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Experimental Analysis of Smart Green House with Rotary Garden

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Abstract. To overcome climate change that affects agriculture in all over the world, shows the estate and farming for the raising of the extreme weather (e.g., floods, droughts, *etc*). Therefore, the smart greenhouse is essential in providing sustainable food for humans. The application of Smart Greenhouse, The ultimate and most common monitored variables are temperature, moisture, the intensity of sunlight and environmental conditions to support the using of sunlight a source of electricity. This is necessary for the Smart Greenhouse to manipulates the environment in appropriate to its plant's needs. In this case, the temperature and humidity in the greenhouse are important to keeps the productivity of the plants. So, it's using automatic system to keep suitable environmental conditions as explained before for the plants. In this research , the smart Greenhouses is shaped Ferris wheel to make sprinkling and radiation of sunlight for plants is equally distributed for all plants and its parts, Based on the results of this experiments with rotary mechanical system for Smart Greenhouse as well shown that Smart Greenhouse can preserve suitable temperature and moisture for growing the plants.

Keywords. the temperature, moisture, the light of the sun, and rotary motion for sprinkling


1. Introduction

Currently, the problem faced in the world is the adequacy of agricultural food evenly throughout the world. Uneven distribution of agricultural food occurs all over the world including production, distribution and affordability. Then, there is often disruption of agricultural food production and has greatly detrimental to people's health as well as directly initiating a major confidence crisis to government and agricultural food companies.[1]

Other researcher explains an indoor intelligent agricultural IOT system is designed and implemented by the author in order to attack this conundrum [2]. Jun et.al also make the system directs a new trend for agricultural development the capability of parallel extension, and the system can connect to large-scale indoor farms gradually thus to make these farms combining with each other organically.

The researcher [3] introduce the climate-smart agriculture (CSA) concept. That is gaining considerable traction at international and national level to meet the challenges of addressing agricultural planning under climate change. He [3] also describe CSA is a concept that calls for integration of the need for adaptation and the possibility of mitigation in agricultural growth strategies to support food security.

Climate change that affects agricultural around the world, shows plantation and plants to the extreme weather condition such as flood, drought, etc. Therefore, of the smart green house in environmental is

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important to provide food for humans, while they are preparing the place of ideal cultivation for the environment. But to have a common idea about suitable greenhouse for nowadays needs It necessary to have that detailed information, at least, of the most relevant variables that affect the environment. Smart Greenhouse is a controlled building of agricultural conditions to keep the plants from outside extreme conditions. Smart Greenhouse technology gives farmers the freedom to choose plants at any time of the year. The quality of and productivity of plants in the smart greenhouse very much dependent on the quality of management and the scheme good management defined by the quality of the amount of information collected out of the smart greenhouse of the living environment. Therefore, continuous environmental monitoring variables such as temperature, humidity, and soil moisture provide information to farmers, this information needed to understand how each factor influences growth and how to manage maximum plant productivity[4]. The authors already done a preliminary research on smart greenhouse can be found at [5].

In this research, the writers used rotary smart greenhouse as productive cultivation and that sprinkling and radiation of light for plants is equally distributed for all plants that evenly using the sun as a source of electric power, rotary smart greenhouse is also able to minimize the use of land with a number of plants more than other smart greenhouses.

2. Smart Green House Concept

Greenhouse or nowadays known as the Smart Greenhouse is not a new item in the agribusiness sector, especially horticultural agribusinesses such as vegetables and decorative plants. However, it does not guarantee that all Indonesian farmers understand and know about this greenhouse. Based on these considerations, in this study will be reviewed the general description of what exactly and the benefits of a greenhouse as a supporter of our agribusiness.



Figure 1. Smart greenhouse (Poly-Tex, 2017)

The advantages of Greenhouse are settings schedule of productions i.e., to increase production output, improving production quality, to minimize pesticides and to increase the performance of the system. The Greenhouse is also widely used as a collection room for various types of high-value plants. Inside the greenhouse visitors can see a variety of interesting plants, even rare, so it can be an attraction. There is a special collection of cactus, orchids or various types of plants with the atmosphere made in the wild. In Indonesia greenhouse like this can be found in many botanical gardens and places of agrotourism.

3. Automatic Control System of Smart Green House

The process of controlling the rotary smart greenhouse is a process that is carried out continuously, over a long period of time and requires a high accuracy of control. Therefore automatic control is needed, in this case, to reduce the problems such as on the manual control, among others: fatigue, uniformity and human inaccuracy. In this automatic control, the control stages such as measuring, comparing, counting and correcting are performed by the instrument repeatedly. With automatic control can be achieved the purpose of the smooth operation, control of security and product quality.

