FRUITS AND VEGETABLES DEHYDRATION USING TEMPERATURE AND MOISTURE SENSORS

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***Abstract*—**Dehydration is the process of removing water or moisture from the food. Drying is one of the oldest and easiest method of food preservation. The shelf life of fruits and vegetables are increased by different methods. This process involves using different techniques such as air-drying sun drying, oven drying, freeze drying, Thermal dehydration and dehydrated machines. The thermal dehydration is one of the most used method. We can decrease the spoilage of micro-organisms through removing water content from the fruits and vegetables. The packing and transporting of dehydrated fruits and vegetables will be very easy. Thermal dehydration which is very easiest way to dehydrate. During the experiment we found that optimum condition of fruits and vegetables is 40-degree calciols. These values depend on the types of fruits and vegetables**.** An optimum drying system for the preparation of quality dehydrated products is cost effective as it shortens the drying time and cause minimum damage to the product. Dehydration lowers the water content and the microorganisms will be in an active stage. The popularity of food dehydration has increased due to its numerous advantages such as reducing food waste, promoting healthy eating, and improving food security.

Keywords- *Thermal dehydration, Sensors, Arduino, Fruits Vegetables preservation.*

I. Introduction

Food dehydration is the process of removing moisture from food items to increase their shelf life and portability. The ancient practice has been used for centuries to preserve food, and it achieved through various techniques. Each methods have its benefits and limitations, but they all share the common goals of reducing water content of food to prevent spoilage and extend shelf life. Dehydration preserves the nutritional value and flavour of food, making it a popular method for preserving fruits and vegetables, meats, and herbs. Additionally, food dehydration is a sustainable method of food preservation that can reduce food waste and improve food security by making food available year-round. Preserving food to extend its shelf-life, with ensuring its safety and quality, is a central preoccupation of the food industry. As a result, there has been a steady stream of new 'minimal' preservation techniques. At the same time, the development of the hurdle concept has led to renewed interest in the use of more traditional preservation methods and the ways they can be combined with newer technologies. Food preservation is the process of treating and handling food to stop or greatly slow down spoilage (loss of quality, edibility or nutritive value) caused or accelerated by micro-organism. Preservation usually involves preventing the growth of bacterium, fungus, and other microorganism as well as retarding the oxidation of fat which cause rancidity. It also includes processes to inhibit natural ageing and discoloration that can occur during food preparation such as the enzymatic browning reaction in apples after they are cut.

Fig:1.1.Stackable Dehydrator

Dehydration of fruits and vegetables using electricity is a commonly used method for preserving the foods. The process involves removing the moisture from the food item using heat generated by electric energy. The most used method for dehydration of fruits and vegetables based on electricity is the use of electric dehydrators. These are machines that use a heating element to produce heat which is then circulated within the unit to dehydrate the food items. The process of dehydration using an electric dehydrator freeze dry involves the slicing of fruits and vegetables into thin pieces and placing them on to the trays of the dehydrator. The dehydrator then uses electricity to heat the food items, which causes the moisture to evaporate.

As the moisture evaporates, it is drawn out of the dehydrator using a fan or other circulation mechanism. This helps to speed up the process of dehydration and ensure that food items are evenly dried. One of the advantages of using an electric dehydrator for fruits and vegetables dehydration is that it is relatively simple and convenient process. The dehydrator can be set up in kitchen or other food preparation area and left to for several hours. Another advantage of using electric dehydrator for fruits and vegetables is that they are energy -efficient method food [reservation. This is because they use a relatively low amount of energy to produce the heat needed for dehydration, which makes them an environmentally friendly option. Overall, dehydration of fruits and vegetables based on electricity is

an effective method of food preservation that occurs a number of food preservation that occurs a number of benefits over the other preservation methods.

