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IoT-Based Cultural Movement and Monitoring Systems with Renewable Energy Utilities

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Abstract

The procedure of watering for and keeping track of the temperature and humidity levels in the room has a significant impact on the growth and productivity of oyster mushroom plants. It is often believed to be less effective and efficient because people in the Banyuwangi district perform the irrigation process conventionally with human aid. In order to construct digital businesses, artificial intelligence, cognitive technology, and (IoT) are being developed. People's daily lives are becoming more advanced and connected because to this transformation. This will encourage the creation of fresh innovations. Given this context, the idea to undertake research on the method of automatically and continuously monitoring watering (spraying) mushroom production using the Internet of Things (IoT) developed. In order to improve the effectiveness and productivity of mushroom cultivation, this instrument is designed with a temperature sensor (LM35) to monitor the humidity conditions of oyster mushroom plants. It is also fitted with a solar renewable energy system. In order to improve the effectiveness and productivity of mushroom cultivation, this instrument is designed with a temperature sensor (LM35) to monitor the humidity conditions of oyster mushroom plants. It is also fitted with a solar renewable energy system. The five steps of this study's execution were: a needs analysis; tool design; tool prototype; prototype testing; and conclusion. According to test results, the IoT-based control system for watering mushroom cultivation has an average error of 0.1% when measuring temperature and an average error of 2.66% when measuring humidity. This is almost perfect in terms of sensor readings, indicating that it can be used properly. While the success rate for the spray control system using the IoT system after five trials was 100%, the voltage, current, and power for solar panels were 17.60 V, 4.10 A, and 55.7 Watt at 14.00 during the day.

***Keywords**: Control, Monitoring, Renewable Energy*

Abstrak

Proses penyiraman dan pemantauan kondisi suhu kelembapan ruang sangatlah berpengaruh terhadap pertumbuhan dan produktifitas tanaman jamur tiram secara maksimal. Pada umumnya masyarakat diwilayah kabupaten Banyuwangi melakukan proses penyiraman secara konvensional dengan bantuan manusia, sehingga dirasa kurang efektif dan efisien. Dalam perkembangan teknologi kecerdasan buatan, teknologi kognitif, dan (IoT) untuk menciptakan perusahaan digital. Revolusi ini menambahkan teknologi yang cerdas dan terhubung dalam keseharian manusia. Hal ini akan memacu inovasi baru yang akan di kembangkan. Berdasarkan latar belakang tersebut muncul ide untuk melakukan penelitian tentang proses penyiraman (penyemprotan) budidaya jamur secara otomatis dan termonitoring yang berbasis (IoT). Dalam perancanganya alat ini dilengkapi dengan sensor suhu (LM35) untuk memonitoring kondisi kelembapan tanaman jamur tiram guna untuk meningkatkan efisiensi dan produktifitas budidaya jamur serta dilengkapi dengan sistem energi terbarukan tenaga surya. Dalam perancanganya alat ini dilengkapi dengan sensor suhu (LM35) untuk memonitoring kondisi kelembapan tanaman jamur tiram guna untuk meningkatkan efisiensi dan produktifitas budidaya jamur serta dilengkapi dengan sistem energi terbarukan tenaga surya. Penilitian ini dilakasanakan 5 tahapan, yaitu meliputi surve kebutuhan, perancangan alat , prototype, pengujian prototype, Kesimpulan. Dari hasil ujicoba sistem control berbasis IoT untuk penyiraman pada budidaya jamur ini dari segi monitorin suhu memiliki rata – rata error 0.1%, sedangakan pada monitoring kelembapan memiliki rata – rata error 2.66 % hal tersebut hampir mendekati kesempurnaan dalam pembacaan sensor yang artinya dapat digunakan dengan baik. Sedangkan dalam sistem control penyeprotan dengan sistem IoT dengan 5 kali uji coba tingkat kebarasilannya 100 %, sedangkan untuk panel surya mendapatkan tegangan 17,60 V, Arus 4.10 A, daya 55,7 Watt di waktu siang hari pukul 14,00.

