



Design and Implementation of an IoT-Based Misting Control System for Orchid Plants in the ITERA Botanical Gardens

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ABSTRACT

Orchids are one type of plant that can be cultivated in a greenhouse. The growth of orchid plants is influenced by several factors, including altitude, light intensity, environmental temperature, environmental humidity, and water content in the planting medium. If some of these factors do not meet the needs, then the growth of the orchid plant will be disrupted, the roots and flowers produced by the orchid will not be healthy and beautiful. The aim of this research is to create a system that is able to monitor and control the environmental conditions in the place/location where this orchid grows so that it is always in a stable condition. The technology used is misting misting based on an Android application using sensors and IoT to maintain and maintain the condition of orchid plants so that they are always in optimal condition. In the results of the tests carried out, the data obtained were good, namely that this instrument had an accuracy of 80%. The application that has been created is capable of controlling and monitoring the environmental conditions of orchids very well

INTRODUCTION

Institut Teknologi Sumatera (ITERA) is an educational institution that develops science and technology to answer problems that exist in society, especially in the Sumatran environment. The development of science and technology carried out by the ITERA community is required to be applied in a real and sustainable manner. ITERA, which has a land area of 285 Ha, has great potential for developments in terms of technology, one of which is the ITERA botanical garden.

The ITERA botanical garden is under the Unit Pelayanan Terpadu Konservasi Flora Sumatera (UPT KFS). The ITERA botanical garden is currently developing the Smart Botanical Garden edu-tourism, where this development must be carried out continuously and sustainably. The ITERA botanical garden is one of the facilities on the ITERA campus. The aim of building the ITERA botanical garden is to integrate campus activities with environmental conservation as a single ecosystem. Apart from that, with the existence of the ITERA botanical garden, it is hoped that it can become one of the pioneers of educational tourism for the academic community and the surrounding community. One of the plants cultivated in the ITERA botanical garden is orchids.

Indonesia is a country that has the greatest wealth of orchids in the world (Rinaldi, Rita, & et al., 2020). From 26,000 species, Indonesia has 6,000 species of orchid plants. The tropical environmental conditions in Indonesia meet the requirements for the development of orchid plants.

Orchids are one type of plant that can be cultivated in a greenhouse or plant house. Orchid plants have several factors that need to be considered so that they can grow optimally. The factors that influence the growth of orchid plants are altitude, light intensity, environmental temperature, environmental humidity, and the water content of the planting medium. If these factors do not match the needs of the orchid plant, it can cause the plant's growth to be disturbed so that the root conditions and

flowers produced are less healthy and beautiful. One way that can be done to maintain environmental conditions when cultivating orchids in a plant house is to use technology that can monitor and control the environmental conditions where orchids grow. This technology must be able to answer the problem of maintaining stable environmental conditions in the plant house. Apart from that, the application of environmental monitoring and control technology also aims to simplify orchid plant care activities, thereby reducing the need for labor in terms of plant care.

Previous researches have studied the automated misting system (Rukhiran & et al., 2023), (Widiono & et al., 2023), (Panpaeng & et al., 2022), (Junior & et al., 2022), and (Goswami & et al., Arduino Based Smart Chicken Farming Using Temperature Sensor, 2022). However, there is a lack of studies of IoT-based misting for plantation. In this paper, our work investigate the performance of the prior implementation of automated misting control systems, specifically for orchid plantation.

METHODS

The development that has been carried out in the research "IoT-Based Misting Control System for Orchid Plants in the ITERA Botanical Gardens" uses several facilities and devices combined with sensor and IoT technology based on Android applications. The tools used in developing this system includes:

- Temperature sensor
- Humidity sensor
- Light sensor
- Raspberry pi 4 module
- Cloud server
- Noozle
- Fan
- Mobile Apps

The system that has been designed is specifically to maintain light intensity, temperature and air humidity in the microclimate of the green house room as illustrated in Figure 1.

