Design and construction of air temperature and relative humidity measurement system in solar dryer using Android operating system

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Abstract: This research aims to design and create air temperature and relative humidity measurement system for solar dryer. Solar dryer used in this research created by Physics Program, Faculty Science and Technology, Thepsatri Rajabhat University. After creating the measurement system, the measurement system was installed inside solar dryer and temperature and relative humidity were measured by using this system. Blynk application which is a mobile application on Android operating system. The measurement system can be opearated real time and the data can be exported in Excel file. To do this, ESP8266 and DHT22 were connected with Blynk application. The measurement system was used to measured temperature and relative humidity inside solar dryer. The temperature value inside solar dryer is between 51.517 to 56.22 oC, relative humidity value is between 6.143 to 12.154 % For the outside solar dryer, temperature is between 44.949 to 42.1 oC and relative humidity is between 9.891 to 12.382 %. Using a microcontroller form Blynk application compared with a standard measuring instrument that is used is Data Loggers of HIOKI form Japan. Where when comparing, there is an error of 0.5%

Keywords: Solar dryer, ESP8266, DHT22, Application Blynk, The system measures the temperature and humidity

1. Introduction

Thailand is an agricultural country ; as a result, there is a lot of agricultural products. In the past, there was a way to preserve food to extend the food expiration dates for eating or using, such as fermentation, sugar syrup, stirring and smoking, etc., which natural drying has become very popular due to the potential of Thailand in terms of solar energy which is relatively high because it is located near the equator, resulting in an average daily radiation exposure of 17.4 megajoules per square meter. [1]. It also helps in the use of clean and economical energy. Natural drying is also an easy process. Most of the production processes are fruits, herbs, meat, but natural drying often suffers from pest infestation or dust contamination. So far, many researches related to drying technology have been invented to help reduce this problem.

In the physics program , faculty of science and technology, Thepsatri Rajabhat University has conducted research on the study and development of household solar dryers to help accumulate heat energy, The dryer also consists of a polycarbonate sheet covering a parabolic shape to assist in the accumulation of thermal energy. There is an open-close front door and a fan that uses 10 watts of DC power direct power directly to the solar cells to help drain moisture from household-grade solar dryers [3]

As a result of the research of solar dryers, temperature and humidity are measured through data loggers, collecting data through an SD card, making it unknown to temperature changes, humidity at that time, as temperatures change over time. Therefore, the researcher realized that building and designing a temperature sensing system including the humidity inside the solar dryer transmitted through the Android operating system is convenient to monitor the temperature data. In creating this measurement system, it will have a positive effect on maintaining the product being baked to see if the temperature conditions are appropriate. If it baked further, it could damage agricultural crops. Therefore, the creation of a real-time measurement tool, which measures its temperature and humidity, is essential for measuring inside a solar dryer and transmitting it through the Android operating system through the Blynk app, allowing timely data analysis.

2. Principle and Theory

Most solar dryers have been developed for drying agricultural products as substitutions for natural sun exposure or replace the drying with mechanical equipment (mechanical dryer) to solve the problem of damage and contamination caused by natural sun exposure or to reduce energy costs. The drying researchers specializing in the drying will design a solar-powered dryer to be more efficient than natural sun exposure and can solve the problems by placing the products to be dried in a cabinet, box, room or air tunnel. Generally, a solar dryer consists of two parts: one for solar radiation and the parts for placing the product, both of which may be in the same structure or separately. In operation, solar radiation is converted into heat energy and the resulting thermal energy is used to evaporate water from the product.

This greenhouse drying system uses polycarbonate sheets after covering. When the sun's rays pass through the polycarbonate sheet, Some of them will fall on the floor, and inside the drying system, the temperature is higher. This causes the moisture in the product to evaporate and is driven by an exhaust fan attached to the rear of the drying system to drain the moisture to the outside environment. The ambient air then flows through the front vent to replace it. The humidity of the product will gradually decrease as shown in figure 1.