Kata kunci: *Kontrol, Monitoring, Budidaya Jamur, IoT, Energi Terbarukan.*

Introduction

The cultivation of spruce mushrooms is one of the most promising business potential. In pursuing the cultivation of mushrooms need several stages. The first stage is preparing a bush made of bamboo. The roofs are usually made with several shelves that are arranged vertically to lay baglogs. The buildings that are made must be able to maintain the temperature and humidity inside so that the fungus growth process is more productive. The second stage is the preparation of a baglog, which is a fungus planting medium made of powdered powder. The third stage is the treatment of mollusk mushrooms, which includes the process of irrigation and treatment of plant moisture conditions. The fourth stage is the harvest of the mushrooms [1]. Cultivating mushrooms as food processing for independent villages, this mushroom can boost the economy in the village community, because this processing is managed with proper management and there is evolution in processing and sales to keep the quality of processed products up to the end [2].

In the cultivation of mushrooms among communities both in the small scale and the industry, the mushroom has a temperature in the low plains of 30^0C, in the growth of the fungus requires a temperature of 27^0C – 29^0C with a humidity of 70 – 90 % RH, the method control on – of relay, in this study the testing is running smoothly [3]. In some stages of cultivation, the irrigation process and the monitoring of humidity conditions have a great deal to do with the growth and productivity of the plants. Generally speaking, people in the Banyuwangi district conduct conventional irrigation processes with human assistance, which makes it less effective and efficient. Based on this background, the idea arose to conduct research on the process of automatic and monitoring based mushroom cultivation irrigation. In its design, the device uses LM35 sensors to monitor the humidity conditions of mushroom plants in order to improve efficiency and productivity in fungus cultivation and is equipped with a solar renewable energy system.

Literature Review

Riau University has successfully implemented technology to ensure that people cultivate and process fungus [2]. Increased cultivation of fungus has undergone training in the village of Bandar sari, the main purpose of this training is to provide knowledge about the types of fungi and their benefits. In this activity, it is also provided training for cultivating fungus that starts to prepare baglogs as well as the irrigation process with a frequency of 2 – 3 times a day whileining the temperature and humidity of the fungus in the range of 16 – 24^0C [4]. According to the research, the temperature of the dryer of white mushrooms affects water levels, protein levels and dew. The chemical properties of the fungus resulting from the white mushroom fungus are the best treatment temperature of 45 °C and drying within 20 hours resulting in a water content of 7.76%, protein content of 21.82%, sedimentation of 10.23% [5].

The IoT is a sensor as a data collection medium, an internet connection as a communication medium and a server as a collector of information received by the sensor. [6]. In this study, the IoT with the ESP 8266 module was used to operate remote dragonfruit garden lights for off-season harvesting [7]. An IoT-based temperature and humidity monitoring system is one of the measures of anticipation against material damage in the process of poduction of semiconductor components, because it is a moisturizing factor for material damage and reduced component quality.

This IoT-based chicken feeding monitoring and control system is very useful to the user and managed efficiently. This device utilizes NodeMCU ESP8266 test results which achieves a level of accuracy and speed of transmission of data carried out for 10 times. The result can be sent at a speed of 1.4 seconds with Internet access 2.8 Mbps [8]. This study using a DHT22 sensor and the wifi module esp8266. The results of the study succeeded in sending data continuously [9]. The study used a polycrystalline silicone solar panel which used 1000 Wp, with the maximum voltage generated 24 Volt DC, and the maximum current generated is 29 Ampere. Solar cell is a paltform that works to convert solar energy into electricity. Basically, a solar panel can be analogous to a semiconductor circuit that can absorb photons from sunlight and convert it into an electric current voltage [10].

