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Application of I2C SHT11 Sensors on Automatic Egg Hatching Machines

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Abstract **– Many automatic egg-incubators have been developed with bulb lamps as heating media. However, this automatic egg incubator still uses analog sensors to measure temperature and humidity in the incubator room. Similarly, egg screening is done manually using human hands, which is by tilting the position of the eggs one by one. This condition requires time and great human energy and causes the temperature in the incubator to become uneven. Electronic technology Inter Integrated Circuit (I2C) temperature and humidity sensors SHT11 is a single chip temperature and relative humidity sensor with multi sensor modules whose output has been digitally calibrated so that a good output signal, fast response time, and resistance from interference outside. While Real Time Clock (RTC) is an I2C chip that has the function of storing time and date, using the I2C DS1307 interface as a timer in 12 hours or 24hours mode until year 2100 with leap year compensation so that it is easy to set the time in egg playback automatically. These egg-based I2C egg hackers can help improve the economy of the community and indirectly contribute to improving the strategic value of livestock civilization conservation on the island of Sumbawa, West Nusa Tenggara Province.**

Keywords **– Egg Incubator, I2C Sensor, RTC, Sumbawa.**

I. INTRODUCTION

In principle, automatic egg hatching technology is to eliminate the period of hatching on the poultry mother so that the poultry parent is able to produce more eggs during his life without being cut off by the period of incubating for 21 days and raising his child at least for the next 30–45 days, before the mother starts laying eggs back. Based on the reference, the optimal temperature in the hatching machine is 37-40.5 ºC and the optimal humidity is 55-70% RH. Thus chicks can be produced in large quantities at the same time [1-5]. Many automatic egg-incubators with bulb lamps have been developed as heating media. However, this automatic egg incubator still uses analog sensors to measure temperature and humidity in the incubator room. On the other hands the eggs that will be hatched are very sensitive to temperature and humidity. Conditions of temperature and humidity outside of the provisions can result in decreased hatching success [4-8].

In addition to the temperature and humidity factors, there is one other factor that greatly determines the success of egg hatching, which is egg screening. Egg screening aims to prevent the egg embryo from attaching to the inner membrane of the egg and also to flatten the heat received by the egg during the hatching period [8-9]. In the existing egg incubator, egg screening is done manually using human hands, which is by tilting the position of the eggs one by one. This condition requires time and great human energy and the temperature in the incubator becomes uneven [10-11]. To overcome these problems, applied electronic technology, especially Inter Integrated Circuit (I2C) technology, in this case is the I2C temperature sensor and humidity SHT11 and I2C Real Time Clock DS1307. The I2C SHT11 sensor is a single chip temperature and relative humidity sensor with multi sensor modules whose output has been digitally calibrated to produce a good output signal, fast response time and resistance from external interference [12]. While Real Time Clock (RTC) is a chip that has the function of storing time and date, using the I2C DS1307 interface as a timer (days, dates, months, years, seconds, minutes and hours) in 12hours mode or 24 hours to years 2100 with compensation for leap years. The existence of an automatic egg incubator that implements this I2C technology can help improve the economy of the community and indirectly contribute to increasing the strategic value of livestock civilization conservation on the island of Sumbawa and West Nusa Tenggara Province in general.

II. Research Methods

The research was conducted at Sumbawa University of Technology, especially in the Faculty of Information Technology Electrical Engineering Study Program. The choice of the research location was accompanied by the hope that this research would be a place for students to implement the theories they gained during lectures, especially those relating to the design of electronic equipment, as well as being a trigger for them to think innovatively in developing independent businesses and contributing actively in advancing the local economy.

To clarify the work system of the tool, the system design is broadly divided into two parts, namely;

1) The design of the control system includes the design of hardware and software design, and

2) Mechanical design includes the design of installations and installation of equipment in the field.

