Progress in Engineering Application and Technology Vol. 2 No. 2 (2021) 396–404

PEAT

Homepage: http://penerbit.uthm.edu.my/periodicals/index.php/peat
e-ISSN : 2773-5303

Swiftlet House Cooling System Powered by Solar Panel

Gideon Barry[1], Lilywati Bakar[1]*

[1]Department of Electronic Engineering Technology, Faculty of Engineering Technology,
Universiti Tun Hussein Onn Malaysia, 84600, Pagoh, Johor, MALAYSIA

*Corresponding Author Designation

DOI: https://doi.org/10.30880/peat.2021.02.02.039
Received 13 January 2021; Accepted 01 March 2021; Available online 02 December 2021

Abstract: In every season of the year Malaysia will encounter hot season which will cause damage to some ecosystem and habitat. To overcome this type of problem with the help of Arduino, it can manage the system and ease some people by saving their time to do all the work manually. In this project, Swiftlet House Cooling System Powered by Solar Panel will able to achieve and solve the problem which focusing more on the habitat of swiftlet. This system will be using the technique of cooling the building itself so that it able to create a perfect and suitable environment for the swiftlet to creating their nest. The temperature sensor that will be installed inside of the building will record and send a signal to Arduino which is the brain of the system about the condition inside of the building. The Arduino will take some action if needed by sending a signal to other equipment to handle this situation automatically. Finally, the system will able to maintain the quality of the bird's nest by keeping the moisture high as possible.

Keywords: Swiftlet, Cooling System, Arduino, Quality,

1. Introduction

Malaysia is one of the top five countries in the world which producing swiftlet birds nest, the nest consist of 90.00 to 95.00 % are edible and 5.00 to 10.00 % are the feathers and purities. Swiftlet Nest has been high demand which due to high market value depends on the qualities grade if the nest. While in Malaysia, the temperature can get very hot and could make the nest dry. So from this project is to maintain the quality of the birds' nest without making the value drop. Room temperature-controlled system is a system which able to be controlled by an individual automatically. Usually, in our daily life, we all see or adjust the temperature-controlled system at the refrigerators, air conditioners and many more. Based on [1] has stated that each individual will experiencing difference thermal environments and will not be able to satisfy each and everybody. If there are goals to be made to satisfied everyone so they become more tolerant, it would be hard because everyone would have control over their thermal environment according to their needs.

**Corresponding author: lilywati@uthm.edu.my*

The comfort to be able to work indoor environments and residential able to enhance the efficiency and the quality of our life as it is directly been evaluated based on the physical types of elements which is temperature, humidity, radiation and the air currents which all of these are related to thermal environment [2] [3].

This project is to create a system that can helps to cooling a swiftlet house when the temperature increase inside the building. Whenever the temperature increased more than standard room temperature, the water pump started to sprinkle on top on the rooftop to prevent a huge amount of heat enter the building. Next, an exhaust fan that were installed at the wall will also turn ON to eliminate the heat that are trap in the building. If the temperature kept increasing both the water pump and exhaust fan will still operate, in order to reduce huge amount of heat and helps to decrease the temperature.

From this project, we will use Arduino by programming a program that can create this type of system and can be adjustable by the user itself if they wanted to change any constant temperature according to their needs and the system will be powered by solar panel to save electrical bills and going towards environmentally friendly.

2. Literature Review

2.1 Microcontroller Based Environment Control for Swiftlet

D. Tristanto et. al [4] has reported that swiftlet nests contain lots of health benefits and have a high value on economically which attract many attentions of business owner. Some facts about swiftlets is that they like to live and create their nest that have humidity of 80.00 – 95.00 % RH and temperature of 22-28 °C and that's why usually many swiftlets living inside caves because of it meets the criteria which their needs to live. In order to make the swiftlet feels like home, they proposed a microcontroller based system for controlling the temperature and humidity of the house and a system to updating the owner by sending alarm notification through short message services (SMS) [3]. The hardware of the controller unit is ATMega8535 MCU, Sensirion's SHT11 chip is used for sensing both humidity and temperature. Microcontroller connect the output of heater, cooler, blower and fogger so that it can maintain the percentage of humidity and temperature inside the house. The type of language that the controller was using is codevision's C language. The firmware will handle TWI communication goes to readout the sensors and responding to the queries based on the monitoring computer and controlling the imperfect temperature and humidity through an ON-OFF controller build in mechanism to control the heater, cooler, fogger and blower. A program of software was developed so that the progress can be monitored at the computer that shows the temperature and humidity and sends queries to the controller units.

