Food Processing Unit Using IOT

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***Abstract* - With food being produced for billions of people worldwide, the food processing sector is essential to the global economy. But the sector is also up against a lot of obstacles, such as escalating competition, worries about food safety, and the requirement to lessen its environmental impact. Food safety is one of the main issues facing the food processing sector. Food-borne infections have the potential to be fatal or create major health issues. Food processors have tight rules and processes to follow in order to guarantee food safety. Nevertheless, the implementation of these processes can be expensive and time-consuming. Reducing the food processing industry's environmental impact is another challenge. Food preparation generates large amounts of trash in addition to using a lot of water and energy. Processors of food are under growing pressure to lessen their influence on the environment, yet doing so without compromising effectiveness can be challenging. The apparatus will make use of sensors to keep an eye on temperature, humidity, and pH levels, among other factors of food processing. Appropriate chambers are designed for the purpose of drying.The sensors' data will be sent to a cloud-based platform so that it may be examined and utilised to regulate the food processing procedure.**

Keywords:ExhaustFan,ThermalPeltier,Temperature Sensor,Arudino Mega,Silica gel,Electric Heater,ESP Cam.

I. Introduction (*Heading 1*)

This project's purpose is to revolutionize the traditional method of changing grapes into raisins, which might take several weeks or months. The main goal is to increase the quality and flavor of the raisins while also dramatically cutting down on the time and energy needed for this transformation. This discovery may result in consumers having access to fresher and more reasonably priced raisins.The project's main goal is to reimagine the food industry's processes in order to increase productivity and raise quality standards.The technologies developed or employed in this project improve the system's output efficiency. We can accomplish high-quality data analysis and good data representation by using contemporary IOT architecture. The structure is made up with of three main procedures: chemical processing and cleaning come first, followed by controlled drying, and process control and monitoring. The grapes are cleaned and rinsed carefully in this initial step. Following cleaning, the grapes are doped with Australian oil. Next, a dehumidifier produces dehumidified air, which is crucial for the drying process. Finally, after the dehumidified air enters the chamber, we use IOT to regulate the temperature, humidity, and video capture.

II. Literature Review

In this article by X. Ou, X. He, W. Cai, Q. Wang and Y. Wu.[1], use a method to transfer heat and mass using a packed bed-liquid desiccant which further uses lumped parameters through which humidity and temperature relation. The accuracy of this system is pretty good with respect to real time performance. This method of dehumidifying has an error rate of 10% which affects the entire system.Sharma, A. K Somkuwar, et al [2] helps to study the various types of drying methods used for grape drying which helps us think in the right way while researching dehumidification. This research has in-depth information about the physical properties of the grapes i.e. its micro-nutrients, diseases, its harvesting and the entire grape drying process. This study does not give any idea on how to reduce the waste grapes and its recycling.
Jiskani, S. A. Ahmed et al. [3] researched and helped realize the importance of solar drying and its methodology was understood to try to implement it on the system. This method creates a differential of the temperature using solar energy. By implementing this solar drying system not only time required for drying is reduced but even the cost of Basista Narayan Jena, A. S. Saily et al [4] use an infrared heating lamp to produce heat inside the dehydrator Chamber.
Nikolay Petkov Valov and Irena Marinova Valova et al. [5] show the implementation using MATLAB simulation and a hardware setup, this study proves the forced drying processes to be useful and accurate. This MATLAB implementation provides accurate and efficient modes of

fruit drying and controlling which helps us understand the in-depth functionalities of the system. This system can be costly, more complex, and the entire setup needs to be done again for other types of fruits and it needs more technicalities.

Muhammad Jahangir, M. Atiq et al [6] These Peltier Plates work on a principle effect known as the Peltier Effect, which allows one side of the substrate to absorb heat and the other to dissipate heat, separating them using a junction. Using a Thermal Peltier plate, the heat segregation along with a cooling side makes this system very low complex but highly efficient. This method uses more power and more current which can be resolved and overcome.