A. *Design of an Egg Incubator Control System*

In designing this automatic egg incubator control system using Arduino Uno microcontroller as the main controller of the factors needed in hatching. The input device consists of the SHT11 and RTC DS1307 sensors which will provide information on temperature, humidity and time (seconds, minutes, hours, days, months and years). While the output device consists of a light bulb as a medium producing heat energy, the fan is to produce evenly distributed humidity and freshness in the hatching chamber, and the linear actuator used to tilt the egg rack. The output device is also equipped with a display device to display activities that occur in the incubator hatching room.

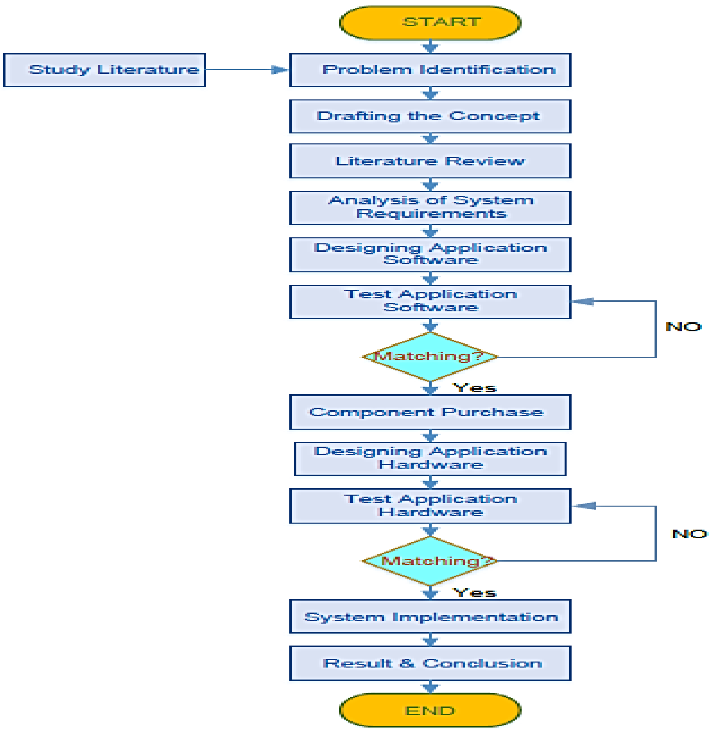

Fig. 1. Flowchart of Research Method.

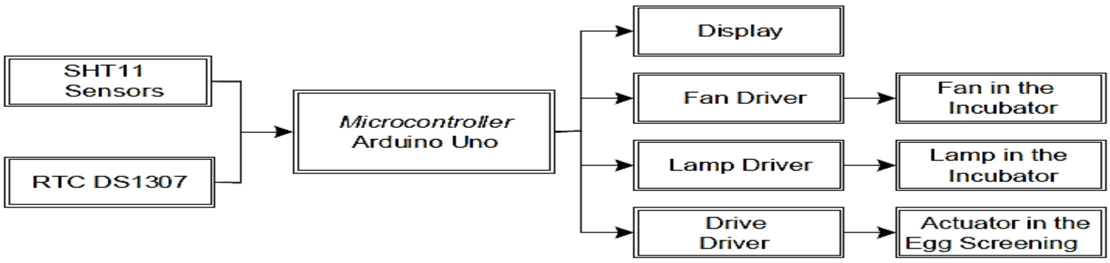

Fig. 2. Block diagram of an automatic egg incubator system.

Figure 2 shows the overall system block diagram which includes: I2C SHT11 sensor circuit, DS1307 RTC circuit, fan driver circuit, lamp driver circuit, drive driver circuit, and LCD circuit. The design of each group is presented as follows:

1. *Design Temperature and Humidity Control*

Before starting the design of temperature and humidity control, the work algorithm of the I2C SHT11 temperature and humidity sensors is first determined for the on / off lights and fans. To run this temperature and humidity control algorithm, several components are connected to each other as shown in Figure 3.

