordance with the amount of rice . The creation of a machine to improve and develop the post-harvest procedure of Philippine farming, notably drying, is discussed in this research.It intends to assist farmers in raising rice output and productivity levels, which will raise revenue. The Solar-Powered Paddy Grain Humidifier-Dryer is made up of a power sourcewith two alternating batteries that are charged by solar panels, a control system that regulates temperature, humidity, and moisture content automatically based on the user's desired moisture content, a humidifier and dryer that produces heat and humidity, and a GSM module for updated inventory. A manual that explains in simple terms how to set their desired moisture content by pressing a button is provided to the machine's users (farmers) [2]

This is a different way to dry agricultural products in the sun using a solar dryer that includes a heating element. It is an economical method that locals can employ on a huge scale. The primary component of the system is the energy captured by the absorbers. Thetraditional method for preserving plants, seeds, fruits, meat, fish, timber, and other agricultural or forest items is open-air sun drying. Because solar irradiation is so high for the most of the year, sun drying of crops is the most popular technique of food preservation in most of India. However, open-air drying's drawbacks for large-scale production are well established. The development of the solar drying process allowed the sun-drying method to be improved upon. Solar drying also makes use of this readily accessible renewable energy source, but it does it in a different way. The goal of a dryer is to provide the productwith more heat than is naturally possible in order to sufficiently raise the vapour pressure of the crop's stored moisture, significantly lower the relative humidity of the drying air, increase the air's moisture carrying capacity, and ensure a low enough equilibrium moisture content. In the collector, air is heated before being partially cooled as it absorbs moisture[3].

With the use of an IR-based system and a microcontroller-based system, this method of drying is utilised to dry fruits. The project's energy source is solar energy. Blowers are utilised to complete the drying process after infrared rays are employed to hydrate the water content. A small-scale fruit drying device that is effective for drying various varieties of fruit is the Solar Powered Automatic Fruit Drying System. Fruits can be dried and preserved to extend their shelf life and increase usage efficiency. Fruit preservation throughdrying has been a crucial process since ancient times. Grapes can be dried using infrared radiation. It is a distinct method that differs significantly from conventional or organic drying. The natural drying process has many disadvantages, including the need for additional time, expensive space requirements, and infrastructure for drying, which a middle-class farmer cannot afford . By giving a farmer in a developed country access to a contemporary, automated, and affordable fruit drying facility, his financial situation can beimproved. This research describes a regulated environment that is appropriate for a closed chamber's small-scale fruit drying procedure (89s52). In order to remove the fruit's water content, the infrared light is first employed to heat the fruit from the inside out. The humidair is then evacuated from the chamber and air is blasted inside to maintain the humidity below a predetermined threshold. The operations of heating, blowing air, providing time indication, and maintaining a constant temperature throughout the chamber are controlled by a microcontroller(89s52) [4].

Hybrid solar energy is the utilisation of both solar and electrical energy. The dryer's motorfan arrangement creates airflow within, and sunlight falling on materials heats them. Here,temperature is managed using temperature sensors, which also manages the temperature of the heating agent. As a result, it serves as an excellent model for future drying systems . A small-scale fruit drying device that is effective for drying various varieties of fruit is the Solar Powered Automatic Fruit Drying System. Fruits can be dried and preserved to extend their shelf life and increase usage efficiency. Grapes can be dried using infrared radiation. It is a distinct method that differs significantly from conventional or organic drying. The natural drying process has many disadvantages, including the need for additional time, expensive space requirements, and infrastructure for drying, which a middle-class farmer cannot afford [5].

The authors wanted to construct a closed circuit that could track how electrical energy was used and automatically control it. When a user exits a room, the radio frequency signals emitting from the device detect the state of the electricity in that space and turn off the circuit. Safety precautions are ensured by programming microcontroller[6].

The method is appropriate for use with plants that are sensitive to temperature. This revisedapproach benefits farmers and is more effective. Smart agriculture requires a strong Internet of Things (IoT) infrastructure. Thanks to IoT devices that may supply information about their agricultural fields, smart farming is a novel concept . IoT, or the Internet of Things, is essential to smart agriculture. Because IoT sensors may provide information about their agricultural fields, smart farming is a new concept. The goal of the article is touse IoT and smart agriculture using emerging technology. The main component to increase the production of productive crops is to monitor environmental conditions. This paper's feature involves employing CC3200 single chip-based sensors to monitor the temperature and humidity in agricultural fields. The camera is connected to the CC3200 so that picturescan be taken and sent through MMS to the farmers' mobile devices over Wi-Fi [7].