Implementation of PLTS in the BPR BKK district of the nation had a grid-connected system with a daily load of 9.619 Wh on Monday, Tuesday, Wednesday, Thursday, Friday, and Saturday, and 6.848 Wh on Sunday, whereas the energy from PLN is roughly ten times greater. Electric energy consumption from the PLTS installation was reduced by 22.1% [11]. Electricity is a series of physical phenomena that connect electricity charges, manual electricity needs that are increasing every day can lead to electricity crises, from which will emerge a new innovation that is the use of renewable energy in the form of PLTS to be developed [12]. In a study of a 100 WP PLTS with a 1000 Watt inverter, the maximum voltage of the panels in the three-day submersible test produced the second and third days of 17.08 Volts at 12:00 a.m. at 7:00 p.m. The 100 watt solar panel produced only the maximum power of 256.01 watt obtained in the second test with an average of 14.19 volts and 1.58 A. With this condition, it took 5.47 hours to charge 100% [13].

Mushroom cultivation in Purwoharjo district is still manually in control. Optimal temperatures in the growth phase of mushrooms require temperatures between 26°C-28°C with humidity between 70% RH - 90% RH. Technological developments with temperature control and moisture monitoring systems can be done remotely with the concept (IoT), using a DHT22 sensor [14]. In order to meet food needs in Indonesia, innovation is needed, namely, the design of IoT-based systems, using microcontrollers to facilitate control and monitoring of temperature and humidity at mushroom power levels, i.e. regulating temperatures between 27°C – 29°C and 70% RH – 90% RH connected in the Internet network, as well as monitoring can be done remotely. The results of the temperature and moisture sensor testing can be controlled according to the growth of mushrooms, can be monitored remote and real-time using the WiFi module ESP8266-01 connected to the Thing Speak website [15].

Methodology

a. Research Stages

The research was carried out in three stages, which included (1) the need survey in this phase of research looking for the need for technology developed on mushroom capacity, (2) the design of the research instrument has obtained the survey results so that the process of designing the device of the irrigation system and monitoring of fungus cultivation (IoT) based with the use of renewable energy, (3) at the stage of prototype of the system of Irrigation and Monitoring of the cultivation of mushrooms based (IOT) with the utilization of renewed energy, at this stage the researchers testing in the scale of the prototypes, the conclusion of the results obtaining. Here's the stage of the research method.

b. Planning stages

At this stage, every step of research is designed up to the stage of toolmaking.

c. Prototype Spraying Phase

Here are the stages of manufacture of the prototype that will be developed in the research in Figure 3 in showing microcontroller on automatic irrigation on mushroom cultivation with the use of renewable energy, whereas on Figure 4 the plan of installation on the fungus cube with the application of IoT technology pathway automatic Irrigation with renewables:

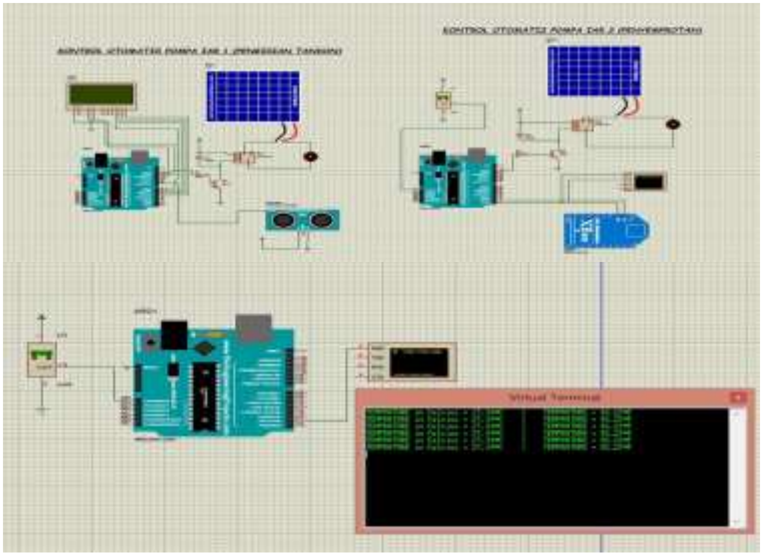

Figure 1. Automatic Irrigation Microcontroller Prototype

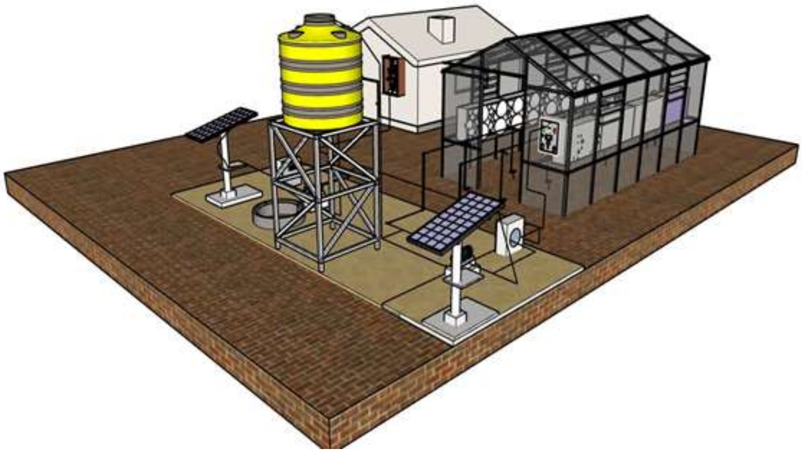

Figure 2. Fungus Cube Installation Plan

d. Prototype Trial Stage

In this investigation, there were three trials. The device of the planned system must first pass a success test, then a test of temperature resistance, and finally a success test of moisture monitoring. A successful test of solar panel power storage will follow.

Result and Discussion

a. Result

The following can be shown in table 2 from the test results of the prototype on the testing of IoT-based control system, temperature monitoring system, and renewable energy that uses solar energy:

Table.1 IoT-based Control System Tools

Test to	Time	Condition Status		Description
		On	Off	
1	06.00	✓		Sukses
2	10.00	✓		Sukses
3	12.00	✓		Sukses
4	14.00	✓		Sukses
5	16.00	✓		Sukses

Table 2. Test Trial Successful Temperature Monitoring

Test to	Temperature Value		Error
	Sensor	Digital Thermometer	
1	26,2	27,2	0,1
2	27,6	28,3	0.3
3	27,2	26,5	0.2
4	28,2	28,9	0.1
5	27,1	27,1	0

Table 3. Test Trial Successful Moisture Monitoring

Test to	Humidity Value		Error
	Sensor	Digital Thermometer	
1	79,9	81	1,1
2	83,1	85	1,9
3	89,5	86	3,5
4	91,6	88	3,6
5	92,2	89	3,2

Table. 4 Trial Success Storage Power Solar Panel

Time	Value		
	Voltage (V)	Current (I)	Power (Watt)
07.00	13,91	1,65	17,1
09.00	14,25	2,25	21,8
11.00	15,49	3, 8	41,10
13.00	15,2	3,0	39,8
14.00	17,60	4,10	55,7
16.00	13,44	1,50	14,8

b. Discussion

The test was conducted five times at 7:00, 10:00, 12:00, 14:00, and 16:00, respectively. Based on the test results of the IoT-based control system for irrigation on mushroom cultivation in Table 1, it can be operated by IoT-based control system by controlling the process of erosion of mushrooms with a high rate of success. Although test error 1 (0.1%), test error 2 (0.3%), test error 3 (0.2%), test error 4 (0.1%), and test error 5 (0%), of the temperature monitoring trial's results show that the average error result between temperature sensor and digital thermometer is 0.1%. While the table 3 test result for the success of the humidity monitoring test indicates that the test was conducted five times, the error between the temperature sensor LM 35 and the digital thermodynamics was 1.1% for test 1, 1.9% for test 2, 3.5% for test 3, 3.6% for test 4, and 3.2% for test 5. The test has an average sensor error of 2.66% of the test findings. In contrast, the solar panel's power storage is tested from 7 a.m. to 16 p.m., although measurements are made every two hours to gauge the size of the input power into the output.

Conclusion

It can draw conclusions from this study about the effectiveness of the control system, the monitoring of humidity and temperature in the mushroom house, and the usage of renewable energy based on solar energy. The average inaccuracy in monitoring temperature is 0.1%, while the average error in monitoring moisture is 2.66%. While the success rate for the spray control system using the IoT system after five trials is 100%, solar panels may be used to provide a voltage of 17.60 V, a current of 4.10 A, and a power of 55.7 Watt at 14:00 during the day.

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