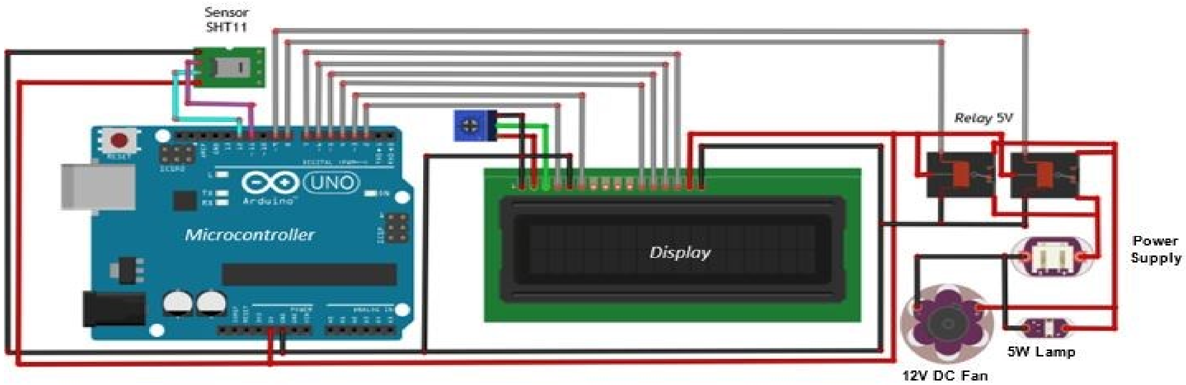

Fig. 3. Temperature and humidity control circuit.

The software design (program) from the design of temperature and humidity control includes 3 (three) main parts, namely 1) programs for SHT11 sensors, 2) programs for display on display, and 3) programs for lights and fans. The program in all of these parts is designed by following the temperature and humidity requirements needed in the hatching process and what activities will be carried out by the fan and lamp as an output device in response to changes in temperature and humidity. For example, the ideal temperature required in the hatching process is 37 ° C - 40.5 ° C, so if the SHT11 sensor reads the temperature less than 37 ° C then the microcontroller will give the light command to on. This situation will cause the temperature to increase slowly. When the SHT11 sensor reads a temperature of more than 40.5 ° C, the microcontroller will instruct the lamp to turn off and this condition will cause the temperature to slowly decrease. The same thing applies in the design of humidity control, and this cycle will continue to repeat during the hatching period.

2. *Design Control of Egg Shelf Playback*

The on / off of the linear actuator depends on the time setting, which is every 4 hours. In this case selected every 04.00; 08.00; 12.00; 16.00; 20.00; and 24.00. In this design, the DS1307 RTC IC timer can be used as a digital clock. To run this playback control algorithm, several components are connected to each other as shown in Figure 4.

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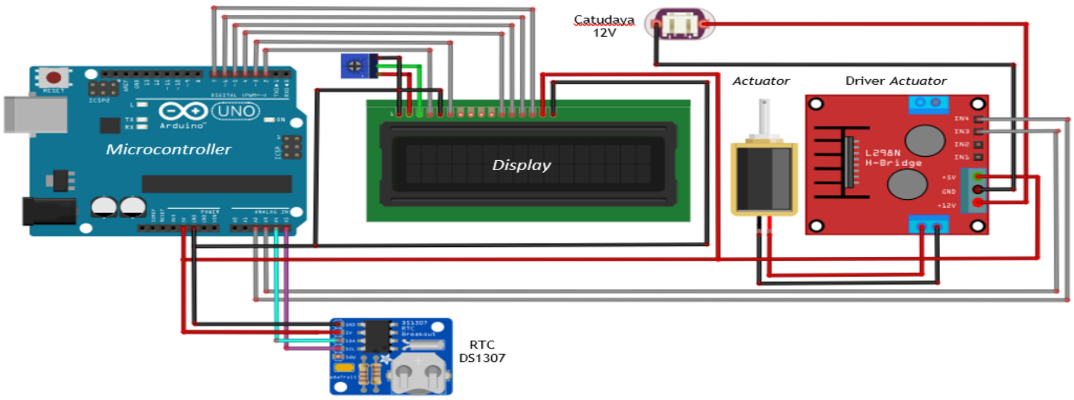

Fig. 4. Design of DS1307 RTC as Timer.

