

**DEVELOPMENT OF REMOTE REGULATING SYSTEM WITH AUTOMATIC
WATER MISTING FOR OYSTER MUSHROOM
(*Pleurotus ostreatus*) PRODUCTION**

**ABELARDO H. CARINGAL
MARC ANTHONY D. JIMENEZ**

An Undergraduate Thesis Submitted to the Faculty of the Department of Agricultural and
Biosystems Engineering, College of Engineering, Central Luzon State University,
Science City of Muñoz, Nueva Ecija, Philippines
in Partial Fulfillment of the Requirements
for the Degree of

**BACHELOR OF SCIENCE IN AGRICULTURAL AND BIOSYSTEMS ENGINEERING
(AB Land and Water Resources Engineering)**

JUNE 2023

TABLE OF CONTENTS

	PAGE
TITLE PAGE	i
ACCEPTANCE SHEET	ii
BIOGRAPHICAL SKETCH	iii
ACKNOWLEDGEMENT	v
TABLE OF CONTENTS	viii
LIST OF TABLES	xi
LIST OF FIGURES	xii
LIST OF APPENDIX	xiv
LIST OF APPENDIX TABLE	xv
LIST OF APPENDIX FIGURE	xvi
ABSTRACT	xvii
INTRODUCTION	1
Background of the Study	1
Statement of the Problem	3
Objectives of the Study	3
Significance of the Study	4
Scope and Limitation of the Study	5
Time and Place of the Study	5
REVIEW OF RELATED LITERATURE	6
Remote Monitoring System	6
IoT “Internet of Things”	7

Advantage and Disadvantage of IoT	9
Arduino Microcontroller	10
Automatic Water Misting	11
Theoretical Model of Misting	12
White Oyster Mushroom	13
White Oyster Mushroom Growth & Production	14
Varieties	14
Season	15
Mushroom House	15
Spawn (Mushroom Seeding)	16
Preparation of Mushroom Bed	16
Harvest	17
Problem of Mushroom Production	18
Cost Analysis	18
METHODOLOGY	20
Conceptualization of the Study	20
Materials and Equipment	21
System Architecture of the Device	22
Condition of the Device	25
SMS Communication	25
Sensor Base Function	25
Manual Override Functions	26
Sensor and Water Misting	26
Sensor Description	26
Theoretical Model of the Mist	27
Mushroom House	28
Sensor Calibration	29
Procedures on Calibrating Sensors	30
Equipment Testing	30
Preliminary Testing	31

Final Testing	32
Data Gathering	33
Water Consumption	34
Statistical Analysis	35
Cost Analysis	35
RESULTS AND DISCUSSION	38
Description of the System	38
Environmental Parameters	39
Temperature Monitoring	39
Humidity Monitoring	41
Plotted Graph of Humidity and Temperature	45
Regulating System Functionality	46
Data Calibration	47
Sensor Accuracy	47
Oyster Mushroom Evaluation	48
Cap Diameter	48
Stalk Length	50
Cap Counts	51
Color	52
Yield	54
Cost Analysis	55
SUMMARY, CONCLUSION AND RECOMMENDATION	58
LITERATURE CITED	61
APPENDICES	64

LIST OF TABLES

TABLE		PAGE
1	Major materials and equipment of the project.	22
2	Hygrometer and Sensor Value	48
3	Sensor, Dry and Wet Bulb Reading	48
4	Cost of Billing Materials	56

LIST OF FIGURES

FIGURES		PAGE
1	Conceptual Framework	21
2	The Design Concept	23
3	Flowchart for the SMS and Base Mushroom Control System	24
4	Sensors and Water Misting Layout	27
5	Schematic Diagram of the Mist	28
6	Mushroom House Layout	29
7	Sensor calibration at PAG-ASA CLSU	29
8	Testing and Calibrating the Developed Device	31
9	Controlled Set-up	32
10	Conventional Set-up	32
11	Average Temperature, °C of inside the Mushroom House	40
12	Zoomed data of temperature	40
13	Temperature Reading	41
14	Average Humidity Inside the Mushroom House	43
15	Data zoomed of humidity	43
16	Humidity Reading	45
17	Data zoomed of humidity and temperature	46
18	Cap Diameter from Controlled and Conventional System	49
19	Stalk Length from Controlled and Conventional System	50
20	Cap Counts from Controlled and Conventional System	51

