SCSE_45_2018

A smart system based on wireless sensor network for monitoring and controlling mushroom growing conditions

*** K. H. Fernandopulle, * N. P. Gunathunga, * R. D. D. P. Ranasinghe, * V. P. P. Ireshika, P. Samarasinghe, T. M. K. K. Jinasena**

University of Sri Jayewardenepura,
Sri Lanka
** Kaushilafernandopulle93@gmail.com, * nethmini.pabasara93@gmail.com,*
** dulaniranasinghe2610@gmail.com, * ireshikasw91@gmail.com*

Abstract

The word mushroom may mean different things to different people in different countries. Mushrooms can be used as food, tonics, medicines, cosmeceuticals, and as natural biocontrol agents in plant protection with insecticidal, fungicidal, bactericidal, herbicidal, and nematocidal activities. Plant growth is affected by various factors. The most important factors for the quality and productivity of plant growth are temperature, humidity and light. This research presents the design and implementation of a smart system based on the wireless sensor network for monitoring and controlling mushroom growing conditions for farmers. The system contains five main units; namely sensing, transmission, decision making, controlling and monitoring. The system contains two main unit named as transceiver unit and receiver unit. The humidity sensor, temperature sensor and soil moisture sensor measure current environment condition and send the sensed value to the receiver unit using ZigBee. Then the ZigBee module which contains in the receiver unit receive the sensed value and give to the Arduino Board. Then Arduino board compares sensed value with pre-set value and ON or OFF pump, fan and heater automatically. As well as send the SMS to farmer's mobile phone using Global System for Mobile Communication (GSM) module. Therefore, farmer is able to monitor the mushroom cultivation room in remotely instead visit the mushroom cultivation room and can save time and labor which is need to cultivate the mushroom.

Keywords: Mushroom cultivation, Wireless Sensor Network, ZigBee, GSM

Introduction

Mushrooms show an incredible impact on agriculture and the environment, and they support to build a great socio-economic impact in human welfare on local, national, and global levels (Shu Ting Chang et al., 2017). Mushrooms are not just like plants, they derive their all energy and growth material from their growth field Therefore in the mushroom cultivation specially consider about the environment condition of the mushroom cultivation room. When consider about the environment condition impact to well growth of mushroom, it is relative with humidity level of around 95-100% and substrate (growth medium) moisture level of 50-75% (Chang et al., 2004). Therefore, in the mushroom cultivation there should be a correct combination among humidity, temperature and substrate moisture level.

In this research only consider about the indoor mushroom cultivation. In the indoor mushroom cultivation farmer build windowless, purpose-built buildings for cultivation. Indoor mushroom cultivation is help to tightly control the light, temperature and humidity while excluding contaminants and pests. There are six

steps in the indoor mushroom cultivation (Daniel J. Royse et al.,). They can identify as phase I composting, phase II fertilizing, spawning, casing, pinning, and cropping. Prepare the growth medium for the mushroom is the first step of the mushroom cultivation. Then they placed on the trays contain in the mushroom cultivation room.

In the spawning stage humidity in the room should be 70-80% and temperature should be $25^0 – 28^0$. The traditional mushroom cultivators in the Sri Lanka spread wet sand on the land of mushroom cultivation room to maintain the humidity of the room environment. And also spray the water to maintain the humidity of the room. If we can automate this process it will help to farmers to save the time, labor.

The aim of this system is to automate the environment controller of the mushroom cultivation room. The main objectives of the system are increase the harvest, and qualitative of the harvest, control the pest diseases, increase the number of the cultivators, provide the supplement according to demand, increase the demand of local and international market.

The proposed system uses ZigBee module to send the sensed values from transceiver unit to receiver unit (Krishnan et al., 2013). ZigBee module is lower power, cost effective and it is suitable wireless option for medium range of network (Gopalkrishna & Yaashuwanth., 2013). Using the proposed system farmer can be monitoring the filed remotely using SMS receive from the GSM module in the receiver unit. GSM can be used to set up a distance communication between farmer's mobile phone and proposed system (Gao & Shao., 2010).

Methodology

This proposed system can be divided into transceiver units and receiver unit. Following figure.1 describe the block diagram of the proposed system. The transceiver unit and receiver unit get power from battery and each battery charging from solar panel in the daytime. The transceiver unit contains a temperature sensor, a humidity sensor and a soil moisture sensor. These sensors would be connected to the Arduino board. The ZigBee module would be connected to the Arduino board which would wirelessly send the data to the receiver unit.

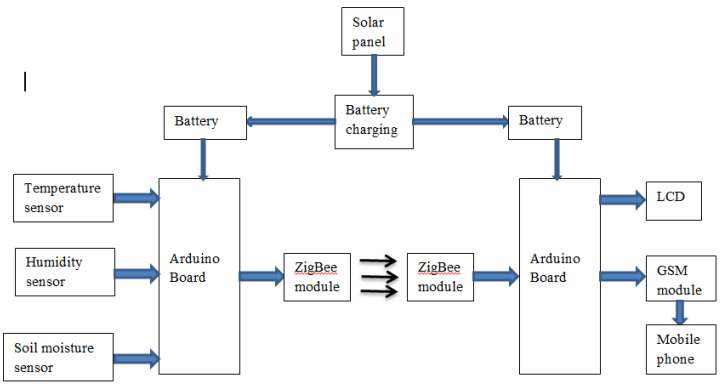

Figure1. Block diagram of the system

The receiver unit would contain a ZigBee module which would receive the data and give to the Arduino board. Then sensed values collected from sensors compare with pre-set values and then automation is takes place. Then Sensed values and controller ON/OFF status is display in a Liquid Crystal Display (LCD). The automation process is taken place according to arguments in the Table 1. Then

GSM module with active SIM card connected to the receiver unit send a SMS to the farmer's mobile phone informing current status of the mushroom cultivation room. Therefore, farmer can be monitoring remotely the environment condition of the mushroom cultivation room without visit the onsite. And also, farmer not need to ON or OFF the motor, fan or heater by himself, because it is fully automating on the variation of the environment conditions.