Zhen Qin, Swapnil Dubey, Fook Hoong et al. [7] In this study we gained an exciting and undiscovered approach to thermal energy storage and level maintenance of the heat by using Phase Change Materials (PCM). The major advantage or the upper edge of this system is the time and the work efficiency of the system. These PCMs have extreme heat absorption properties and are extremely useful. These PCMs are non-renewable sources of energy and get exhausted after a particular life cycle which is not cost efficient and eco-friendly.

Md. Najibullah, Md. Moine et al. [8] The solar powered exhaust fans are one of the best methods to reduce power consumption and dependency on the main supply line, which can be really helpful while taking in mind the load voltage and current drawing of the circuit. This system is environmentally friendly and more efficient than normal exhaust fans which have the same power output which gives a really good edge to the solar exhaust fans. The circuit gets more complex as we use more and more fans which is the requirement of our project, and they need more maintenance than normal, regular exhaust fans.

III. Generalized Methodology

The main power supply for our system is 230 volts AC which is then converted to 12V DC using rectifier circuits. The main processing unit for our system is Arduino Mega that gets various inputs from sensors and other input devices such as ESP CAM Module, and temperature sensors. The thermal peltier module is used to dehumidify the air which is passed into the chamber after heating it. According to the thermal peltier module, and the temperature inside the chamber the microcontroller controls the exhaust fans and heaters. In a controlled way, the moisture present inside the fruits is released out into the air hence drying them. The LCD module displays live temperature inside the chamber to get accurate data from time to time.The Wifi module enables the Arduino Mega to connect to the cloud for data analysis. Additionally, the Arduino Mega can transfer data to the cloud using the Wifi module and display system information on the LCD display. The fans and exhausts are controlled by relays and other actuators. In this way the system works.