3.1. Temperature and humidity sensors

DHT11 is a digital sensor that can measure the temperature and humidity of the surrounding air. This sensor is very easy to use along with Arduino. It has excellent stability levels as well as highly accurate calibration features



Figure 2. Temperature and Humidity Sensors DHT11

4.2. Relay Devices

The list of authors should be indented 25 mm to match the abstract. The style for the names is initials then surname, with a comma after all but the last two names, which are separated by 'and'. Initials should not have full stops—for example **A J Smith** and *not* **A. J. Smith**. First names in full may be used if desired. If an author has additional information to appear as a footnote, such as a permanent address or to indicate that they are the corresponding author, the footnote should be entered after the surname.

A relay is a device for disconnecting or connecting a circuit, almost the same as a switch only the relay works automatically and can be used as a remote control device, see figure 2.7. The relay consists of an iron-core coil and a switch. If this iron-core coil is electrified then the relay will work.



Figure 3. Relay devices

3.3. Arduino Uno Microcontroller

4
Arduino is developed by a team of people from different parts of the world. The core members of this team are Massimo Banzi Milano (Italy), David Cuartielles Malmoe (Sweden), Tom Igoe (New York, US), Giulio Martino Torino (Italy) dan David A. Mellis Boston (MA, USA)

The main component of the Arduino board is an 8-bit microcontroller with ATmega brand made by Atmel Corporation. Arduino boards use different types of ATmega depending on the specifications, for example, Arduino Uno uses ATmega328 while the more sophisticated Arduino Mega 2560 uses ATmega2560.



Figure 4. Board of Arduino Uno

3.4. Solar Cell System

Solar Cell is one type of photovoltaic light sensor, a sensor that can change the intensity of light into electrical voltage. Solar Cells are made up of solar cells, also known as photovoltaic or "PV" cells. These cells are made of silicon pieces that have opposite electrical charges and cause electrons to flow when exposed to sunlight. At the most basic level, the solar panel when connected to the right material along with the inverter and battery will collect energy from the sun and release the usable knobs as shown in figure 5.

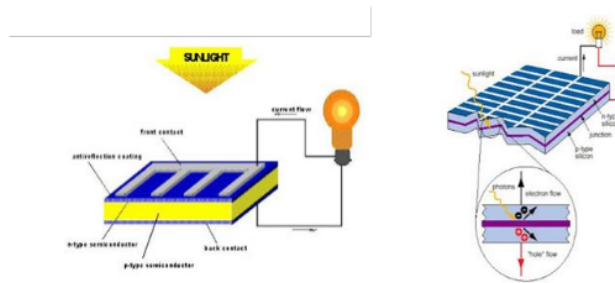


Figure 5. Solar Cell work diagram

8
In solar cells, there is a junction between two thin layers made of semiconductor material, known as a "P" (positive) semiconductor and an "N" (negative) semiconductor type. N-type semiconductors are made from crystalline silicon and there are also a number of other materials (generally phosphorus) in the range that the material can provide an excess of free electrons.

4. Research Method

In the Figure 6 shows the model of the rotary design of Smart Greenhouse for producing productive plants. The system could be rotate with slow speed.

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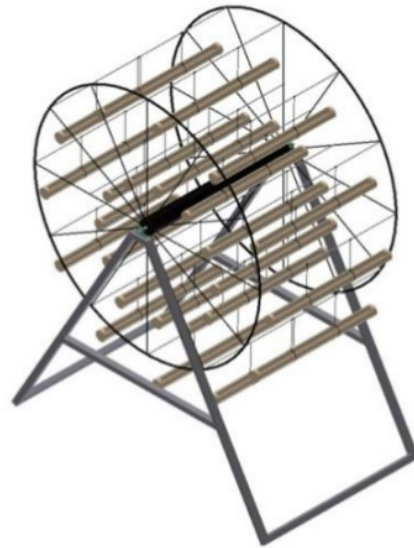


Figure 6. Smart rotary greenhouse design for productive plants

Stages of Design Rotary Smart Greenhouse for productive plants

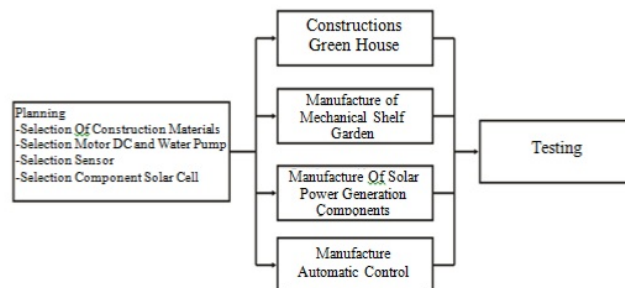


Figure 7. Stages of the smart rotary design of a green house for productive plants

4.1. The Automatic control system on smart greenhouse rotary

In the greenhouse there are several automatic conditioning control systems that are used:

- a. Plant watering control system.
- b. Plant positioning control system.