Software design from the design of egg rack playback controls also includes 3 (three) main parts, namely 1) program for DS1307 RTC, 2) program for display on display, and 3) program for linear actuator. The programs in all of these sections are designed to follow the egg screening requirements needed in the hatching process and what activities the actuator will do as an output device in response to changes in the time given by the DS1307 RTC. When the clock shows 04.00 for example, the microcontroller will give an order to the linear actuator to move the sloping shelf to the right with a certain slope. The same thing happens when the clock shows 8:00 a.m., the microcontroller will give an order to the linear actuator to move the egg shelf tilted to the left with a certain slope, and this cycle will continue to repeat during the hatching period.

After designing the temperature and humidity control and controlling the egg playback, these two controls are then combined into the overall control system by adjusting the availability of Arduino Uno microcontroller pins.

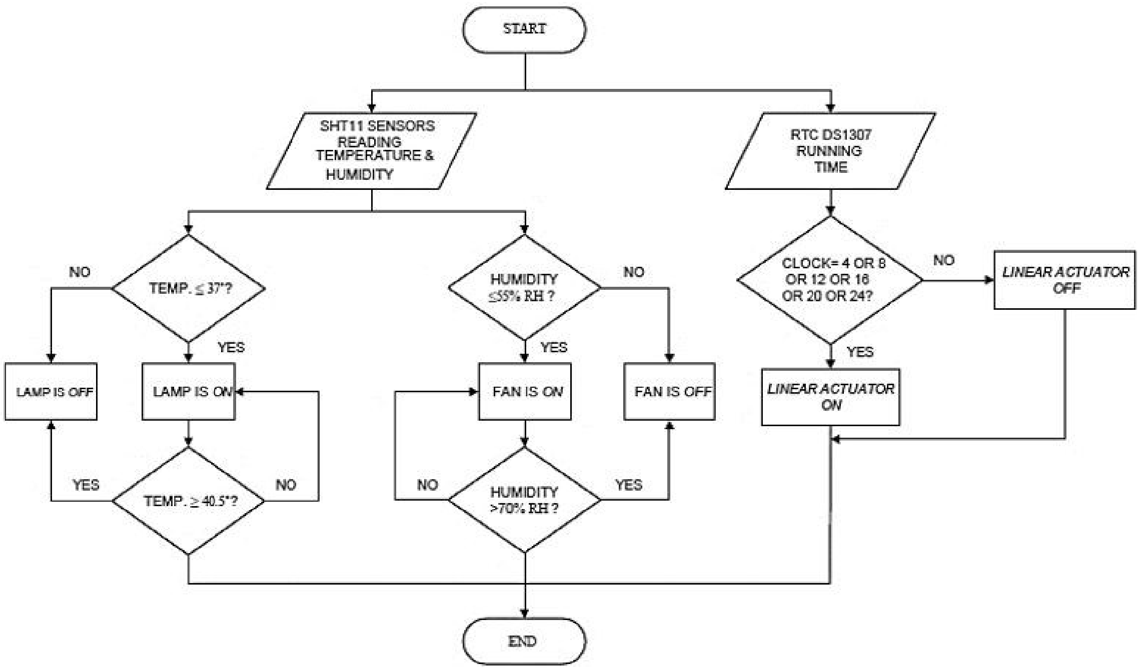

Fig. 5. Overall Control Design.

B. *Mechanical Design of an Egg Incubator*

The mechanical design of this automatic egg incubator consists of an egg shelf frame and a cashing box. Egg shelf framework will be designed with a size of p × l × t = 90cm × 30cm × 80cm. Thus, cashing is made with a size of p × l × t = 110cm × 50cm × 120cm as shown in Figure 6.