II. Theory

There are the some of the fruits and vegetables based on their time period. Different species have different timings based on their water and moisture content. The species which have less moisture content can dehydrate very fast and which have more moisture content can dehydrate slowly which is an inversely proportional. These dehydrated fruits will be very easy to carry because of loss of weight. These are very useful when there is a scarcity of food throughout anywhere. The thermal dehydration which is dehydrated based on heat energy. We can dehydrate through the electricity very easily and the Arduino is also can be used. Based on our room temperature we can set the temperature and humidity ranges. We can adjust these ranges which will be Applicable for an all types of species. It is very easiest way to dehydrate the fruits and vegetables .

Table 2. Blanching and Drying Times for Selected Vegetables

Vegetable	Blanching		Drying time (hrs)*
	Method	Time (mins)	
Beets	cook before drying		3½–5
Carrots	steam	3–3½	3½–5
	water	3½	
Corn	not necessary		6–8
Garlic	not necessary		6–8
Horseradish	not necessary		4–10
Mushrooms	not necessary		8–10
Okra	not necessary		8–10
Onions	not necessary		3–6
Parsley	not necessary		1–2
Peas	steam	3	8–10
	water	2	
Peppers	not necessary		2½–5
Potatoes	steam	6–8	8–12
	water	5–6	
Pumpkin	steam	2½–3	10–16
	water	1	

Table:2.1

Fruits and vegetables are the most commonly consumed super or functional foods (Rwubatse et al., 2014), yet their high moisture content (over 80%) makes them especially susceptible to bacteria that cause spoiling (Misname et al., 2017; Valarmathi et al., 2017). Keeping fresh is the best way to preserve the nutritional value of fruits and vegetables, but most storage methods necessitate low temperatures, which are difficult to maintain throughout the distribution chain. In contract, drying is an effective post-harvest management strategy, particularly in Nigeria and other Sub-Saharan African countries where power outages and rising fuel prices make low-temperature storage, handling, and distribution facilities scarce (Dereje and Abera, 2020). their shelf life and increase food security, approximately one-fifth of the world's fresh produce are dried (Pragati and Preeti, 2014; Betoret et al., 2016; Feng et al., 2021). Dried fruits and vegetables make healthy eating more practical and can help close the gap between recommended and actual fruit consumption. By lowering water activity, dehydration keeps fruits and vegetables healthy and safe, prolonging their shelf life much beyond that of fresh produce. Drying processes also affects enzymatic behaviour, sensory properties, and microbial growth (Özbek et al., 2007; Dereje and Abera, 2020). Fruit and vegetable storage through drying has a long history and is based on sun and solar drying processes (Sagar and Kumar, 2010). Drying used to be as simple as lying the product out on mats, rooftops, or drying floors in the sun (Ahmed et al., 2013), using solar radiation and convective air. Other options include drying the harvest beneath a cover, on treetops, or even on field shelves (Rwubatse et al., 2014). Heat is transferred to the fruit or vegetable raw material through convection from the ambient air and radiation from the sun on its surface during sun drying. Since foods to be dried are exposed and climatic changes can occur, the method is highly unsanitary and volatile. Mechanized solar dryers such as tray, cabinet and tunnel dryers have been designed to overcome the challenges of damage, dust, pest infestation and unexpected rainfall encountered in open air drying (Pragati and Preeti, 2014; Rwubatse et al., 2014; Karam et al 2016; Ajuebor et al., 2017). Application of mechanized drying to conserve agricultural produce has grown significantly, necessitating the development of fast drying methods and approach that decrease the amount of fuel dispelled in these operations. It has been noticed that the aim of drying agricultural products has shifted. Previously, the goal was to lengthen the life span of dried fruits and vegetables, but now the goal is to produce high-quality dried vegetables and fruits.

III.Problem Description

There are different types of techniques which are used for an dehydration but all the techniques are not suitable for an all the environmental conditions. Thermal dehydration is one of the easiest methods and because of this food dehydration we can easily face the shortage and scarcity of the food. Thermal dehydration where we can consume the power easy to use in a household. Were in ancient the dehydrations are done through the sun rays which is a time taking process and we cannot dehydrate them in a winter and rainy season. Which is one of the disadvantages.