The IoT-based monitoring system gathers all measurements at intervals of one minute using IoT sensors and stores the information on a remote cloud server. Based on the data collected, we can understand the SWH's operational state and evaluate its overall performance . This essay examines a few solar heating system control strategies in detail. We tested new recommended IPC control methods as well as proportional and ON-OFF controls. Utilizing the author's technique of clustering measurement days, experimental tests were carried out in the field. The findings for all tested control strategies are shown as thermal energy gains in the storage tanks. The ON-OFF control mechanism works well in situations with minimal solar radiation variability, but it fails in situations with dynamicsolar radiation [8]

A. *Finding from the Literature Survey*

We discovered the following gaps that needed to be focused on from the extensive investigation of various drying and monitoring systems . Earlier systems have drawbacks or disadvantages in them . On the automatic control of devices that write the points that haven't been done before, very little focus is given. Previous systems had significant disadvantages and many problems were also present . Most of the limitations and drawbacks are covered in this system and latest technologies were used to fullfill the objective of the system .

III. PROPOSED SYSTEM

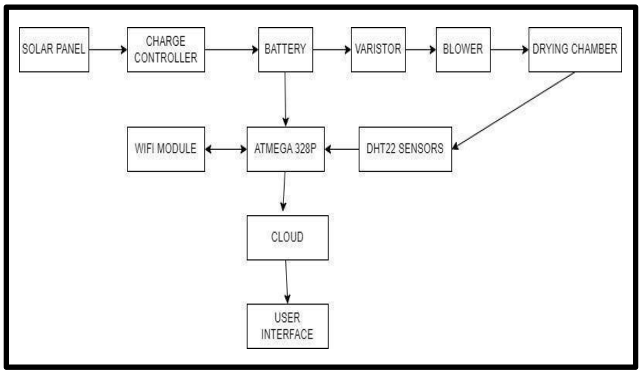


Fig 1. Block Diagram Of Proposed System

IV. WORKING

The entire system is made up of a charge controller , a solar panel , a varistor , a battery , and a blower. The solar panel is directly exposed to the sun. The Charge Controller receivesthe solar panel's output. The lead acid battery receives a controlled energy supply, its outputis applied to the varistor, and hot air is fed into the rectangular sun drying chamber via a blower. The Atmega328P microprocessor and sensors govern the entire environment. The microcontroller, which needs to be continuously recharged, is also charged using the extension board. The programming is then fed into the microcontroller and the proper connectivity is formed after temperature sensor configuration is also done on a computer. This microcontroller's Wi-Fi connectivity is established by the wifi module. An internet server is used by the wifi module to transmit sensor data to the mobile application. The microcontroller and the Blynk software can be used to remotely control the drying chamber over the Internet. Use the Android app Blynk to set use limits for your internet access. TheInternet of Things was taken into account when creating Blynk. It can record data, displaysensor data, visualize it, manage hardware remotely, and do a lot of other fantastic things .

V. HARDWARE & SOFTWARE REQUIREMENTS

- Atmega 328P microcontroller
- DHT 22 Sensor
- Wifi module
- 16 x 2 LCD Display
- Solar panel
- Charge Controller
- Varistor
- Battery