2.2 Microcontroller Based Automatic Temperature Control for Oyster Mushroom Plants

P. Sihombing et. al [5] has reported that oyster mushrooms need a special kind of treatment as they are susceptible to disease. Oyster mushroom will only able to growth when the temperature around 22-28 ºC and 70.00 – 90.00 % of humidity of its surrounding. This project is controlled by Arduino Uno Microcontroller and with an android smartphone to monitor the status of the oyster mushroom in the area. The type of sensor for temperature and humidity that was used is SHT10 and TC35i GSM to updating the owner to a smartphone or a module for communication that are wireless. The sensor will be placed around the root of oyster mushroom and the result will be transmit to Arduino microcontroller. Arduino microcontroller will act as a real-time system and become an alarm to pump some water, when the alarm was activated it means water will be pump to the oyster mushroom. The owner will able to monitor the water level and temperature of the surrounding of oyster mushroom plant and the data will be stored at thingspeak.com that was sent by microcontroller so the owner will able to record the data online.

2.3 IOT based Greenhouse Environment Monitoring and Controlling System

Vimal. P. V [6] has done a project of controlling and monitoring the environment of a Greenhouse so that the quality and productivity of the plant can be improved. In this project, he used a multiple type of sensor which is DHT11 sensor for both temperature and humidity. LDR sensor, pH sensor and soil moisture sensor. Arduino ATmega328P will be used as a microcontroller as it can receive multiple input of sensors and control the cooling and exhaust fan, water pump and artificial light. All of the information will be able to be sent to android mobile phone both offline and online which used GSM modem and ethernet. Basically, everything can be control through SMS and the mobile owner will activate and control any output needed if the sensor detects any part that are not in range or level. GSM SIM800 is a quad type band of GSM device and it will work with 850 MHz, 900 MHz, 1800 MHz and 1900 MHz that can transmit or sent a voice or SMS with a low power consumption. Mobile owner will also able to set a username and passwords to login and enter the database.

2.4 Infant Incubator Temperature Controlling and Monitoring System by Mobile Phone Based on Arduino

K. Khotimah et. al [7]has made a study on controlling and monitoring temperature inside of infant incubator on a mobile phone. Usually, a normal condition in the incubator is around 36 - 37 ºC of temperature and for humidity is around 70.00 – 75.00 % RH. In the incubator consist a compartment which have a heater, fan, a container of water to regulate humidity and a valve for the flow of oxygen. This system developed by using an Arduino uno to control the system. For sensor, DHT 11 was used to collect the data of temperature and humidity inside of the incubator. A relay was used to heat the infant incubator. For wireless communication, an HC-05 was used to communicate using mobile phone. HC-05 will be operate at 2.4 GHz frequency and to have a better effective range of HC-05 to mobile phone is 10 meters.

3. Materials and Methods

To design this system must be based on logical through theoretical and practical. Arduino will be the main element and brain which store all the information to analyzed and process the best procedure or step to achieve the objective that has been set to the microcontroller. As for the hardware will consists of electrical and mechanical part are very important.

2.1 Component and Equipment

For the planning and designing the cooling system using Arduino as microcontroller will need to consider several aspects before proceeding the project to build the electrical circuit and mechanical structure. For this project, the Hardware of mechanical and electrical part are:

- Water Pump
- Exhaust Fan
- Water Tank
- Solar Panel
- Rechargeable Battery
- Relay
- Arduino Microcontroller
- Temperature and Humidity Sensor

2.2 Methods

System flowchart for this project of Bird House cooling system and it shows the working process step by step which powered by solar as a source of this system. In the beginning, the solar panel will be needed to charge the solar battery bank before it can operate the whole system which will take few

minutes until the battery bank can fully support the load. When the battery bank can support the load, Arduino UNO will be turn ON and runs the system according to the code that had been transfer into the microcontroller. The DHT11 sensors plays the important part of this system which helps to detect and measure the temperature and humidity of the room as accurate as possible.

