TEKNOKOM : Jurnal Teknologi dan Rekayasa Sistem Komputer
Vol. 6, No. 2, September 2023, pp. 78 - 85
ISSN: 2686-3219, DOI: 10.31943/teknokom.v6i2.135

STORAGE ROOM TEMPERATURE AND HUMIDITY MONITORING IOT- BASED MEDICINE

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ARTICLE INFO
History of the article:
Received May 17, 2023
Revised May 25, 2023
Accepted June 15, 2023
Published July 8, 2023

Keywords:
Temperature
IoT-Based Medicine
NodeMCU

ABSTRACT
This research is important as it portrays a notable advancement in current internet technology known as the Internet of Things (IoT), which facilitates advanced services through the interconnection of physical and virtual objects. One crucial aspect of everyday life is air quality, especially indoors, as indoor air pollution differs from outdoor air pollution. An important indicator to determine the cleanliness of a room is its humidity level. In this context, this research holds significant relevance as it can help ensure the effectiveness and safety of stored medications under appropriate temperature and humidity conditions. Therefore, this study designed a drug storage room that requires a tool to measure the humidity value of the room in real time and the humidity conditions in the room. The solution to this problem can be overcome using Internet of Things technology. In this project, a hygrometer, or humidity meter, based on Internet of Things technology is made. Humidity is measured by the DHT-11 sensor, which is integrated on the NodeMCU ESP8266 board. Humidity measurement data can be observed via the Blynk IoT platform available on smartphones. With this tool, humidity can be observed in real time, even from a distance. The results of this study are that the tool can measure the temperature and humidity of the medicine room, and the tool can send humidity and temperature measurement data to the Blynk IoT and MIT APP Inventor servers. On the Blynk IoT website, the dashboard can display temperature, humidity, and drug safety measurement data in real time.

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INTRODUCTION

Internet of Things (IoT) is now a reliable technological standard and a heavily researched field. Sensors are being used almost everywhere in the present time, from everyday products to industrial monitoring systems. The use of IoT and sensorbased intensive health care systems are increasing rapidly [1]. Air is an important element in everyday life. Therefore, air must have quality so that it does not have a negative impact on the body air is divided into two, namely outdoor air and indoor air. In addition to oxygen, there are a lot of elements in the air such as carbon dioxide, microbes, and other substances. That is why it is important to know the condition of the air where we are, especially indoors because indoor pollution is different from outdoor air pollution [2].

Storage is one of the important things that play a role in maintaining product quality. Incompatibility with procedures or storage conditions can result in the ineffectiveness of the drug and even cause damage to the drug which can be detrimental to someone who will consume the drug. The temperature and humidity in the room are the variables that affect the performance of an indoor network [3]. Many factors affect the quality of an ingredient or medicine stored. One of the elements that affect storage conditions is temperature [4].

This wireless internet access smart medicine box allows patients to get daily health care and to establish easy contact without physically meeting between doctor and patient. The recommended medicine box allows the patient to take the correct medicine at the right time, along with an email to help the patient take the medicine [5]. drug storage is exposed to heat and cold causing the drug to change physically, then the drug has the potential to lose its efficacy or even threaten the health of those who use it [6]. The easiest thing to determine whether a room is healthy or not is to know the humidity level of the room. Therefore, a tool is needed to measure the humidity value of the room in real-time to improve the humidity conditions in the room. The solution to this problem can be overcome using Internet of Things technology, which is a monitoring system used to monitor and control various environmental parameters in the data center, one of which is temperature and humidity [7].

In previous research on IoT-based drug storage, there was a need to further emphasize medical applications. This includes monitoring drugs that are sensitive to temperature and humidity, such as vaccines or drugs that require special storage [8]. In the context of drug storage, further research is needed on how variations in temperature and humidity can affect the quality of stored medicines. Research may cover parameters of drug quality, such as chemical stability, therapeutic potency, or physical integrity [9]. Therefore, this study renews the contribution of previous research by presenting several significant updates. This research attempts to integrate an IoT-based temperature and humidity monitoring system with an alarm and notification system that can provide warnings automatically if the temperature or humidity is outside a safe range [10]. In addition, this study also provides real-time monitoring updates and explores the use of sensors specifically designed to monitor temperature and humidity in drug storage. [11]. Explain between the MIT App Inventor platform and blynk. How this research uses MIT App Inventor to develop a user interface and connect it to the Blynk platform [12].

