ISSN: 2581-1274

Prototype of Room Temperature and Humidity Monitoring Device in Shallot Storage Using Microcontroller Arduino

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ARTICLE INFO

Article history:
Accepted

Keywords:
Shallot Storage
Temperature and Humidity
Microcontroller
DHT11 Sensor

ABSTRACT

Allium ascalonicum L or commonly referred as shallot is one type of horticultural plant that is important because it is widely used by humans as a mixture of spices in cooking. The need for shallots increasing more every day without accompanied by a large number of agricultural products, causing the stability of shallot availability in Merauke County become unstable. Support the needs of consumers shallots imported from outside Merauke. Therefore the condition of the shallots in the storage area are cold and humid. While waiting to be sold in storage area, it must be maintained temperature and humidity to reduce decay and shrinkage. This prototype monitoring device works to measure and maintain the temperature and humidity in the storage. The data collection method in this study is Literature Study, Observation, Interview, and Documentation. Microcontroller devices are designed or made to be able to control the state of temperature and humidity in the room where the onion storage. The device also gives notifications via text message to users to be able to find out the state of the onion storage. The results of the study conducted using DHT11 sensor obtained a temperature measurement accuracy rate of 93.848% and humidity accuracy rate was 91.808%. This device can detect the temperature and humidity values in the shallot storage room.

I. Introduction

Allium ascalonicum L or commonly called onion is one type of horticultural plant that is important because it is widely used by humans as a mixture of herbs in cooking and can also be used as a basic ingredient in medicine [1]. The need for shallot increasing more every day without accompanied by many agricultural products, causing the stability of the availability of onions in Merauke County to be unstable, To support the needs of shallot consumers imported from outside Merauke. While waiting to be sold in storage area, it must be maintained temperature and humidity to reduce decay and shrinkage. Good storage will produce stocks with market acceptable quality, and finally expected to control the rise and fall of prices. The process of storing shallots is still carried out conventionally, namely by checking the storage area without knowing the temperature and humidity values of the room where the shallots are stored. Shallot lose about 10-17% of their weight during storage, causing considerable losses. Weight loss and damage to shallot in the form of shrinkage, germination and decay are influenced by two factors, namely water content and storage temperature[2]. Based on description above, this study will design a system using an Arduino Microcontroller in the form of temperature and humidity detection using sensors placed in the shallot storage, if the room temperature has reached a certain limit then Microcontroller will control the fan to rotate and if it's too low then the lamp will turn on. Another device used is a communication device that can send messages that will be received by the owner of the shallot storage area if the moisture in this area exceeds the limit to immediately flip the shallot.

II. The Proposed Method

A. Data Collection

During Storage at Different Moisture Content Levels and Temperatures" the results of this study are shallots at a moisture content of 80% with storage at 5°C giving the best quality among other treatments after storage [2]. Other research states that the measuring device is designed to be able to measure the temperature on the server device using the LM35 sensor continuously so that users do not need to carry out continuous monitoring[3]. Storage Room Temperature and Post-Storage Treatment on the Quality and Productivity of Shallots are also influenced by Storage which Can Suppress the Physical Damage of Shallots[4]. Data collection for this study used several methods, such as observation which is to observ the Shallot Storage Area to obtain information for design of the system to be used as research. Interview conducted with the owner of shallot storage area aims to find information by asking direct questions to he/she who are used as research samples. And then collect of documents or photos that can be a description or evidence related to the research process to the results of the proposed application of the prototype.

B. Proposed Metdhod

Shallot storage is carried out of ties and then hung on shelves. Storage temperature 30-33°C, relative humidity 65-70%. This shallot storage room is usually 6m x 4m x 3m (length x width x height). Inside the storage, there is a storage rack capable of holding 2-5 tons of shallots stored in a hanging position on the rack. Shelves can be made of boards arranged in such a way [4]. So that in making this prototype, we modeled the storage size with a scale size of 1:25. The proposed method can be seen in the figure below which is a draft concept or flowchart of the proposed metdho from the research being conducted.