IV.Existing Solution

There are different types of techniques used for dehydration. They are solar dehydration, osmotic dehydration, oven drying, freeze drying etc. But it is not suitable in all conditions. The thermal conditioning which does not depend on the environmental conditions. We can observe the increasing of graphical representation fruits and vegetables dehydration. We can dehydrate not only fruits and vegetables but also herbs at an suitable conditions based on their temperature, humidity and moisture content in it. The herbs will dehydrate quickly than compare with fruits and vegetables. Sun drying is the oldest method of fruit and vegetable preservation (Misha et al., 2013). Solar energy, air, and a smokey flame have all been used to evaporate moisture from fruits, meats, cereals, and plants throughout history (Ahmed et al., 2013). Fruits are safe to dry in the sun because of their high sugar and acid content, but vegetables are poor in sugar and acid, rendering them unsuitable for sun drying. Fruits are placed whole or sliced in trays on elevated slabs and exposed to the open air until desired dryness is achieved. The best screens are stainless steel, teflon coated fiber glass or plastic. The optimum conditions for dying to occur are a minimum temperature of 86°F and a relative humidity.

Fig:4.1. Dehydration Sample

It is one of the dehydrated fruits which is dehydrated through the Thermal dehydration. The dehydration which is considered based on the temperature and the humidity ranges. The temperature and humidity ranges.

Range of age	Temperature	Humidity
1-1.5 hrs	32.5	960
1.5-2 hrs	33	900
2-3.5 hrs	34.5	770
3.5-4 hrs	35	700
4-5 hrs	37	591
5-7 hrs	39	450

Table:4.1. Range of Ages

V.PROPOSED SOLUTION

In this research project, we took only the two important productivity factors of the -- temperature, humidity of the fruits and vegetables the process of monitoring and controlling these parameters using IoT& displays in Things speak webpage. This IoT based smart system improves the overall health of the chicken, reduces the mortality rate and in turn improves the productivity of the poultry farm [6]. This proposed system reduces the manpower and improve the efficiency of the poultry farm. Apart from alerting the supervisor, our proposed system acts automatically to bring back the thermal parameters within the threshold values. There is also a builtin LCD to display the parameters

Hard ware design

Arduino UNO Arduino is an open-source hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices. Arduino board designs use a variety of microprocessors and controllers. It is shown in fig [3]. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards ('shields') or breadboards (for prototyping) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs [7]. The microcontrollers can be programmed using the C and C++ programming languages, using a standard API which is also known as the Arduino language. port.

Features of the Arduino Uno Board:

• It is an easy USB interface. This allows interface with USB as this is like a serial device

• The chip on the board plugs straight into your USB port supports on your computer as a virtual serial port. The benefit of this setup is that serial communication is an extremely easy protocol which is time-tested and USB makes connection with modern computers and makes it comfortable.

• It is easy-to-finding the microcontroller brain which is the ATmega328 chip. Table 2 shows the specifications about Atmega 328p microcontroller. It has a greater number of hardware features like timers, external and internal interrupts, PWM pins and multiple sleep

• It is an open-source design and there is an advantage of being open source is that it has a large community of people using and troubleshooting it. This makes it easy to help in debugging projects.