Figure 1 household solar dryers

2.1 Solar Dryer Principles

The operation of the solar dryer will use the energy from the sunlight to collect it. Used inside the dryer, which is a greenhouse dryer, it causes heat accumulation from the exposure of the solar radiation that passes through the transparent plastic sheet of the solar dryer and the exposure to the solar panels inside the dryer and emits a lot of long wave rays inside the drying machine causing drying heats that accumulates for a longer period of time. As a result, the temperature inside the solar dryer increases and the temperature is higher than the outside or ambient temperature. The drying of the product can be dried faster, but we will have to study the drying of the product in various types to be suitable for the dryer. It also prevents dust in the air and rain that can make products in higher quality. Solar dryers also rely on solar heating energy, saving energy and releasing a lot of carbon dioxide.

2.2 Measurement systems

Micro controller (Microcontroller) comes from two words, micro means small and the term controller means controller or control device. Therefore, the microcontroller means small control device. However, in this small controller it packs the ability to work as a computer system that most people are familiar with, that is, within the microcontroller it integrates the CPU, memory, and ports, which are the core components of a computer system. The program can be programmed to define working patterns and control them independently according to the needs [9]

DHT Sensor Air temperature and humidity sensor DHT is derived from the term Digital Humidity and Temperature Sensor, literally translated as a digital humidity and temperature sensor. It has the ability to detect air humidity and temperature. There are 3 types of values:

1. Humidity whereby absolute humidity is defined as the mass ratio of water vapor contained in air per 1 unit of volume of air in grams / cubic meter. Absolute humidity is altered as the air pressure changes.

2. Temperature , the average value of the kinetic energy of any particle in matter which corresponds to the heat or cold of that substance. (Here is the air)

3. Heat index is the actual measurement of the heat that we feel as a result of effect of humidity in high temperature and high humidity conditions, the human body will feel hotter than the temperature measured by a thermometer.

Arduino ESP8266 (NodeMCU) NodeMCU is a platform used to build Internet of Things (IoT) projects that include an open source Development Kit (Board) and Firmware (On Board Software). Lau has made it easier to use. It comes with a WiFi module (ESP8266) which is the key to connect to the internet. The IoT device control can be programmed without having to go through other devices. Recently, there have been developers who have been able to make the Arduino IDE compatible with the Node MCU, making it possible to use C / C ++ for programming. This allows us to use it in a wide variety of applications. This NodeMCU can do a lot of things, especially related to IoT, whether it is a small web server, controlling the lights via WiFi, and many more. [11]

2.3 Blynk application

Blynk is a ready-made application for IOT work, interestingly, it is easy to write programs, no need to write an App and can be used in Real time, able to easily connect various devices to the Internet, whether it is Arduino, Esp8266, Esp32, Nodemcu, Rasberry pi, can be displayed on Application easily and most importantly, Application Blynk is also free and supported on IOS and Android systems.

The way Blynk works starts with an Arduino esp 8266Esp 32Rasberry Pi device connecting directly to Blynk's server and will be able to send and receive data to each other. Smartphone computers are connected directly to Blynk's Server which is a bridge to connect to each other.

3. Experiment Analyses

The humidity and temperature monitoring system has been used in experiments with household dryers developed by the Faculty of Physics, Science and Technology. Thepsatri Rajabhat University, Lopburi Province, and installed a temperature sensor. The humidity inside the solar dryer and outside the solar dryer as shown in Figure 4 is compared to the data logger value every 15 minutes and transmitted via the Blynk application on the Android system via mobile phone, which makes it convenient to store the product in real time

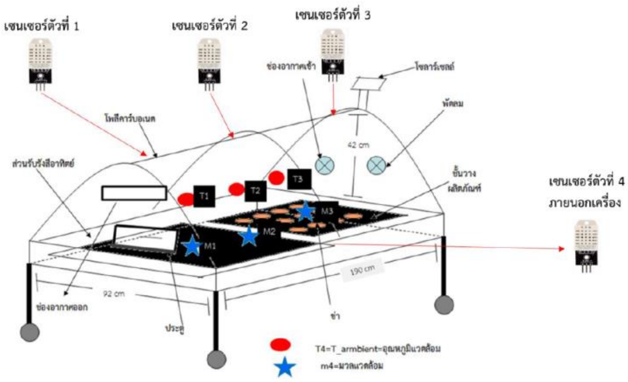

Figure 2 DHT 22sensor mounting position

Effects of the system on the Blynk application by designing the system on the Blynk application through the Android operating system for recording data and storing temperature, humidity, The research process obtained data from analytical studies to create and design Blynk apps for temperature measurements and moisture in numerical form and graphs on the pages of the application.