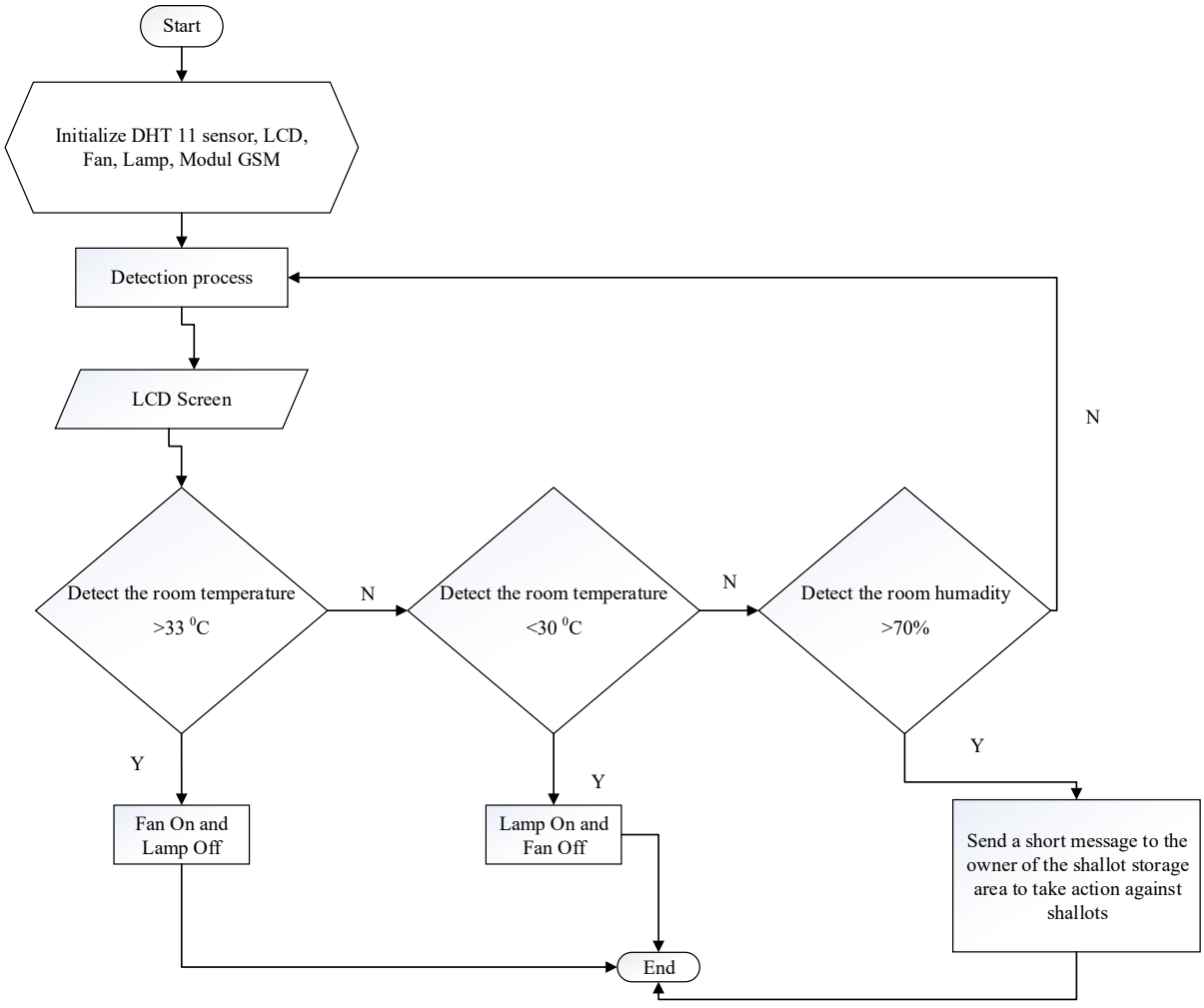


Fig. 1. Proposed Block Diagram

III. Method

The system proposed in this study is to build system or device that is expected to be a problem solution for shallot owners in the storage process. Furthermore, a monitoring system is also needed in the storage area with the aim of being able to measure temperature and humidity conditions. The research methodology is divided into several stages:

A. System Block Diagram

The prototype design is made by an overview of the tool as a whole. With this design, the working principles of the tools and components of the system used will be clearly seen. Therefore, the system block diagram can be seen in the figure below :