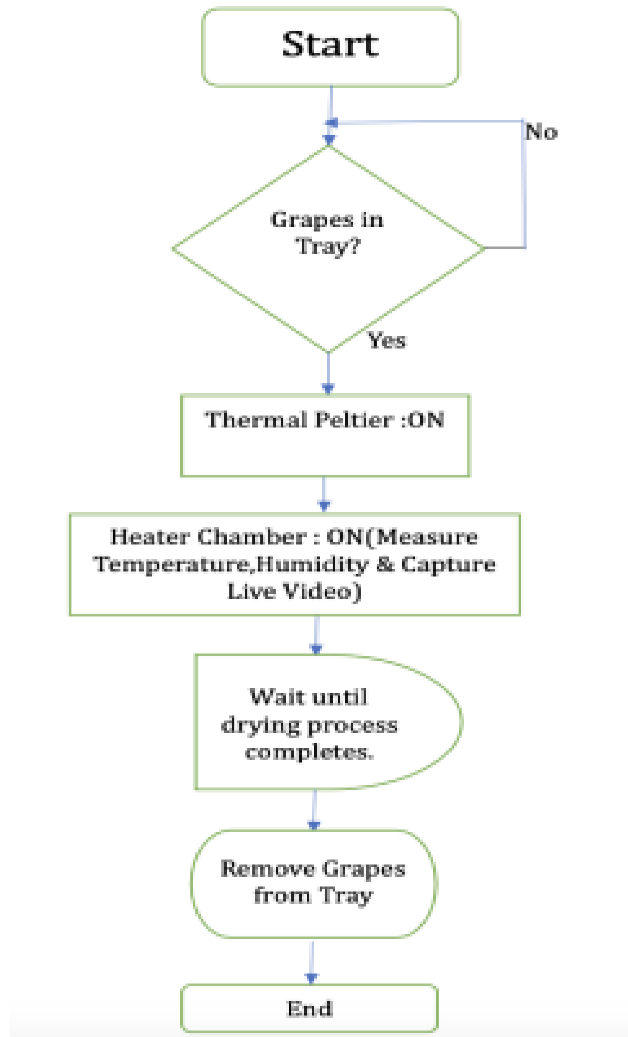

Fig. 1. FlowChart

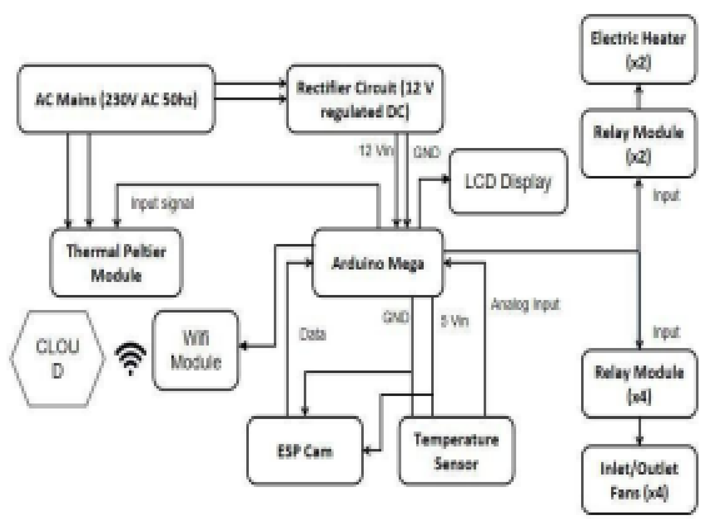

Fig. 2. Block Diagram

IV.Gap Identification

Sr No.	Journal Name	Gaps/Limitations
1	A simple dynamic model of dehumidifier for control and optimization in LDDS.	This method of dehumidifying has a error rate of 10% which affects the entire system.
2	Production of quality and safe dried grapes.	This study does not provide any idea on how to reduce the waste grapes and its recycling.
3	Fabrication & performance analysis of direct type passive solar dryer for chillies and grapes drying.	Solar drying process is costlier than other traditional methods of fruit drying which can be a major factor in the industry.One of the primary cost considerations in solar drying is the initial investment required for installing solar drying equipment and infrastructure.
4	Development of Dehydrator for Domestic Use of Fruits.	There is a major delay in the initial rising temperature which can lead to implementation of external circuits that can make systems more complex.
5	Design and Implementation of a System for Monitoring and Control of the Drying Process as a Learning Opportunity.	This system can be costly, more complex, and the entire setup needs to be done again for other types of fruits and it needs more technicalities.
6	Design and Testing of Cooling Jacket using Peltier Plate	This Method Uses more power and more current which can be resolved and overcome.
7	Low Grade Heat Collection from a Latent Heat Thermal Energy Storage Unit	These PCMs are non-renewable sources of energy and get exhausted after a particular life cycle which is not cost efficient and eco-friendly.
8	Solar Based Energy Saving Smart Industrial Exhaust Fan.	The circuit gets more complex as it use more and more fans which is the requirement of our project, and they need more maintenance than normal,regular exhaust fans.

V. Hardware Components & Specification

1.Thermal Peltier

Peltier plates are devices that can produce both cooling and warmth. When current flows across the plate's PN- junctions, electrons absorb heat energy and transfer it to the opposite junction, causing one side to become hot and the other to become cold. The cooling produced is determined by two factors: the current through the plate and the removal of heat from the hot side of the plate. The more current flows through the plate and heat is removed from the hot side, the greater the cooling produced.

2.Exhaust Fan

Overall, the findings indicate that exhaust fans only provide minor levels of ventilation compensation. Monitoring the common indoor air pollutants (radon, formaldehyde, carbon monoxide, nitrogen dioxide, and water vapour) revealed that the usage of exhaust fans had no harmful effect on indoor air quality. Nor did their use yield any quantitative or meaningful benefits, as no increase in air quality was seen.

3.Temperature Sensor

The NTC Thermistor temperature sensor module is low-cost and tiny in size. It is quite sensitive to environmental temperature. It is mostly used to determine the temperature of the surrounding environment. The temperature detection threshold can be adjusted using a potentiometer. The DO output can be directly connected to the microcontroller to identify high and low levels by sensing temperature changes in the surroundings. The temperature sensing range of the module is 20 to 80 degrees Celsius. This module can be changed with a line temperature sensor to regulate the water temperature, tank, and so on. Generally, the 4 wire technique of thermistor measurement is the most precise, because there is effectively no current flowing in either of the measurement cable wires, and hence no added resistance due to the cable wires.