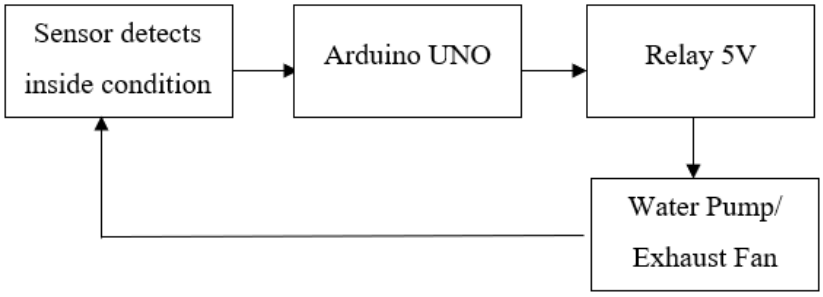

Figure 1: Block Diagram of the system

When DHT11 sensor detected an overheat of temperature inside of the building, it will send a signal to the microcontroller to activate both water pump and exhaust fan. The water pump will sprinkle the water on the roof zinc, and it can help to cooldown the heat on the roof. The water will be collected and flow back into the water tank which was used by the water pump to bring the water up to the roof. This method will enable the owner to recycle the water supply without wasting the water supply and able to collect rainwater to refill the water if it is not full level. As for the exhaust fan, it will eliminate the hot air or heat which has entered inside the building from the entrance or through the wall. The exhaust fan will be installed in every level of the building so the process to let the heat flow out will be much faster.

The water pump and exhaust fan will continue to operate until the sensor measure the temperature of the building back to 26 ℃ which is the constant temperature and most suitable temperature for the swiftlet to stay. If the temperature still above the constant temperature, the process will keep looping without any instruction demand it to stop.

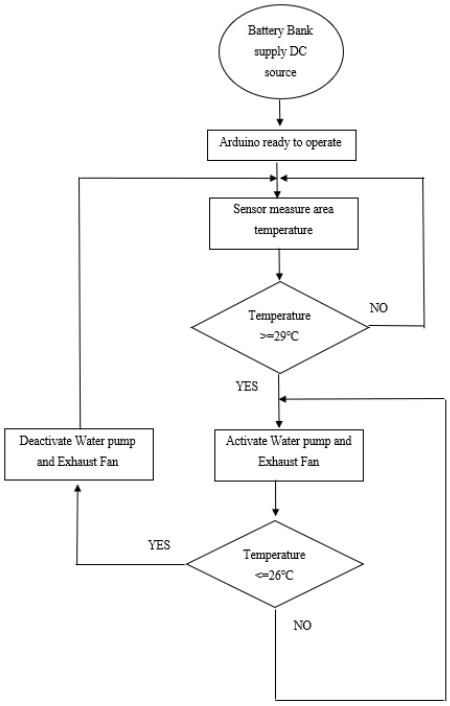

Figure 2: System Flowchart

4. Results and Discussion

The results and discussion section presents data and analysis of the study. This section can be organized based on the stated objectives, the chronological timeline, different case groupings, different experimental configurations, or any logical order as deemed appropriate.

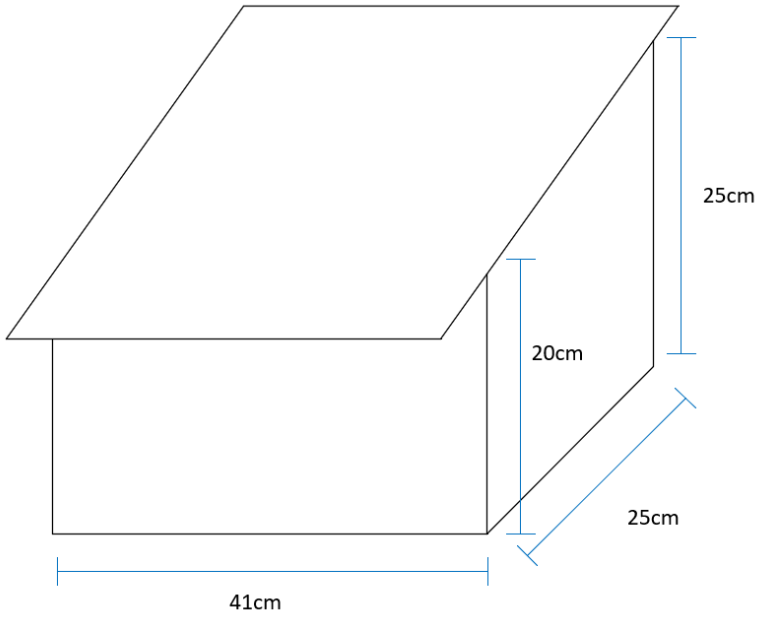

Figure 3: Design Model of the Bird House

Figure 4: Prototype Model of Bird House

3.1 Simulation Results

Figure 3 shows the sensor of DHT11 detected the temperature reach 30 °C which is more than 29 °C that had been set to activate the water pump and exhaust fan when the temperature is equal or more than 29 °C.