VI. BLOCK DIAGRAM

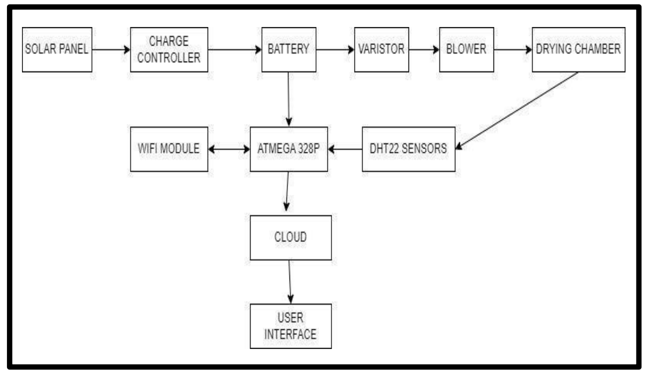


Fig 2. Block Diagram Of Proposed System

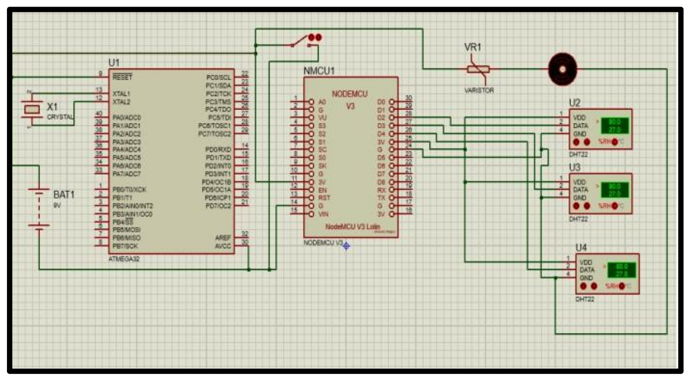
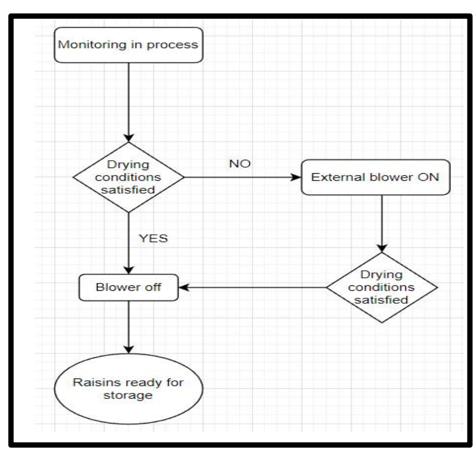
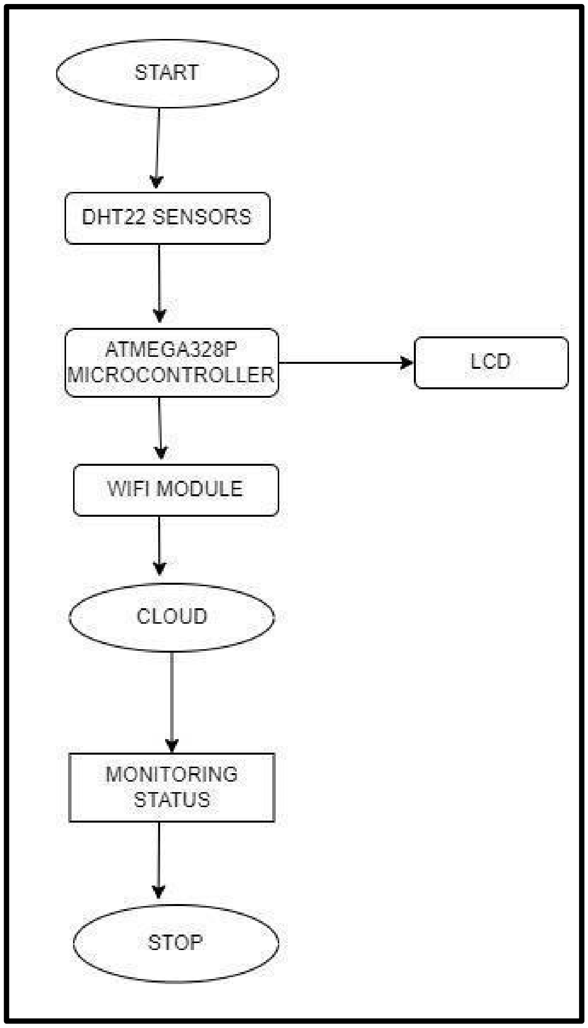


Fig 3. Circuit Diagram Of Proposed System

The above circuit diagram shows the connections to be made on the hardware setup to Implement system for usage . All the hardware connections are made as per the circuit . The Atmega 328P microcontroller is connected to the wi-fi module and the power supply . All the sensors are connected to the module to gather information and present it on the cloudServer .

VII. FLOWCHART





VIII. RESULTS

	Collector Readings	Dryer Readings
Time (Hours)	Temperature (Degree Celsius)	Temperature (Degree Celsius)
9	80.6	38.6
11	78.6	57.5
13	80.7	59.4
15	75.8	52.5
17	61.2	38.5

IX. ADVANTAGES

The following list of benefits of the suggested system can be summed up:

1. Renewable Solar energy supply .
2. Quick Intimation of food Product condition using different parameters like temperature, moisture etc .
3. Proper monitoring of food conditions .
4. Effective drying as needed .
5. Controllable using IoT and Automatic .

X. CONCLUSION

In this study, an IoT-based control system is examined for enhancing solar drying on farmsand in homes. The Internet of Things-based solar grape dryer monitoring and control system has been created and tested with success. The Blynk program, which can be usedby both farmers and homeowners for drying, has made the monitoring process simpler and more intelligent with the development of IoT. Users will eventually be helped by this grape drying and monitoring system in assessing and projecting the solar dryer's performance inreal time.

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