This research aims to fill this tension by developing an IoT-based temperature and humidity monitoring system for drug storage rooms that can be integrated with MIT App Inventor and Blynk. This can include developing efficient methods of communication between platforms and hardware as well as using application interfaces. In addition, it is also necessary to consider aspects of reliability, such as tolerance for device or network failures, so that monitoring continues to run well and the data collected is reliable [13]. It is also important for health workers, medical personnel, or individuals to have easy and intuitive access to storage room temperature and humidity data available on the mobile application [14]. Thus, we hope that this research can make an important contribution to increasing the use of IoT in monitoring the temperature and humidity of drug storage rooms in a way that is more integrated and easy to use [15]. With this tool, the drug storage room can be observed in real time, even from a distance.

RESEARCH METHOD

This study uses a method consisting of several steps, namely:

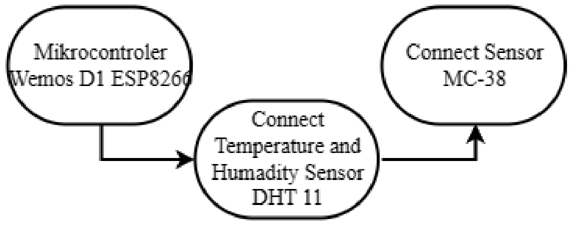

Figure 1. indicates the steps of the hardware preparation method.

The WeMos D1 ESP8266 microcontroller was chosen as the hardware platform. This microcontroller has the ability to connect to a WiFi network, thus enabling wireless data transmission. The WeMos D1 ESP8266 has a relatively small size, low power consumption, and is flexible enough to be integrated with other components. Furthermore, DHT11 temperature and humidity sensors are installed on the microcontroller. This sensor has the ability to measure indoor temperature and humidity. The DHT11 provides accurate readings with a degree of accuracy sufficient for temperature and humidity monitoring applications.

In addition, the MC-38 door sensor is also installed on the microcontroller. This door sensor functions to detect the status of the drug storage room door, whether the door is open or closed. This door sensor is useful for monitoring the presence of drugs and ensuring that the room door is not opened without a valid reason.

Network Configuration and WiFi Connection

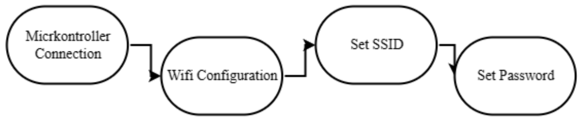

Figure 2. Indicates the steps of the network configuration and wifi connection methods.

After connecting to a WiFi network, the microcontroller will use the appropriate WiFi protocol to transmit and receive data over a wireless connection. This protocol ensures that the data sent is safe and protected during the transmission process. In addition, at this stage, additional configurations can also be made, such as setting a static IP address or using special protocols such as MQTT (Message Queuing Telemetry Transport) to send data to the relevant server or cloud service.

With the right network configuration and WiFi connection, the WeMos D1 ESP8266 microcontroller can connect to an existing WiFi network and is ready to transmit temperature, humidity, and door status data to the server or platform used in this study, thus enabling monitoring of storage room temperature and humidity. medicine wirelessly via IoT technology.

Temperature and Humidity Measurement

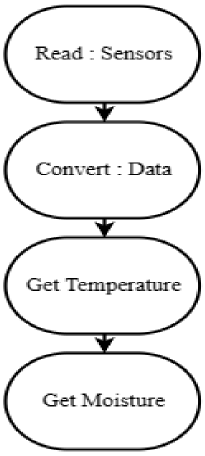

Figure 3. Indicates the steps of the temperature and humidity measurement method.

To take measurements, the microcontroller sends a signal to the DHT11 sensor to start the process of reading the temperature and humidity. The sensor will respond by providing the appropriate reading value. The temperature and humidity data obtained from the sensor can then be used for further monitoring and analysis. This data will be the basis for determining whether the drug storage room conditions are within a safe range or not.

Door Status Detection

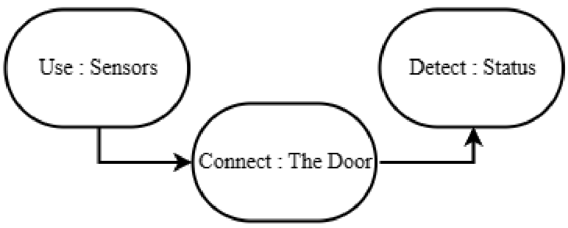

Figure 4. Indicates the steps of the door status detection method.