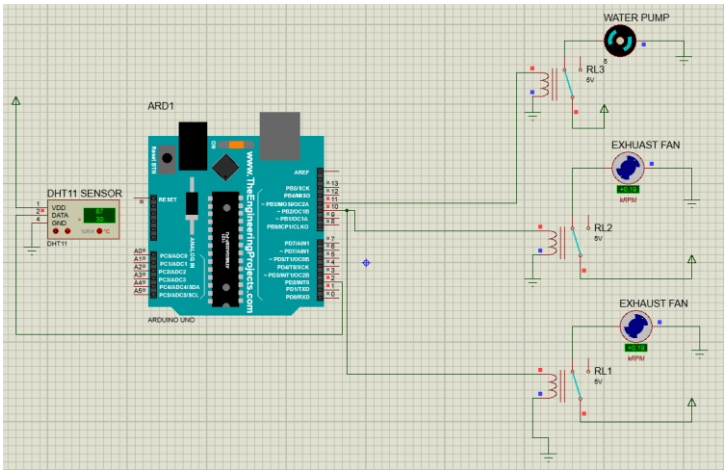

Figure 5: Water Pump and Exhaust Fan turn ON

Figure 4 shows that when the sensor detect that the temperature had been drop to 26 °C, the relay will be de-energize and cut OFF the water pump and exhaust fan simultaneously.

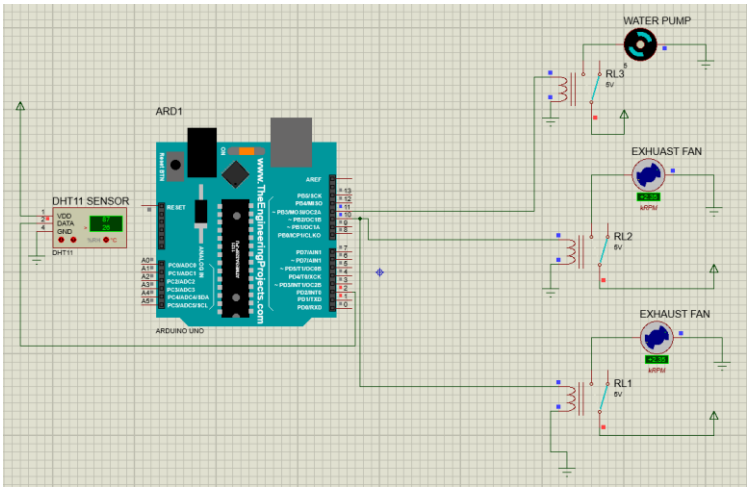

Figure 6: Water Pump and Exhaust Fan turn OFF

3.2 Data Analysis

Tables should be numbered based on the section number and formatted based on the style as presented in the following:

Table 1: Result when the system is ON

Day	Operating Time (hours)	Moist (percentage)
1	3.5	80%
2	4	80%
3	4.5	75%
4	3	70%
5	3	70%

Table 1 shows that the water pump and exhaust fan able to fully operate around 3 to 4 hours daily and normally the output will be triggered and operate on 11:40 am and ends on 4:00 pm. The moist percentage is based on visual towards the bird nest and not by any digital meter to evaluate the moisture

and dryness of the nest. At the end of the day, the bird nest is still very moist and not too yellowish, and the condition is in a high quality and have the potential to sell it in a higher price

Table 2: Result when System is Off

Day	Operating Time (hours)	Moist (percentage)
1	-	85%
2	-	80%
3	-	65%
4	-	60%
5	-	50%

Based on Table 2, it shows that the water pump and exhaust fan will not able to fully operate daily and normally the output will be zero as the building does not installed any system. The nest that was put inside of this building does getting dryer compared to the other building that was installed with cooling system. At the end of the day 5, the quality of the nest is very low as it is very dry and yellowish, and this will cause the value of the nest to drop drastically and may able to be sell in very low price.