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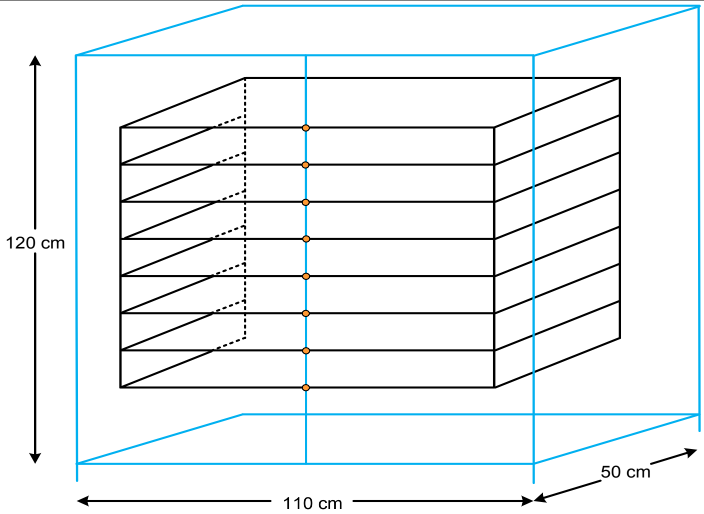


Fig. 6. Design of Egg Rack Cashing.

III. Results and Analysis

All stages of circuit testing are described in accordance with the research design described in the research method chapter which includes testing hardware and testing software simultaneously.

A. *Testing Temperature and Humidity Control*

Temperature and humidity controls that have been designed are implemented on electronic devices as shown in Figure 7 (a). To facilitate testing, the given temperature range is 27 ° C - 32 ° C and the range of humidity given is 55% RH - 60% RH. After ascertaining that all electronic devices are properly assembled, the next step is compiling and uploading the program into the microcontroller.