Table 1. Environment conditions and component automation process

Environment Condition	Status	AC	Heater	Water Pump
Temperature	HIGH	ON	OFF	ON
	LOW	OFF	ON	OFF
Humidity	HIGH	OFF	ON	OFF
	LOW	ON	OFF	ON
Soil moisture	HIGH	OFF	ON	OFF
	LOW	ON	OFF	ON

Results

In the proposed system used prototype for testing the reliability and feasibility of the system. In the prototype include DHT11 temperature and humidity sensor and soil moisture sensor. A fan used to as an AC, a bulb used as the heater, mini water pump used as the pump and LCD for display current status of the prototype. Following Figure2 show the prototype of the system.

Using prototype, conducted two experiments. The first testing is collect data from prototype for seventeen hours by using the control procedure. The second testing is collect data from prototype for same period without using control procedure. These two tests are done to ensure the ability of the system work without any problems and how the system work to achieve proposed goals. Following graphs show prototype of mushroom cultivation room parameters collected from prototype with control and without control. According to following result the research ensure that, this proposed system can be used to effectively control the mushroom cultivation room environment conditions to get qualitative harvest.

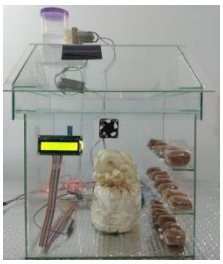

Figure2. Prototype of the system

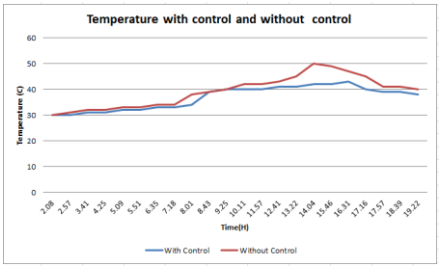

Figure3. Temperature variation with and without control

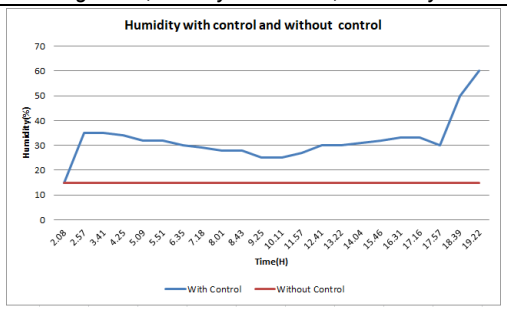

Figure4. Humidity variation with and without control

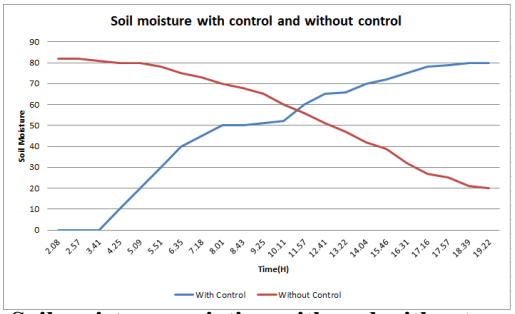

Figure5. Soil moisture variation with and without control

Conclusion

The proposed system achieves a main goal which is environment condition control automation and other goal that remotely monitoring the field is achieves through the sending SMS to the user. This system used temperature sensor, humidity sensor and soil moisture sensor as the sensors and ZigBee used to communicate between transceiver unit and receiver unit. GSM module used to communicate with farmer. This system will help to farmers for saving their time and labor and also can be get qualitative harvest rather than use manual ways.

References

Ting, S. H., & Wasser S. P. (2017). The Cultivation and Environmental Impact of Mushrooms.

Chang, S. T., Chang, S., & Mile, P. G. (2004). Mushrooms, Culitavtion, Nutritional Value, Medicinal Effect and Environment Impact. pp. 15-17.

Royse, D. J., Duffy M. D., & Wuest, P.J. (1988). Six Steps to Mushroom Farming.

Chaitanya, N. K., Kumar, G. A., & Kumari, P. A. (2013) Zigbee based Wireless Sensing Platform for Monitoring Agriculture Environment. International Journal of Computer Applications. Volume 83. pp. 7

Moorthy, K. G., Yaashuwanth, C., & Venkatesh, K. (2013). A Wireless Remote Monitoring of Agriculture using ZigBee. International Journal of Engineering and Innovative Technology (IJEIT) Volume 2. pp.72-73.

Mingming, Gao., & Liangshan, S. (2010). The Design of Wireless Smart Home system based on ZigBee. 3rd International Conference on Computer and Electrical Engineering. Volume 53.