21	Color Classification on Controlled	53
22	Color Classification on Conventional	53
23	Total Yield from Controlled and Conventional System	55

APPENDIX

APPENDIX		PAGE
I	System Coding	65
II	Cost Analysis	71
III	T-test Analysis	73

LIST OF APPENDIX TABLES

APPENDIX TABLE		PAGE
1	Cap Diameter	81
2	Stalk Length	82
3	Cap Counts	83
4	Color	84
5	Yield	85
6	Temperature Analysis	86
7	Humidity Analysis	86
8	Cap Diameter from Controlled and Conventional System	87
9	Stalk Length from Controlled and Conventional System	87
10	Cap Counts from Controlled and Conventional System	88
11	Yield from Controlled and Conventional System	88

LIST OF APPENDIX FIGURES

APPENDIX FIGURE		PAGE
1	Site assembly and mushroom house construction	89
2	Regulating system evaluation	92
3	Gathering data of the oyster mushroom parameters	93

ABSTRACT

CARINGAL, ABELARDO HOLGADO and JIMENEZ, MARC ANTHONY DE GUZMAN, Department of Agricultural and Biosystems Engineering, College of Engineering, Central Luzon State University, Science City of Muñoz, Nueva Ecija, Philippines **DEVELOPMENT OF REMOTE REGULATING SYSTEM WITH AUTOMATIC WATER MISTING FOR OYSTER MUSHROOM (*Pleurotus ostreatus*) PRODUCTION**

Adviser: WENDY C. MATEO PhD.

An automatic temperature and humidity regulating is a system that combines the necessary hardware, including temperature and humidity sensor units, SMS Cellular Network, and Arduino as CPUs, to realize the simulation of creation.

This study was conducted to develop the system in situ and determine the performance of regulating system with automatic water misting. The system software is created to use C as the programming language. The system is incorporated with sim card for text message commands and DHT11 sensor with water misting. Environmental parameters such as temperature and humidity inside the growing house were gathered. The white oyster mushroom parameters such as cap diameter, stalk length, cap counts, color and yield were evaluated.

Based on the result of the study the developed remote regulating system with automatic water misting has significant effect towards the yield and quality of white oyster mushroom production. The controlled set-up temperature is significantly lower compared to conventional set-up. Humidity level is significantly lower in controlled set-up than

conventional as well. In the long run utilizing regulating system with automatic water misting helps to minimize work time and labor for white oyster mushroom cultivation.

Keywords: White oyster mushroom, remote regulating system, misting system.

LITERATURE CITED

- Anamosa. (2021). *Common Problems With Growing Oyster Mushrooms*.
- Anta, D. K., Sandra, & Hendrawan, Y. (2021). Neuro-fuzzy humidity control for white oyster mushroom in a closed plant production system. *IOP Conference Series: Earth and Environmental Science*, 905(1), 012066. <https://doi.org/10.1088/1755-1315/905/1/012066>
- Ashgriz, N. (2011). Handbook of Atomization and Sprays. In *Handbook of Atomization and Sprays*. Springer US. <https://doi.org/10.1007/978-1-4419-7264-4>
- Beetz, A., & Greer, L. (1999). *ATTRA // MUSHROOM CULTIVATION AND MARKETING*.
- Bellettini, M. B., Fiorda, F. A., Maieves, H. A., Teixeira, G. L., Ávila, S., Hornung, P. S., Júnior, A. M., & Ribani, R. H. (2019). Factors affecting mushroom *Pleurotus* spp. *Saudi Journal of Biological Sciences*, 26(4), 633–646. <https://doi.org/10.1016/j.sjbs.2016.12.005>
- Bergman, T. L., Lavine, A. S., & Incropera, F. P. (2011). *Introduction to Heat Transfer*.
- Chitra K., Sathyaparvathavarthini B., Mahalakshmi S., Kamalii R., Sharavanan P.T., Balisasikumar C., & Dhanalakshmi K. (2018). Effect of Abiotic Factors on Oyster Mushroom Production (*Pleurotus* Species). *International Journal of Current Microbiology and Applied Sciences*, 7(07), 1032–1036.
- Chu, X., Cui, X., & Li, D. (2013). Remote Monitoring and Control of Agriculture. In *AISC* (Vol. 191).
- Cikarge, G. P., & Arifin, F. (2018). Oyster Mushrooms Humidity Control Based On Fuzzy Logic By Using Arduino ATmega238 Microcontroller. *Journal of Physics: Conference Series*, 1140, 012002. <https://doi.org/10.1088/1742-6596/1140/1/012002>
- Faber T. E. (1995). *Fluid dynamics for physicists*.
- Girmay, Z., Gorems, W., Birhanu, G., & Zewdie, S. (2016). Growth and yield performance of *Pleurotus ostreatus* (Jacq. Fr.) Kumm (oyster mushroom) on different substrates. *AMB Express*, 6(1), 87. <https://doi.org/10.1186/s13568-016-0265-1>
- Hamed, H. A., Mohamed, M. F., Hosseney, M. H., & El-Shaikh, K. A. A. (2021). Intercropping with Oyster Mushroom (*Pleurotus columbinus*) Enhances Main Crop Yield and Quality. *IOP Conference Series: Earth and Environmental Science*, 690(1), 012028. <https://doi.org/10.1088/1755-1315/690/1/012028>