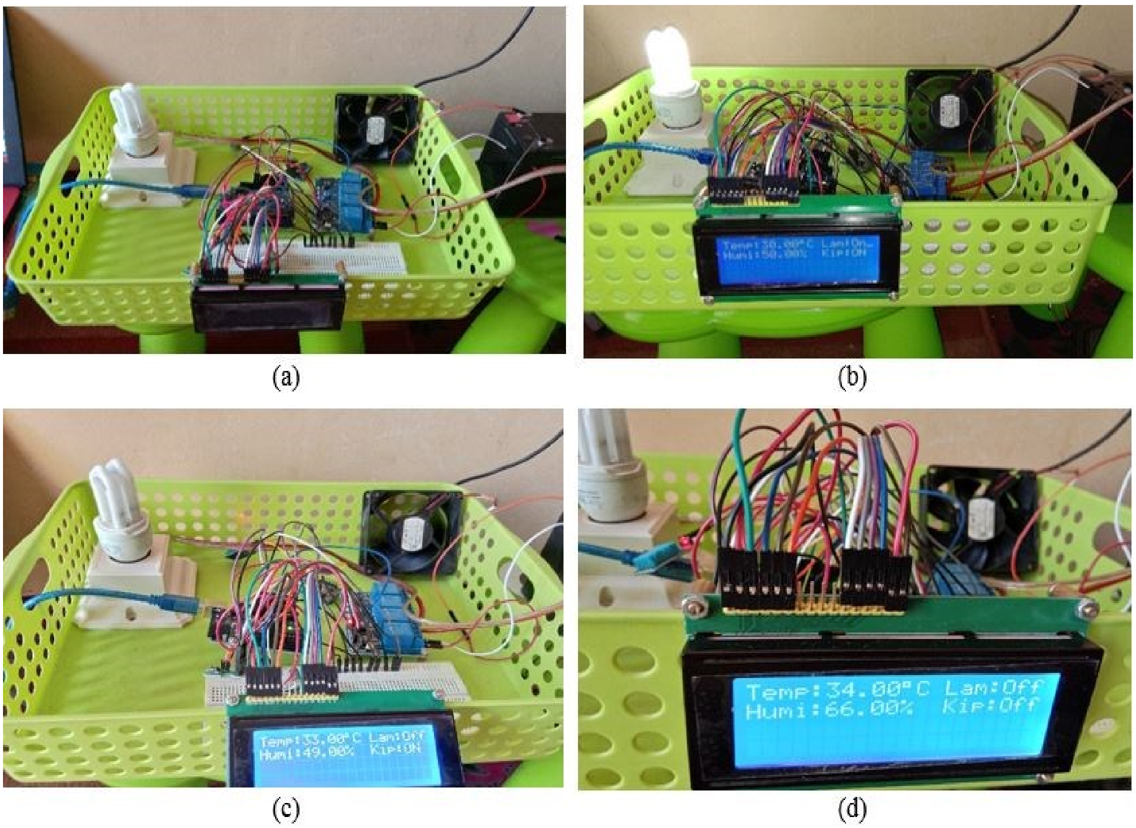


Fig. 7. Design and Testing Results of Temperature and Humidity Control.

Figure 7 (b) shows the lights and fans are on. This occurs because the temperature and humidity read by the SHT11 sensor are 30 ° C and 50% RH, respectively. Figure 7 (c) shows the lights are off and the fan is on. This happens because the temperature read by the SHT11 sensor is 33 ° C (more than 32 ° C required) and the humidity read by the SHT11 sensor is 49% RH (less than 50% RH required). Figure 7 (d) shows the lights and fans are off. This happened because of the temperature and humidity read by the SHT11 sensor 34 ° C (more than 32 ° C required) and 66% RH (more than 60% RH required). The values of temperature, humidity, and lamp and fan activity for each state are displayed on the display device.

B. *Control Testing of Egg Shelf Playback*

Temperature and humidity controls that have been designed are implemented on electronic devices. To facilitate testing, the linear actuator upward motion is adjusted to occur at the time of testing, namely on Saturday, August 25 2018 at 09.20 am as shown in Figures 8 (a) and 8 (b). For the direction of linear actuator motion in the reverse direction adjusted to occur at the time of testing, namely on Saturday, August 25, 2018 at 09:24 hours as shown in Figures 8 (c) and 8 (d). It takes 20 seconds for the linear actuator to move from the initial position to the final position with an overall length of 200mm or 20cm.