The MC-38 door sensor is connected to the WeMos D1 ESP8266 microcontroller, and through the connection that was made in the previous stage, the microcontroller can receive signals from the door sensor. The MC-38 door sensor works on the principle of opening and closing contacts. When the room door is open, the contacts on the door sensor separate, and when the door is closed, the contacts touch. The microcontroller will read the contact status from the door sensor to determine whether the door is open or closed. By detecting changes in contact status, the microcontroller can determine whether the room door is being opened or closed.

By using the MC-38 door sensor at this stage, this research can complement the monitoring system with the ability to detect and track the status of the drug storage room door in real-time.

Connection to Server and Data Delivery

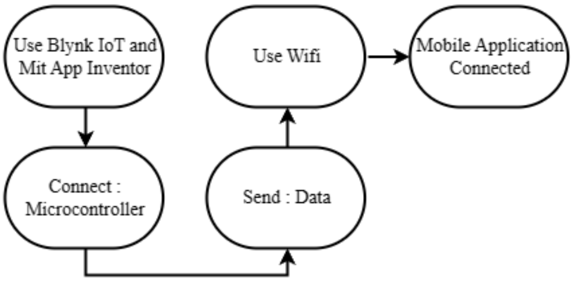

Figure 5. Indicates the steps of the connection to the server and data delivery method.

First, to create a connection between the microcontroller and the server, the Blynk IoT framework is used. Blynk IoT is an IoT platform that allows users to control and monitor IoT devices via a mobile application. In the context of this research, Blynk IoT is used to connect the WeMos D1 ESP8266 microcontroller with the server. Furthermore, using MIT App Inventor, an easy-to-use visual application development platform, a mobile application that is connected to Blynk IoT is created. This application allows users to view and monitor temperature, humidity, and drug storage room door status data in real-time.

Temperature, humidity, and door status data are sent in the form of data packets via a WiFi connection. The communication protocol used will ensure data security and integrity during the transmission process.After the data is sent to the server, the mobile application connected via Blynk IoT will receive and display the data. Users can see the actual temperature and humidity

values as well as the status of the drug storage room door through the mobile application.
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RESULTS AND DISCUSSION

Network Scheme

The circuit that covers all the interconnected components in the system is made using the Fritzing application.

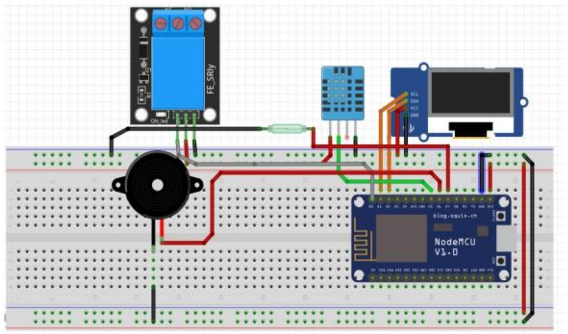

Figure 6. Indicates a schematic of a series of drug storage rooms..

Figure 6 is a schematic circuit on the NodeMCU ESP8266 connected to the DHT11 sensor, which functions as an input for temperature and humidity measurement values, and the MC38 sensor, which functions as an input for detecting open and closed doors. The buzzer functions as an output, which gives a warning with sound; the relay functions as an output for controlling the peltier; and the OLED functions to display sensor measurement values and peltier, buzzer, and door conditions.

The results of this study indicate that in the schematic series on the NodeMCU ESP8266, there are several components that have specific functions to run a temperature and humidity monitoring system for drug storage rooms. The DHT11 sensor is connected to the NodeMCU ESP8266 as an input to measure room temperature and humidity. This sensor plays an important role in collecting the measurement data needed to monitor the condition of the drug storage room. Apart from that, the MC38 sensor is also connected to the NodeMCU ESP8266 as an input to detect the status of the room door. This allows the system to know if the room door is open or closed. This information is very important for maintaining stability and humidity in the drug storage room.