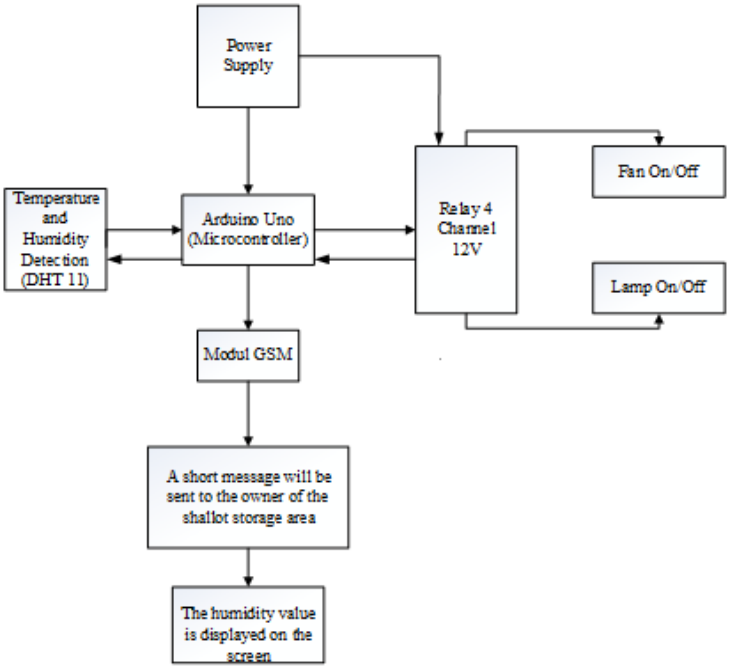


Fig. 2. System Block Diagram

From the diagram above, the workings of the prototype built are as follows:

1. The temperature sensor and humidity sensor will detect the temperature and humidity in the shallot storage area as seen from the rise in room temperature to a higher level, and humidity that exceeds the limit will then be sent to Arduino.
2. All the input/output data are made on Arduino, where when Arduino gets a temperature that exceeds the Arduino limit it will turn on the installed fan and if the temperature is too low then the lamp will automatically turn on.
3. Arduino will send a short message via the GSM module if the humidity exceeds the limit, then the short message will be sent to the owner's cellphone screen where the shallots are stored.

B. Testing

The system test that will be carried out by sscenario testing, and accuracy test. The first testing aims to test the system components that have been designed and ensure that each element of the system functions as expected[5]. The test scenario aims to test the stages that work on each sensor in the tool or system to find out whether the output results are appropriate or not. While testing with the accuracy method aims to determine the level of accuracy in the process of classifying temperature and humidity data in the room where shallots are stored. The testing process is used to test 3 elements which include :

1. Sensor accuracy, conducted to test the DHT11 sensor to determine the temperature and humidity in the room where the shallots are stored.

2. Monitoring tool, to test monitoring tools in the form of fan and lamp to maintain the temperature and humidity of the room where the shallots are stored.
3. Device communication of prototype, to test the GSM module communication to send data via short message on temperature and humidity values in the room where shallots are stored.

IV. Results and Discussion

After a Prototype Device Monitoring Room Temperature and Humidity In Shallot Storage Using Arduino is built, the device can make it easier for owners of shallot storage to monitor and provide appropriate information about the temperature and humidity conditions in the room.

A. Prototype Components

The components that support the performance of the prototype Room Temperature and Humidity Monitoring Device at the Shallots Storage Site which are built so that they can run according to the draft prepared. The devices used in the research that has been carried out have their respective functions to help the ability of the device to be built so that it can run as designed. The following is an explanation of each device :