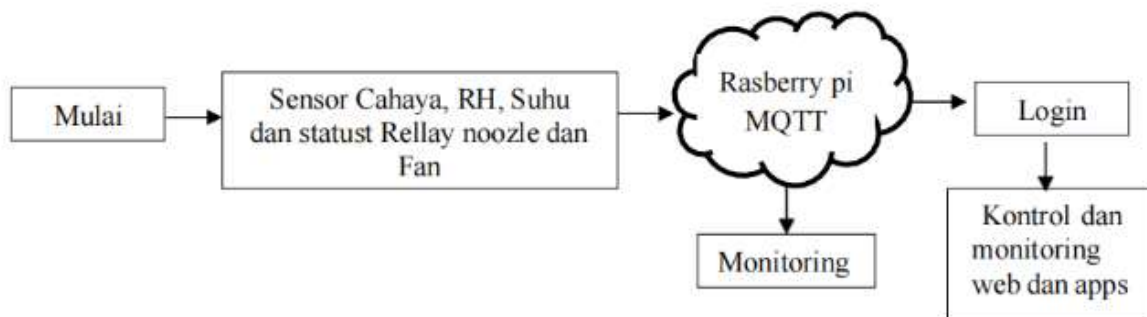


Figure 1. System Diagram Block

RESULTS AND DISCUSSION

Calibration or measurement is an activity to improve (set) measurements based on standard equipment, simulation and comparison, based on phase differences. Calibration can be determined by the deviation from the conventional truth of the indication value of a measuring instrument, or the deviation from the nominal dimensions that a measuring material should have. By calibrating the condition of measuring instruments and measuring materials can be maintained in accordance with specifications. The purpose of this calibration is to obtain the correlation equation and R2 value between the SHT10 (temperature) sensor and a digital hygrometer as a calibrator.

Figure 2 and Figure 3 shows the data from the SHT10 temperature calibration and validation results.

Based on previous research, the R2 value is used to see the level of accuracy of the sensor reading results (Mohamed, Sulaiman, & et al., 2022). In this research, the R2 obtained for the SHT10 sensor was 0.9885. The R2 value is in the range of 0-1, which means that the closer to 1, the better or closer to accuracy (Yang, 2023).

The R2 results of the SHT10 sensor in the design of this tool show results that are close to one, so it can be said that the accuracy of this sensor is close to the actual measuring tool. The results of the validation of the SHT10 sensor with a calibrator in

the form of a digital hygrometer above, according to previous research, the R2 value results are better if the results are close to one (Bogue-Jimenez, Huang, & et al., 2022). So this value shows the level of closeness between the dependent variable and the independent variable in a strong way.

These results show that the level of accuracy of the SHT10 sensor reading results is very high and the error value in the sensor reading results is very low.

Figure 4 and Figure 5 shows the data from calibration and validation of SHT10 humidity. The R2 results of the SHT10 humidity sensor in the design of this tool show results that are close to one, so it can be said that the accuracy of this sensor is close to the actual measuring tool.

Accuracy, Stability and Control Speed Test Results

Accuracy testing aims to determine the level of accuracy of the sensor reading results. The test was carried out by looking at the results of the actual value readings from the sensor with the setting point set at 30°C. The test was carried out 30 times.

The results of accuracy testing with 30 repetitions showed that there were 6 repetitions that did not reach the setting point and 24 repetitions that reached the setting point. The result is that the inaccuracy value is 20%. The results obtained were that this instrument had an accuracy result of 80%.