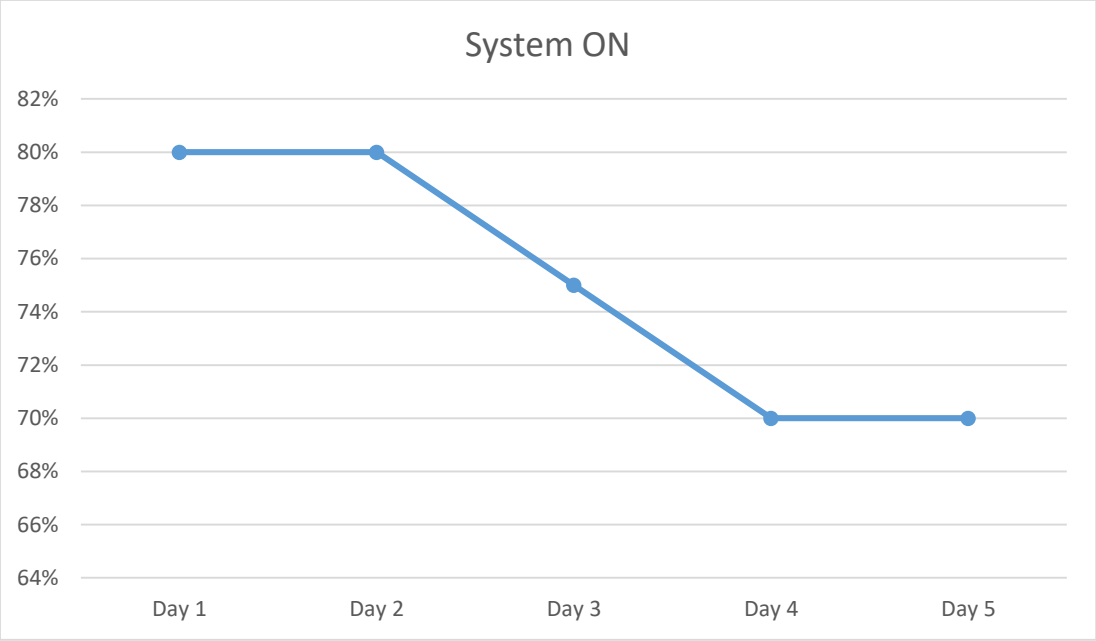

Figure 6: Graph Moisture versus Days (System ON)

Figure 5 shows that from Day 1 the readying of moisture using moisture meter was 80.00 %. While on Day 2, the percentage was still 80.00 % as the system was running for 4 hours. The moisture percentage of the bird nest drops 10.00 % from Day 2 to Day 4. This shown that this system able to slow down the process of dehydrated of the nest. on Day 4 to Day 5 it shows that the moisture percentage able to maintain the same on 70.00 %.

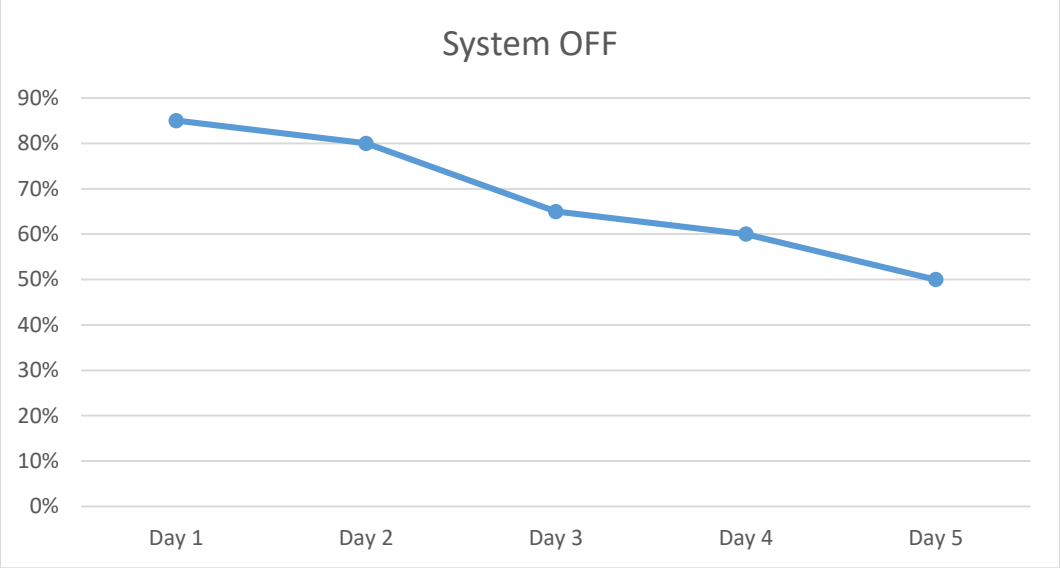

Figure 7: Graph Moisture versus Days (System OFF)

Based on Figure 6 shows on Day 1 the reading moisture of the bird nest that was used was 85.00 %. While from Day 2, the moisture percentage of the bird nest drops 20.00 % from Day 2 to Day 4. On Day 4, the moisture drops 10.00 % and this shown that the process of dehydrated of the nest are much faster without the system was not turning ON.