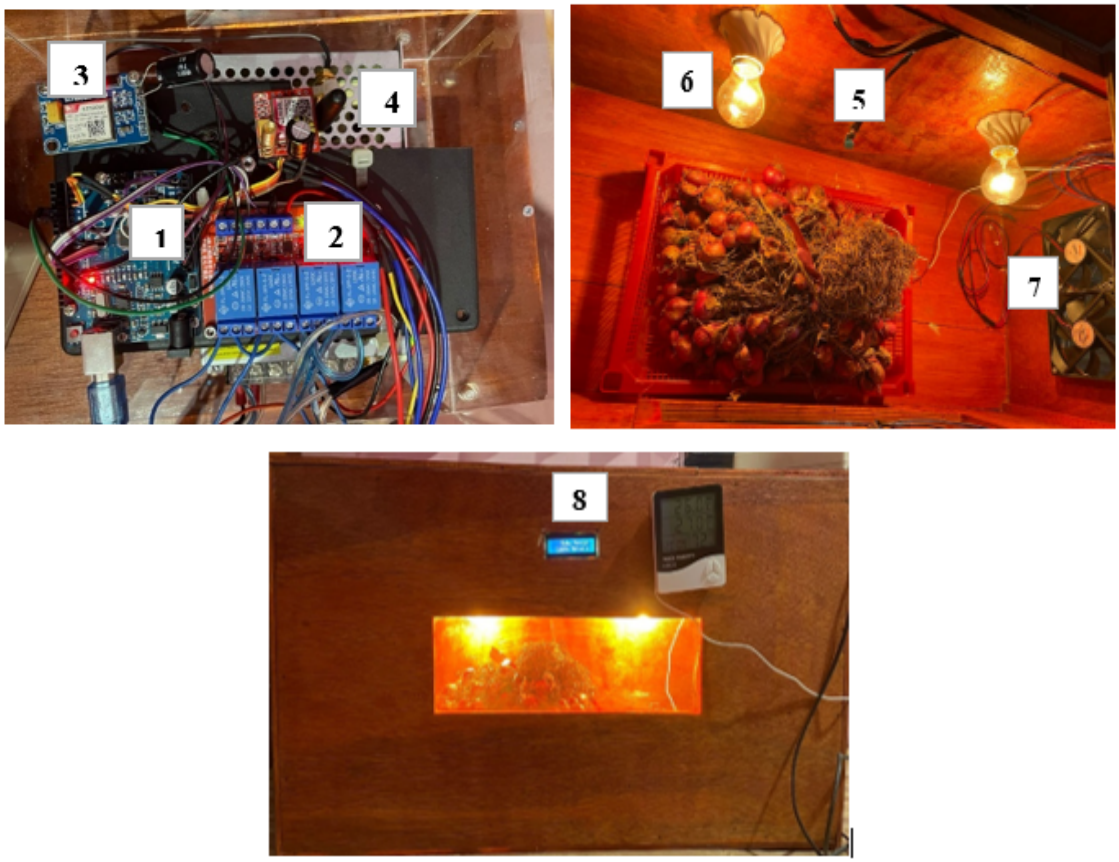


Fig. 3. Tool Components

1. Microcontroller Arduino Uno as the center of the data process[6]. In this prototype to process the i/o data and decision making of the monitoring device of room temperature and humidity in shallot storage.
2. Relay 4 Channel as an electrical switch, where it will work automatically based on the logic commands given[7].
3. SIM 800L as a tool used to send data in the form of messages via SMS[8]. In this prototype the value sent is the humidity value of the room where the shallot storage placed.
4. Adapter Power Supply as an introduction to the electrical current of this device in the form of a Power Supply for devices [9]. So this tool that is used as a power provider for one or more

electrical load for the prototype that exist in temperature and humidity monitoring equipment for shallot storage.

5. DHT11, sensor use for detects temperature and humidity objects that have analog voltage outputs that can be further processed using a microcontroller[10]. In this prototype using for detect a temperature and humidity value for the room where shallot is stored. After detecting the temperature and humidity, the read data will be input into Arduino Uno.
6. Lamp, serves as a tool to raise the temperature in the room for shallot storage.
7. Fan, serves as a tool to lower the temperature in the room for shallot storage.
8. LCD I2C, using for two-way serial communication standard uses two specially designed channels for sending and receiving data on microcontroller[11]. This device serves as a tool to display data on the temperature and humidity values of Arduino in case of a change in the value of the room for shallot storage.

B. Prototype Result

The prototype results below show a figure that a tool for monitoring room temperature and humidity in the shallot storage area that has been made.

Fig. 4. Prototype Results

This device for monitoring room temperature and humidity in the shallot storage area is made to measure the temperature and humidity of the room in the shallot storage area so that the temperature can be maintained and the room owner can find out the temperature and humidity values in the shallot storage area, then output the results of these measurements will be displayed on the LCD screen.

If at the time of measuring the temperature the resulting value is more than 33℃ then this tool will turn on the automatic fan as a tool to lower the temperature in the room. but if at the time of measurement, the resulting temperature value is less than 30℃ then the light will turn on to raise the temperature. The DHT 11 sensor will also detect the value of room humidity, if the value is more than 70%, a short message will be sent to the owner's cellphone where the shallots are stored to immediately check the condition of the room where the shallots are stored.

C. Prototype Testing

The testing carried out on a device or system using the functionality testing method scenario, and accuracy testing. Testing is done by conducting experiments to see possible errors that occur from each process. Sensor accuracy testing is carried out by observing and taking the temperature and humidity values in the shallot storage room and comparing them with Thermo Digital as a reference value.