- Hamonangan Nasution, T., & Yasir, M. (2019). *Designing an IoT system for monitoring and controlling temperature and humidity in mushroom cultivation fields*.
- Hoa, H. T., & Wang, C.-L. (2015). The Effects of Temperature and Nutritional Conditions on Mycelium Growth of Two Oyster Mushrooms (*Pleurotus ostreatus* and *Pleurotus cystidiosus*). *Mycobiology*, 43(1), 14–23. <https://doi.org/10.5941/MYCO.2015.43.1.14>
- Jo, W.-S., Cho, Y.-J., Cho, D.-H., Park, S.-D., Yoo, Y.-B., & Seok, S.-J. (2009). Culture Conditions for the Mycelial Growth of *Ganoderma applanatum*. *Mycobiology*, 37(2), 94. <https://doi.org/10.4489/MYCO.2009.37.2.094>
- LaVia. (2021, May 20). *How and When Do You Harvest Mushrooms?* Cannabis.Net.
- Malone M. (2022, March 15). *Temperature & Humidity for Mushroom Growth*. Ehow.
- MycoMedica d.o.o. (2023). *White Oyster Mushroom*. GOBA.
- Nongthombam, J., Kumar, A., & Patidar, S. (2021). *A REVIEW ON STUDY OF GROWTH AND CULTIVATION OF OYSTER MUSHROOM A REVIEW ON STUDY OF GROWTH AND CULTIVATION OF OYSTER MUSHROOM* View project. <https://www.researchgate.net/publication/349238624>
- Park, H., Roh, J., Oh, K. cheol, Cho, H., & Kim, J. (2022). Modeling and optimization of water mist system for effective air-cooled heat exchangers. *International Journal of Heat and Mass Transfer*, 184, 122297. <https://doi.org/10.1016/j.ijheatmasstransfer.2021.122297>
- Sace, C. F., & Natividad, E. P. (2015). Economic Analysis of an Urban Vertical Garden for Hydroponic Production of Lettuce (*Lactuca sativa*)* Global tilapia markets and development View project Indoor vertical farming systems View project Economic Analysis of an Urban Vertical Garden for Hydroponic Production of Lettuce (*Lactuca sativa*)*. In *International Journal of Contemporary Applied Sciences* (Vol. 2, Issue 7). www.ijcas.net
- Sayner A., & Jong E. (2009). *A complete Guide to Oyster Mushrooms*. . GroCycle.
- Sher, H., Al-Yemeni, M., Bahkali, A. H. A., & Sher, H. (2010). Effect of environmental factors on the yield of selected mushroom species growing in two different agro ecological zones of Pakistan. *Saudi Journal of Biological Sciences*, 17(4), 321–326. <https://doi.org/10.1016/j.sjbs.2010.06.004>
- Taylor J. (2021). *IoT Based Monitoring System for White Button Mushroom Farming*. EasyTyping.Com.
- Tony. (2023). *MUSHROOM YIELD AND BIOLOGICAL EFFICIENCY*. Freshcap.

Vikaspedia. (2023). *Oyster mushroom production*. Vikaspedia.

Watson M. (2021). *What Are Oyster Mushrooms?* Thespruceeats.