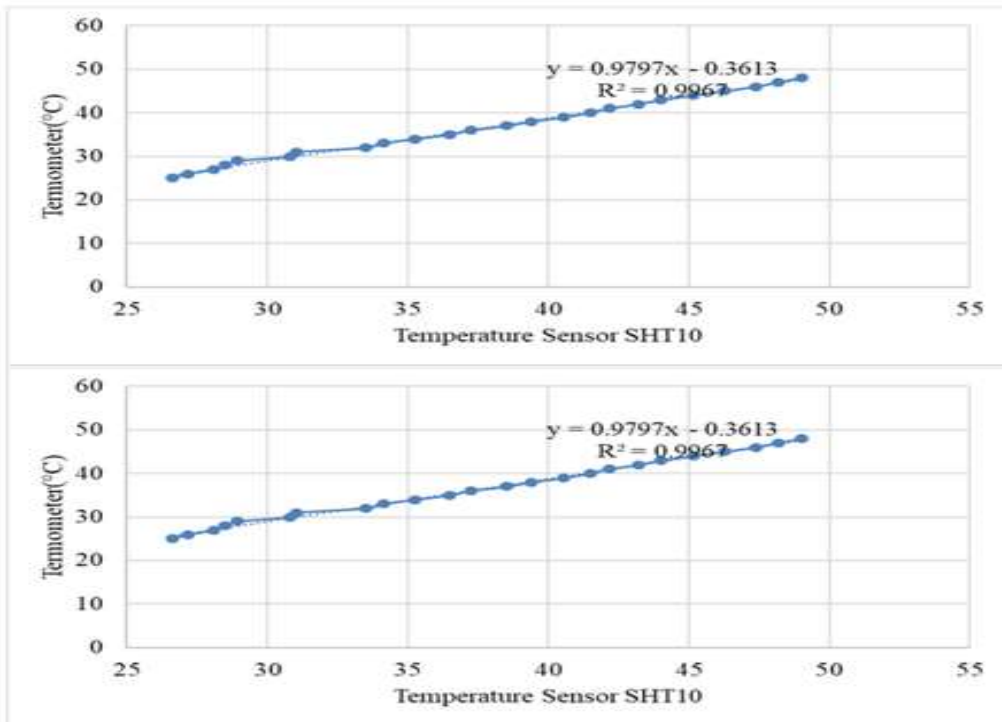


Figure 2. Calibration Data of Temperature Sensor SHT10

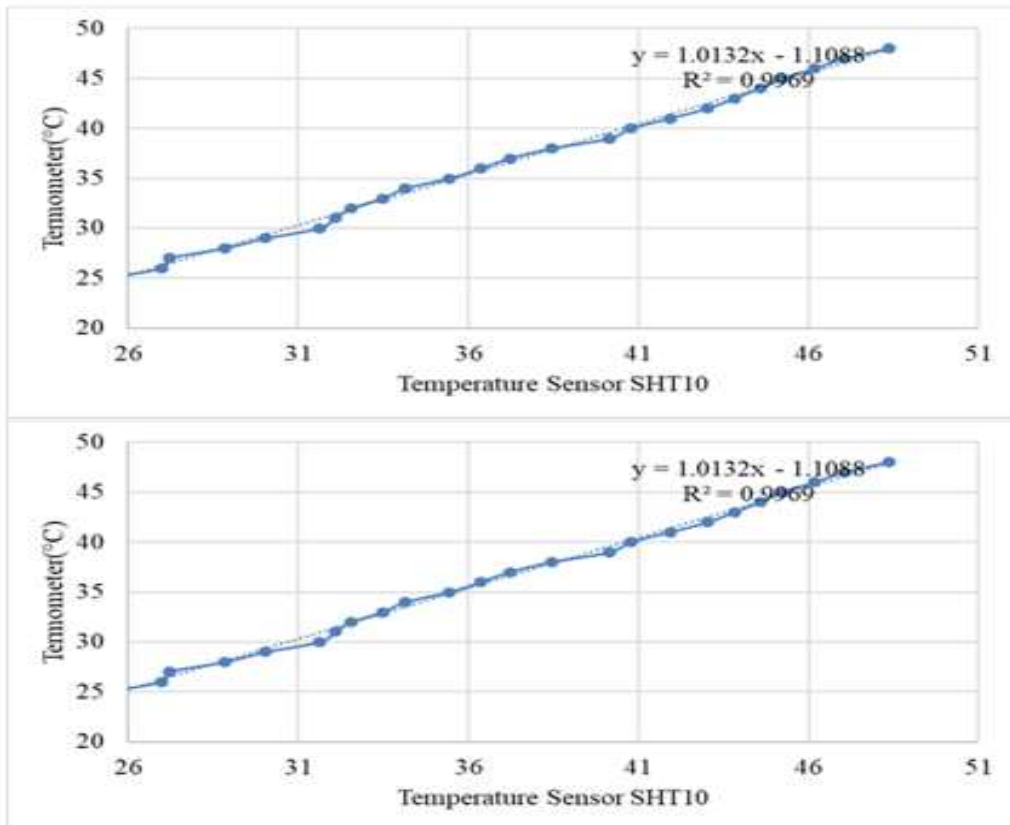


Figure 3. Validation Data of SHT10 Sensor

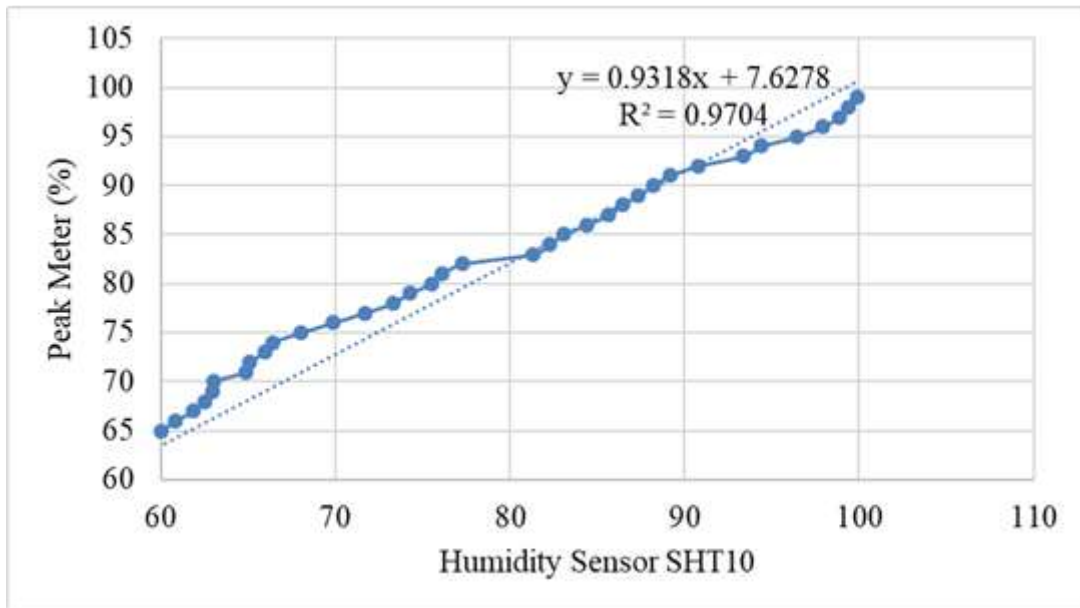


Figure 4. Calibration Data of Humidity Sensor

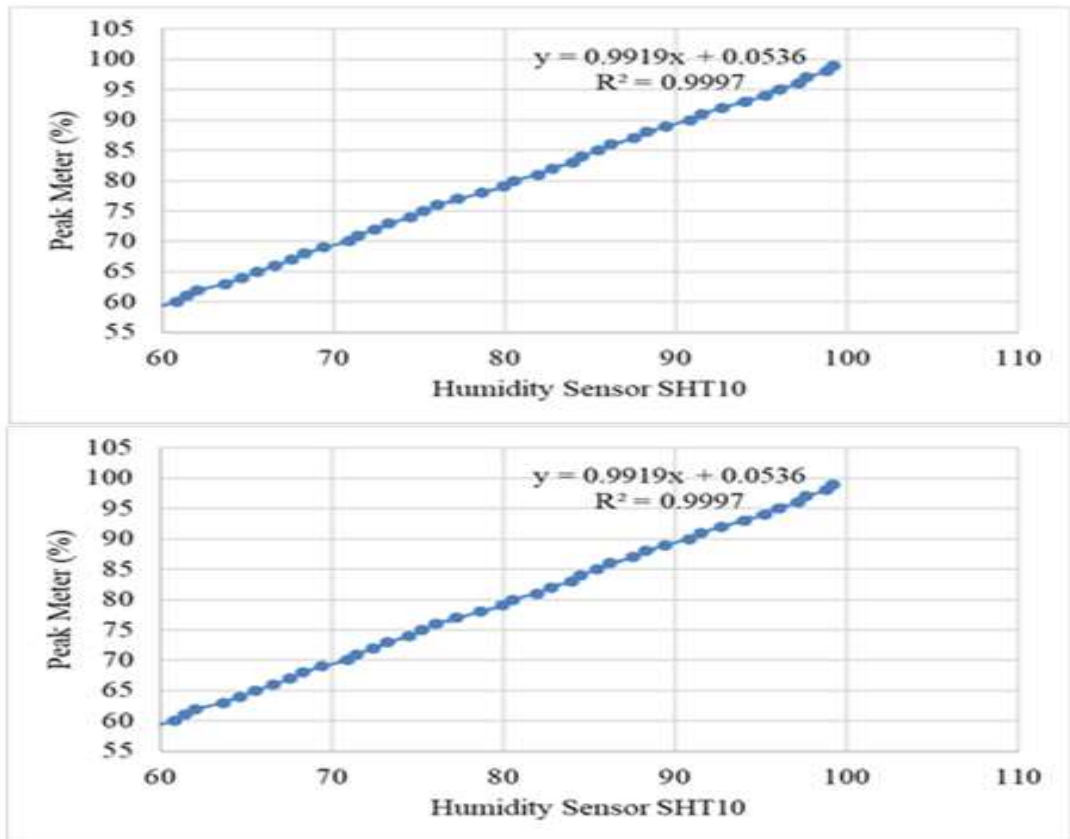


Figure 5. Validation Data of Humidity Sensor

According to previous research, the accuracy results obtained were said to be good when the accuracy value was above 80% (Telaumbanua, Haryanto, & et al., 2021).

Control speed testing was carried out to obtain the average time for the instrument to activate the actuator. The control speed test was calculated using the Equation in Research Methods. This test was carried out to see the average time for this instrument to activate the actuator (Telaumbanua & et al., 2019). This test was carried out 30 repetitions on the instrument. From the test results, it was found that

the actuator was activated 30 times, amounting to 30.5 minutes, with a total of 24 active actuators. These results are consistent with the results that the control speed of the designed instrument is 35 seconds. From the results obtained, where the actuator lights up more or reaches the setting point than the actuator which does not light up or does not reach the setting point, these results are also in accordance with the design criteria for the tool applied.