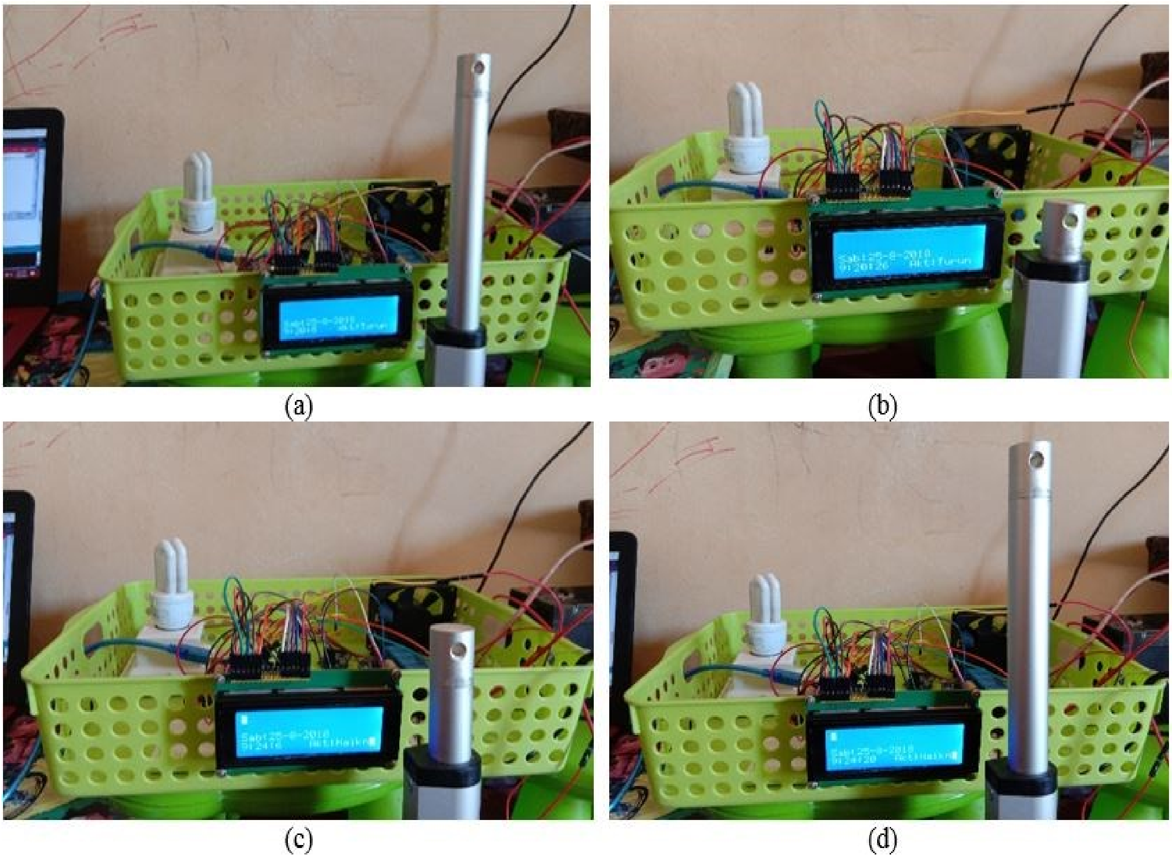
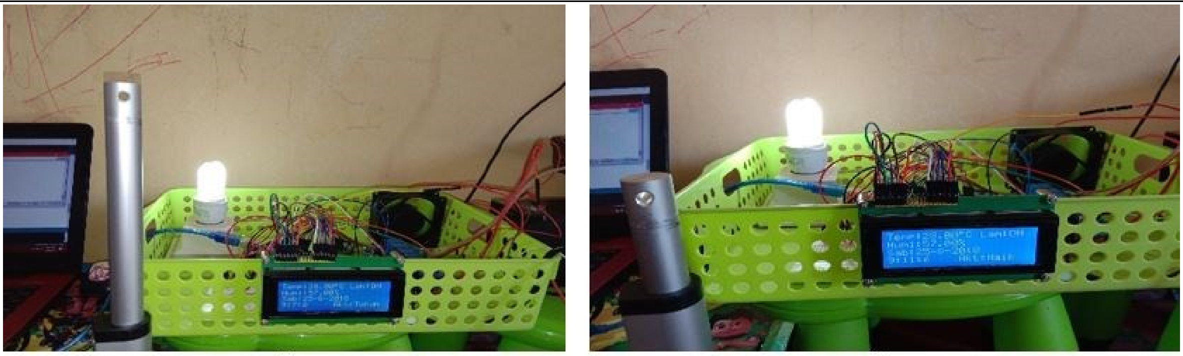


Fig. 8. Design results and Egg Screening Control Test.

C. *Overall Control Testing*

The next testing phase is to combine all the components used into the control system as a whole, as well as coding the program in each section. Figure 9 shows the results of this test where the control activities carried out by the microcontroller on all output devices are carried out simultaneously based on information on temperature and humidity of the SHT11 sensor and the information given by the DS1307 RTC.



(a) (b)

Fig. 9. Design results and Overall Control Testing.

After getting good results on testing the overall control, the components will be placed in the incubator room according to the function of each component. The incubator room is shown in Figure 10 where each egg rack can be filled with 90 (ninety) eggs. With the total shelf composition consisting of 8 (eight) interchanges, the maximum capacity of the egg incubator is 720 eggs.

Fig. 10. Results of Mechanical Incubator Egg Incubator Design.