5. Conclusion

In conclusion, the objective of the project had been achieved by controlling the building temperature to maintaining the quality of the bird nest. The only time that the owner needs to visit and do some repair is when the owner needs to do some nest harvesting. Finally, this project able to contribute to reduce CO_2 and eliminate waste sources by using a renewable energy as a power source which is solar for this project and reusing the rainwater as a water supply. this project, also help me to realize what is the important target which is to create a greener system for the benefits of the environment and use the sources efficiency without any waste or contribute to global warming.

Acknowledgement

The authors would like to thank the Faculty of Engineering Tcehnology, Universiti Tun Hussein Onn Malaysia for its support.

References

[1] S. Karjalainen, “The characteristics of usable room temperature control,” VTT Publications, no. 662, pp. 3-133, 2007

[2] J. Y. D. L. E. P. J.-R. S. Insick Nam, “A study on the thermal comfort and clothing insulation characteristics of preschool children in Korea,” Building and Environment, vol. 92, pp. 724-733, 2015

[3] P. M. M. A. A. C. P. D. Peffer Therese, “How people use thermostats in homes: A review,” Building and Environment, vol. 46, no. 12, pp. 2529-2541, 2011

[4] H. U. D. Tristanto, “Microcontroller based environmental control for swiftlet nesting with SMS notification,” Proceedings of the 2011 International Conference on Electrical Engineering and Informatics, ICEEI 2011, no. july, 2011

[5] T. H. D. P. Sihombing, "Microcontroller based automatic temperature control for oyster mushroom plants," Journal of Physics: Conference Series, vol. 978, no. 1, 2018

[6] K. S. P. Vimal, "IOT based greenhouse environment monitoring and controlling system using Arduino platform," 2017 International Conference on Intelligent Computing, Instrumentation and Control Technologies, ICICICT 2017, Vols. 2018-Janua, pp. 1514-1519, 2018

[7] M. S. S. H. K. Khotimah, "Infant Incubator Temperature Controlling and Monitoring System by Mobile Phone Based on Arduino," 2019 2nd International Seminar on Research of Information Technology and Intelligent Systems, ISRITI 2019, pp. 494-498, 2019

[8] J. A. Diffley, "ALL ABOUT CIRCUITS," 11 JUNE 2015. [Online]. Available: https://www.allaboutcircuits.com/projects/use-relays-to-control-high-voltage-circuitswwith-an-arduino/#:~:text=To%20control%20high%2Dvoltage%20or,the%20Arduino%20with%20a%20relay.&text=A%20relay%20consists%20of%20an,and%20the%20circuit%20being%20controlle

[9] "Whole Sale Solar," Solar, 23 October 2018. [Online]. Available: https://www.wholesalesolar.com/blog/lead-acid-vs-lithium-batteries#:~:text=October%2023%2C%202018-,Lead%2Dacid%20vs.,match%20their%20higher%20price%20tag..

[10] D. M. M. P. a. Y. P. Ventje Aror, "Utilization of Solar Cells as Energy Sources for Heating and Fan (Exhouse) in White Copra Dryers with Arduino Uno as Temperature Control," 2018 International Conference on Applied Science and Technology (ICAST), p. 5, 2018

[11] L. S. C. Siti Najihah Zukefli, "A Comprehensive review of edible bird nests and swiftlet farming," Journal of Intergrative Medicine Editiorial Office, p. 14, 2016

[12] S. P. O. N. L. C. C. L. L. Shu Hui Gan, "A Comparative Quality Study and Energy Saving on Intermittent Heat Pump Drying of Malaysian Edible Bird;s Nest," Dring Technology, p. 38, 2017

[13] C. F. C. a. A. O. H. K. Tan Kok Hong, "Approach to Improve Edible Bird Nest Quality & Establishing Better Bird Nest Cleaning Process Facility"

[14] T. W. B. A. Ibrahim S.H, "A Study on Suitable Habitat for Swiftlet Farming," UNIMAS E-Journal of Civil Engineering , vol. 1, no. 1, p. 7, 2009

[15] C. F. C. a. A. O. H. K. Tan Kok Hong, "Approach to Improve Edible Bird Nest Quality & Establishing Better Bird Nest Cleaning Process Facility through Best Value Approach," Journal For The Advancement of Performance Information and Value, vol. 10, p. 13, 2005