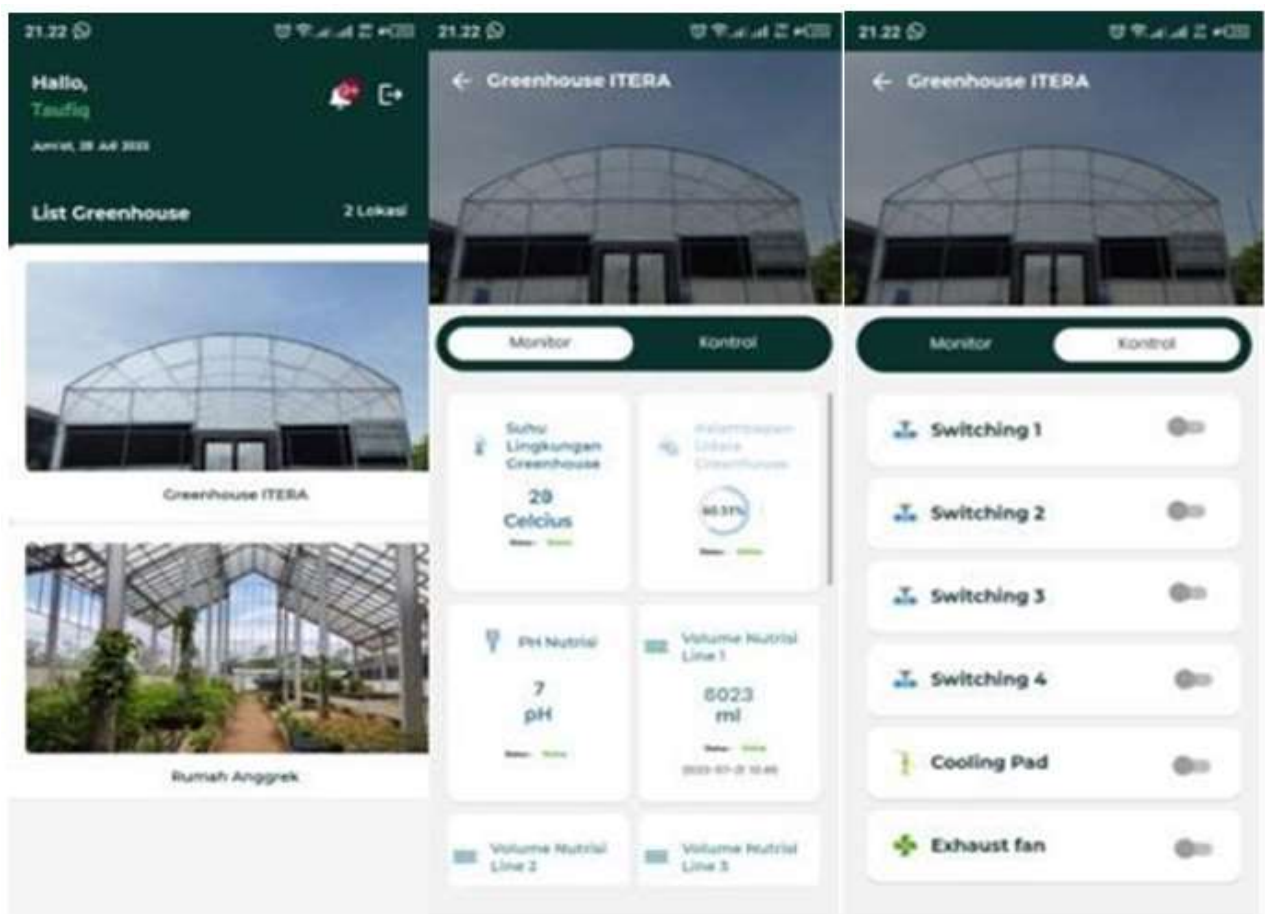


Figure 6. Mobile Application-Based Control and Monitoring Systems

Software Application Design Results

Figure 6 shows the results of the monitoring and control sensor software design that has been installed in the orchid house.

CONCLUSION

The research carried out has gone very well, where the development of mobile application hardware and software as well as IoT-based equipment is capable of monitoring and controlling the orchid of the sensor readings obtained is also very good, namely with an accuracy level of above 80%.house environment at the ITERA Botanical Gardens. The level of accuracy

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