Table 1. Functionality Testing Scenario

No	Test Scenario	Result
1.	Testing the DHT11 sensor as a temperature detector in the shallot storage area.	Prototype can detect and can display the detection results on the LCD screen 
2.	Testing the DHT11 sensor as a humadity detector in the shallot storage area.	Prototype can detect and can display the detection results on the LCD creen 
3.	The temperature where the shallots are stored is more than 33 degrees, then the lamp control will turn off and the fan will turn on to reduce the room temperature. Temperature > 33°C	Protoype can detect the temperature value is more than 33 degrees (33°C) in the shallot storage area. Then automatically the prototype control the fan to turn on and the lamp will turn off. The fan functions as a tool to reduce the temperature value in the room. 
4.	The temperature where the shallots are stored is less than 30 degrees, then the lamp control will turn on and the fan will turn off to increase the room temperature. Temperature < 30°C	Protoype can detect the temperature value is less than 30 degrees (30°C) in the shallot storage area. Then automatically the prototype control the fan to turn off and the lamp will turn on. The lamp functions as a tool to increase the temperature value in the room. 

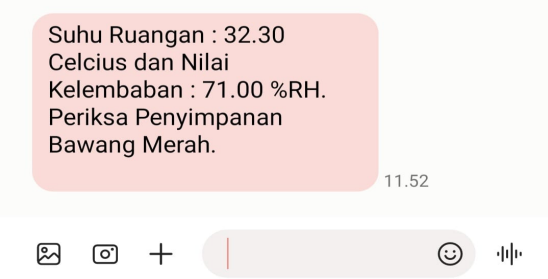
5	The humidity value of the room where the shallots are stored is more than 70%, then a short message will be sent to the user's cell phone to find out the humidity condition of the shallots.	Protoype can detect the humidity value is less than 70 percent (70%) in the shallot storage area. Then the prototype automatically sends a short message to the user' cellphone to check the condition of shallot storage room. 

Table 2. Temperature Sensor Accuracy Test

No	Reference Temperature	Temperature detection	Difference	Error
1.	30,90°C	32,80°C	1,9	6,14%
2.	38,00°C	33,30°C	4,7	12,37%
3.	35,10°C	33,30°C	1,8	5,13%
4.	34,90°C	33,30°C	1,6	4,59%
5.	32,00°C	33,80°C	1,3	4,06%
6.	36,30°C	33,30°C	2,5	6,89%
7.	34,40°C	33,30°C	1,1	3,19%
8.	35,70°C	32,30°C	3,4	9,52%
9.	34,30°C	33,30°C	1	2,91%
10.	35,70°C	33,30°C	2,4	6,72%

Accuracy: 100 - Σ *Match* / Σ *Tp* (1)

Accuracy: 100 - 61,52% / 10

Accuracy: 100 - 6,152 = 93,848%

Then, the accuracy value in testing for the temperature of the shallot storage room is 93,848%.

Table 3. Humidity Sensor Accuracy Test

No	Reference Humidity	Humidity Detection	Difference	Error
1.	72%	75%	3	4,1%
2.	61%	57%	4	6,5%
3.	72%	66%	6	8,3%
4	74%	72%	2	2,7%
5.	63%	52%	11	17,4%
6.	73%	73%	0	0%

No	Reference Humidity	Humidity Detection	Difference	Error
7.	69%	55%	14	20,2%
8.	64%	63%	1	1,52%
9.	68%	71%	3	4,1%
10.	70%	58%	12	17,1%

Accuracy : 100 - $\Sigma Match$ / ΣTp (2)

Accuracy : 100 - (81,92%)/10

Accuracy : 100 - 8,192% = 91,808%

Then, the accuracy value in testing for the humidity of the shallot storage room is 91,808%.

The tests that have been carried out above use several scenarios to find out the level of accuracy which produced by the prototype from the test data that was carried out. So, this test aims to determine the level of accuracy in the classification process for temperature and humidity data in the room where shallots are stored.

V. Conclusion

Based on the results of testing and discussion in this study, this testing for the device or prototype can function as desired and the accuracy test of the detection device reaches temperature accuracy level of 93.848% and humidity accuracy level is 91.808%. Control and monitoring devices can function and work well to monitor and maintain the condition of temperature and humidity storage room also monitoring communication devices become usefull so users can know the condition of the temperature and humidity of shallot room.

Acknowledgment

Thanks to the Faculty of Engineering, Informatic Engineering Department, LPPM teams and the University of Musamus Merauke for the research grants sourced DIPA Unmus funds from 2022.

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