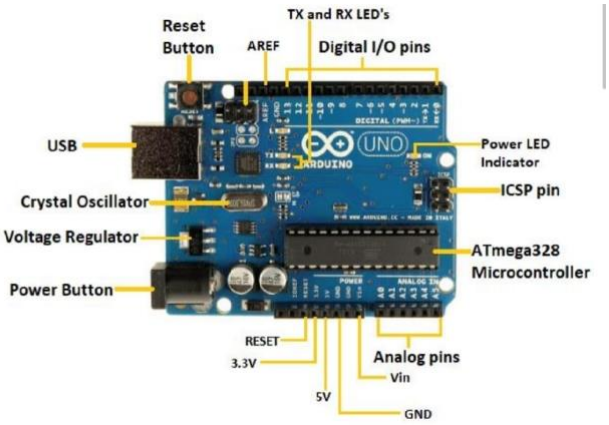


Fig:5.1.Aurdino Board Interfacing

Microcontroller	ATmega328P 8-bit microcontroller
Operating Voltage	5V
Input Voltage	7-12V
Input Voltage Limits	6-20V
Analog Input Pins	6 (A0 – A5)
Digital I/O Pins	14 (Out of which 6 provide PWM output)
DC Current on I/O Pins	40 mA
Flash Memory	32 KB
SRAM	2 KB
EEPROM	1 KB
Frequency (Clock Speed)	16 Hz

Table:5.1.1. Arduino Specifications

A. Temperature and Humidity Sensor Module

The temperature and humidity sensor modules are responsible to collect the temperature and humidity on a regular interval and pass the data to the database through the Wi-Fi controller.

Fig:5.2.Temperature And Humidity Sensor

DHT 11 The DHT11 is a commonly used Temperature and humidity sensor. The sensor comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data. DHT11

Specifications:

• Operating Voltage: 3.5V to 5.5V

• Operating current: 0.3mA (measuring) 60uA (standby

• Output: Serial data

• Temperature Range: 0°C to 50°C

• Humidity Range: 20% to 90%

• Resolution: Temperature and Humidity both are 16-bit

• Accuracy: ±1°C and ±1%

B.LCD

An LCD (Liquid Crystal Display) is a type of flat-panel display that uses liquid crystals to control the amount of light that passes through the display. Here are some of the specifications of an LCD display:

- Resolution: The resolution of an LCD display refers to the number of pixels on the screen. The higher the resolution, the sharper and clearer the images and text will appear.
- Size: LCD displays come in a range of sizes, from small displays for portable devices to large displays for televisions and computer monitors.
- Refresh Rate: The refresh rate of an LCD display refers to the number of times the screen is redrawn per second. A higher refresh rate can result in smoother and more fluid motion.
- Contrast Ratio: The contrast ratio of an LCD display refers to the difference in brightness between the darkest black and the brightest white that the display can produce. A higher contrast ratio can result in more vivid and lifelike images

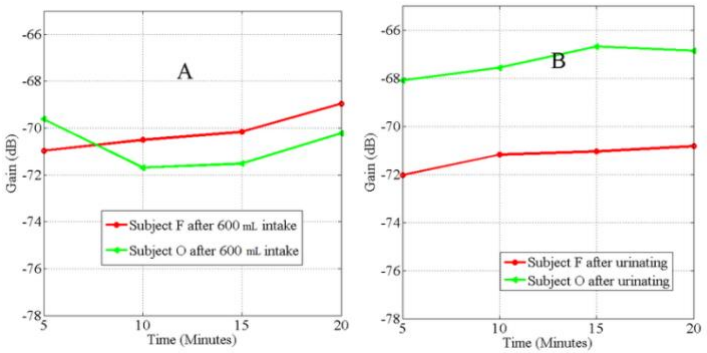
Fig:5.3.LCD

LCD Specifications:

- The operating voltage of this display ranges from 4.7V to 5.3V
- The operating current is 1mA without a backlight
- HD47780 controller
- LED color for backlight is green
- Number of columns – 16
- Number of rows – 2
- Number of LCD pins – 16
- It works in 4-bit and 8-bit modes
- Font size of character is 0.125Width x 0.200height

VI.RESULTS AND CONCLUSION

This work proposes a methodology to monitor and Control temperature and humidity . This work was implemented with the help of Arduino microcontroller. This method can be further implemented in applications involving moisture monitoring of various physical parameters. In LCD we can physically monitor the various parameters of the compartment and make quick actions as seen in fig[4.1]. Things speak web page we can continuously monitor physical parameters like temperature, humidity as shown graphically in fig[5.3].



OUTPUT:

Fig:6.1.Output

VII.References:

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