IV. Conclusion

Automatic Egg Hatching Machine utilizing I2C SHT11 Sensor and Real Time Clock DS1307 has been successfully designed, both in simulation and hardware. As the control center used Arduino Uno microcontroller and output devices in the form of DC fans, incandescent lamps, liquid crystal displays, and linear actuators to drive the egg shelf. This tool was designed and tested at the UTS Electrical Engineering laboratory and at the initial stage will be implemented on poultry farms belonging to the people of Sumbawa District. In this study limited to only 1 (one) SHT11 sensor used egg incubator with the size of the incubator room $p \times l \times t = 110cm \times 50cm \times 120cm$ and a maximum capacity of 720 grains. In the future more sensors can be used to increase the accuracy of temperature and humidity measurements in the entire incubator room, it can also be enlarged the size of the incubator room so that it can increase hatching capacity.

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REFERENCES

[1] Agus R.M. Design an Automatic Egg Incubator Machine based Nodemcu and Android. Essay. Yogyakarta: Strata Satu EUT; 2018.
[2] Adegbulugbe T.A., Dkk. Development of an Automatic Electric Egg Incubator. *International Journal of Scientific & Engineering Research*. 2013; 4(9): 914-918.
[3] Dhanny J., Dkk. *Implementation of the Automatic Chicken Egg Hatcher Machine using the Fuzzy Logic Control Method*. Proceeding of National Conference on Science and Technology. Jakarta. 2015: 1-6.
[4] Ghilman N.H. Design an Automatic Egg Hatcher based Microcontroller. Thesis. Bandung: Diploma III UNDIP; 2011.
[5] Muhammad I., Dkk. Design an Automatic Chicken Egg Incubator System. *Jurnal Teknik Komputer*. 2011; 19(2): 148 – 158.
[6] Mohd B.R., Dkk. *Egg Hatching Incubator using Conveyor Rotation System*. 2nd International Materials, Industrial, and Manufacturing Engineering Conference. Bali. 2015: 527 – 531.
[7] Yudhi G. *Designing and Making Egg Incubator based Arduino Dumilanove*. Proceeding SNPPTI. 2012: 272-277.
[8] Hartono R, Fathuddin M, Izzuddin A. *Designing and Making Egg Incubator based Arduino*. 2017; 7(1): 30-37.
[9] Andriani, T., Khair S., Hidayatulah, M. Pyroelectric Infra-Red Application on Collective Housing System in the Effort of Optimizing the Achievement One Million Cows of NTB. *International Journal of Electronics Communication and Computer Engineering*. 2018; 9(4): 130-134.
[10] Okpagu, P. E., Nwosu, A. W. Development and Temperature Control of Smart Egg Incubator System for Various Types of Egg. *European Journal of Engineering and Technology*. 2016; 4(2): 13-21.
[11] Hannif I. I. *Sistem Kendali Suhu dan Pemantauan Kelembaban Udara Ruangan Berbasis Arduino Uno dengan menggunakan Sensor DHT22 Dan Passive Infrared (PIR)*. Prosiding Seminar Nasional Fisika. Jakarta. 2016; V: 119-124.
[12] Hidayatullah, Muhammad, dkk. Sistem Kendali Keran Wudhu Otomatis Menggunakan Sensor Passive InfraRed Berbasis Mikrokontroler ATMega8535L Untuk Menghemat Penggunaan Air. Jurnal Tambora Universitas Teknologi Sumbawa. 2016; 1(3): 35-38.

AUTHORS PROFILE'

Titi Andriani was born in Kilo Dompu, January 3rd 1985, finished Bachelor degree in Electrical Engineering in Mataram University, West Nusa Tenggara Indonesia in 2010. Achieved magister degree in Electrical Engineering from Institute Technology of Sepuluh Nopember, East Java Indonesia in 2015. She has been a Lecturer at Electrical Engineering Department, Sumbawa University of Technology in West Nusa Tenggara Indonesia since 2015 until now. Her research interest around electronics digital and automatic control with integrated sensor for robotic control and expedotopis technology.

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