This program is to determine how the rotary smart greenhouse can work automatically, starting from the system of temperature and humidity readings, adjusting the movement of DC motors in accordance with the movement of water pumps. Software used is Arduino as shown in figure 8.



Figure 8. Arduino Software Windows Version

After the program from Arduino software for windows is uploaded on the Arduino UNO board, the next step is to combine DC motor and relay with Arduino UNO. In this step that needs to be prepared a relay, Arduino UNO board, power supply and cable. Connect the input port on the relay to the arduino uno board digital port. The greenhouse tool control circuit scheme is as shown below.

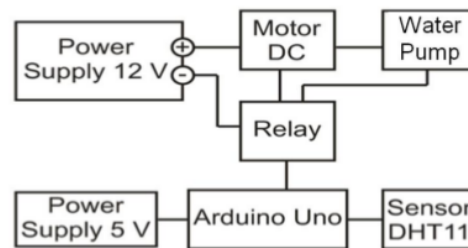


Figure 9. Scheme of rotary smart greenhouse control unit

4.2. Temperature and humidity testing in the rotary smart greenhouse.

In conducting the test or data retrieval, the temperature and humidity sensor (DHT 11) is installed in two different places within the rotary smart greenhouse and outside the rotary smart greenhouse with the intention to compare temperature and humidity between inside and outside the smart greenhouse.

Temperature data's collection is continuous for 2 months starting in March 2017 until February 2018. Temperature data's collection is carried out to determine the amount of temperature and humidity in the greenhouse are regularly doused in accordance with the program and temperature and humidity outside the smart greenhouse without watering or with existing weather condition.

From the results of the test then inserted in the form of graphs as seen in the following figure:

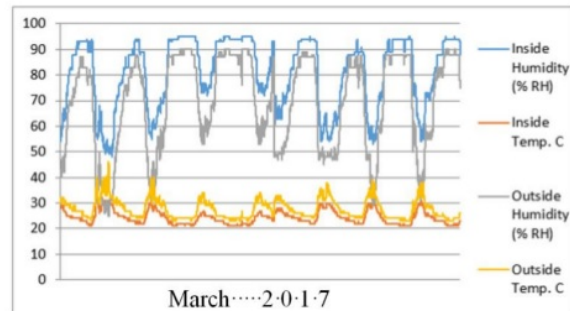


Figure 10. Data on March 2017

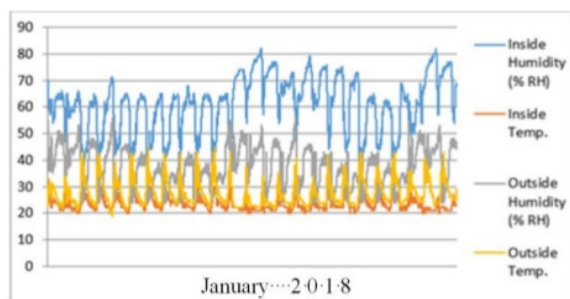


Figure 11. Temperature and Humidity on January 2018

5. Conclusions

From the test results of rotary smart greenhouse system design for productive crops that are done continuously for 12 months can be summarized as follows:

1. Rotary smart greenhouse with the productive crop condition is considered capable of optimizing temperature and humidity between 23oC- 30oC and 40% - 80%.
2. Taking temperature and humidity data using DHT 11 sensors can show the comparison between temperature and humidity inside and outside the rotary environment of smart greenhouse for productive crops.
3. With a watering system designed in a rotary smart greenhouse, this can be watered to all parts of the plant equally.
4. The smart green house with rotary systems works effectively with a decided rotation so that all plants get good sunlight during the day and can be well exposed to water.
5. Rotary smart greenhouse is effective for narrow land and with the number of plants that quite a lot and can be adjusted with to existing dimensions.

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Acknowledgments

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