4. Humidity Sensor

- The module can detect the surrounding environment of the humidity and temperature.
- High reliability and excellent long-term stability Humidity measuring range: 20%~90%RH(0~50 degree (temperature compensation).
- Temperature measuring range:0~+50 degree.
- Humidity measurement accuracy: ±5.0%RH.

5. SMPS (SWITCH MODE POWER SUPPLY)

A switched-mode power supply (SMPS), also known as a switch-mode power supply, switched power supply, or simply switcher, is an electronic power supply that uses a switching regulator to efficiently convert electrical power.The inverter receives the input DC supply from a rectifier or battery and turns it on and off at high frequencies ranging from 20 KHz to 200 KHz using switching MOSFETs or power transistors. The high-frequency voltage pulses from the inverter are fed into the transformer's primary winding, while the secondary AC output is rectified and smoothed to create the needed DC voltages. A feedback circuit monitors the output voltage and advises the control circuit to modify the duty cycle so that the output remains at the desired level.

VI.RESULT AND DISCUSSION

In Fig. 3, we observe the intricate dynamics of the drying process applied to grapes via tray drying methodology. The graphical representation delineates a discernible trend wherein the removal of moisture content intensifies proportionally with the passage of time. This phenomenon is primarily underpinned by the meticulous control of temperature within the drying cabinet, which remains consistently regulated throughout the operation.The pivotal role of temperature consistency cannot be overstated, as it serves as the catalyst for expediting the evaporation of moisture from the grapes. By maintaining a uniform temperature environment, the drying cabinet optimizes conditions for moisture removal, resulting in an accelerated drying rate. Consequently, this early extraction of moisture enables a rapid progression towards achieving the desired level of dryness in the grapes, ultimately leading to the timely production of dried items.This nuanced understanding of the drying curve elucidates the intricate interplay between time, temperature, and moisture content in the tray drying process. It underscores the importance of precise temperature control as a fundamental determinant of efficiency and effectiveness in achieving desired drying outcomes. Furthermore, it highlights the practical significance of this knowledge in optimizing production processes, ensuring the timely delivery of high-quality dried products to meet market demands.

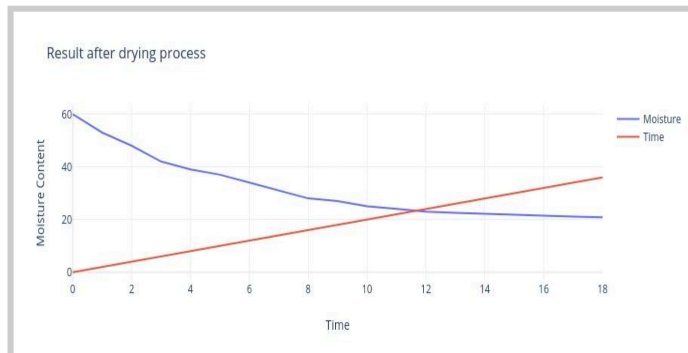

Fig.3. Moisture Content(%) v/s Time(hrs) in tray drying

VII. CONCLUSION

Fruits may be processed quickly and effectively using food processing equipment, saving labor expenses. Food processing facilities can reduce the risk of developing a foodborne illness by ensuring that fruits are handled hygienically. Food processing equipment can be used to create uniformly sized and shaped fruits. Fruits in culinary products may appear nicer as a result. Food processing equipment can be used to make a variety of fruit products, such as juices, smoothies, dried fruits, and jam. Fruit intake could become more convenient and accessible as a result. Food processing facilities can contribute to food waste reduction by increasing the shelf life of fruits. Buying and maintaining food preparation equipment can be expensive. Using certain food processing. equipment can be complex and require training. Certain cooking methods can cause the fruit to lose nutrients. For example, when you peel fruit, some fiber and nutrients can be lost. Food processing methods that involve adding sugar or other chemicals to fruit can be used. As a result, the nutritional value of the fruit can be reduced and it can also be linked to diseases such as diabetes and obesity. Food factories can harm the environment by producing waste and energy.

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