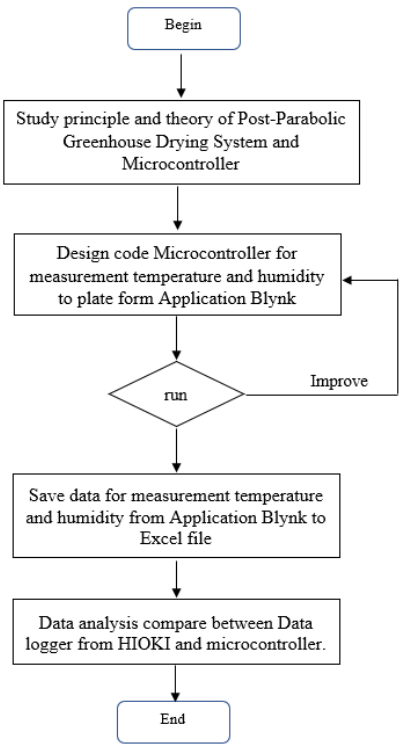

Figure 3 Flow Charge system measurement

3.2 Data Analysis

1) Analytical Induction: measurement humidity and temperature monitoring system and to plate form Application Blynk.

2) Data analysis was used to temperature and humidity from Application Blynk to Excel file. By compare between Data logger from HIOKI and microcontroller

4. Result

From Data analysis was used to temperature and humidity from Application Blynk to Excel file. By compare between Data logger from HIOKI and microcontroller

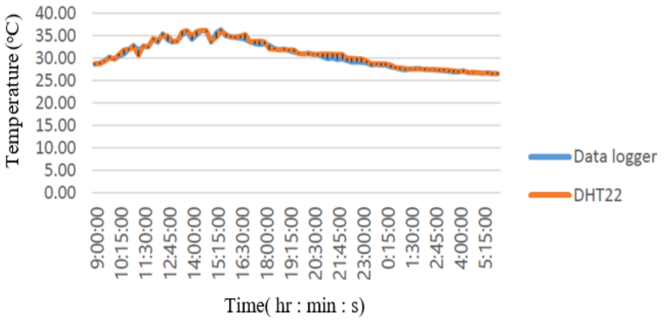

Figure 4 result temperature from Application Blynk to Excel file. By compare between Data logger from HIOKI and microcontroller

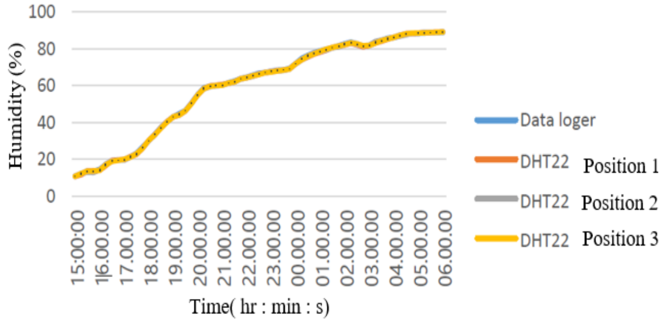

Figure 5 result humidity from Application Blynk to Excel file. By compare between Data logger from HIOKI and microcontroller

5. Conclusion

Design and construction of temperature measurement systems including the humidity in a solar dryer through the Android operating system. It has the purpose of real-time data monitoring and storage. The design and construction of temperature measurement systems can be applied and began to study the temperature measurement system and humidity to be collected and monitored at any time for further troubleshooting of solar dryers.

From the study of the design and construction of the temperature and humidity measurement system , the procedures and methods were studied to develop a temperature and humidity measurement system in order to implement a system designed for data collection and can also send, transmit and store data through Blynk for analysis as well. From the experiment, the measurement system in the solar dryer for the temperature measured inside the solar dryer is in the range. 220.56-517.51degrees Celsius, the humidity ranges from 143.6to 154.12 percent, and for the temperature measured outside, the solar dryer is in the range. 1.42-949.44degrees Celsius. Humidity also ranges from 891.9to 382.12percent. This measurement is compared with the temperature probe and the relative humidity of the K-type probe in all four positions, the error is 2-0percent.

The researcher-built measurement kits can be scaled up and added to sensors to suit the size of the dryer, or can be applied to smart farm measurements.

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