In terms of output, there are several components that play a role in providing information and control. The buzzer, as an output, is used to give a sound warning if there is a condition that requires attention, for example, if the room temperature exceeds a certain limit. The relay functions as an output to control the peltier. A peltier is a device that can produce cooling or heating depending on the applied current. In this system, the relay is used to control the peltier in order to maintain the room temperature within the desired range. The OLED screen functions to display important information such as temperature and humidity sensor measurement values, Peltier conditions, buzzer status, and door status. With an OLED screen, users or supervisors can easily monitor temperature and humidity conditions as well as door status directly. Through this schematic, this study provides a clear understanding of how these components are interconnected and work together to achieve system goals. This allows for effective monitoring and control of temperature, humidity, and drug storage room door conditions.

Test the program code to connect to the Blyink web dashboard. This program uses the Arduino Ide application, which aims to connect to the Blynk web dashboard. Implementation is carried out by connecting all devices that have been prepared and connected so that it becomes a monitoring system in real time and can be monitored in the Blynk application on an Android smartphone. Later, the monitoring system is used to control temperature and humidity in the drug storage room.

The results of this study indicate that a program code test was carried out to connect the monitoring system to the Blynk web dashboard. This program uses the Arduino IDE application as a platform development program that aims to connect to the Blynk web dashboard. Through this implementation, all devices that have been prepared and connected can form a real-time monitoring system. This allows direct monitoring of the temperature and humidity of the drug storage room through the Blynk application installed on an Android smartphone.

At this stage, research focuses on developing and testing program code that connects hardware devices (such as the NodeMCU ESP8266, DHT11 sensors, MC38 door sensors, and outputs such as doorbells, relays, and OLED displays) with the Blynk web dashboard. The program code aims to ensure that temperature and humidity measurement data obtained from sensors can be sent and displayed accurately on the Blynk application. By connecting the monitoring system to the Blynk web dashboard, users or supervisors can monitor the temperature and humidity conditions of the drug storage room in real-time. They can view actual data measurements and control the system, such as changing temperature limits or activating the

Peltier control feature, through the Blynk application installed on an Android smartphone.

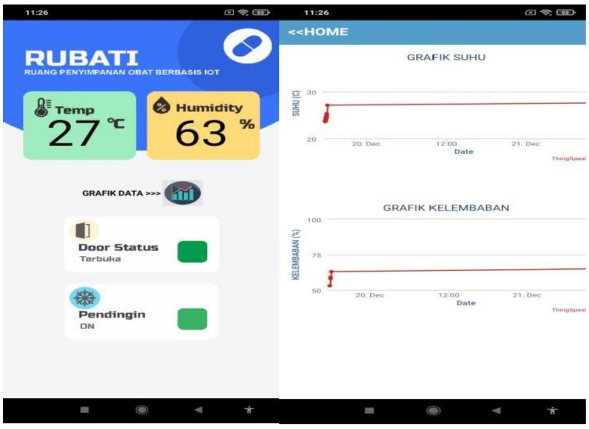

Figure 7. Indicates blynk web dashboard display.

The picture above shows that the WeMos D1 ESP8266 WiFi microcontroller can be connected to the Blynk application via the internet network. After doing the programming, open the web dashboard on Blynk. The Web Dashboard is used to create widgets on the website display. Widgets usually contain things related to controlling and monitoring. The web dashboard display used in this experiment displays temperature, humidity, and indicators on the Peltier, LED, and MC38, which were previously programmed on Arduino Ide. After creating a web dashboard display and connecting it to the Blynk application on the smartphone, To connect here, it is necessary to connect the IoT device to the Blynk web dashboard using the authentication token provided by Blynk. Then, users can access the IoT project that is being worked on on the Blynk smartphone application using the same authentication token. Once connected, the web dashboard view will appear online. At Blynk, you can view data sent by IoT devices, control IoT devices, and perform other interactions with ongoing IoT projects. Thus, the Blynk web dashboard and the Blynk smartphone application are connected to each other.

In this experiment, the web dashboard displays information on temperature, humidity, and indicators on devices such as Peltier, LEDs, and the MC38 door sensor, which had previously been programmed using the Arduino IDE. In order to connect an IoT device to the Blynk web dashboard, it is necessary to use the authentication token provided by Blynk. Furthermore, users can access IoT projects that are being worked on through the Blynk application on smartphones using the same authentication token. Once connected, the web dashboard view will be online. Through the Blynk application, users can view data sent by IoT devices, control IoT devices, and perform other interactions with ongoing IoT projects. With the connection between the Blynk web dashboard and the Blynk smartphone application, users can monitor and control the system in real-time. They can view temperature and humidity data as well as manipulate devices such as changing Peltier states or turning LEDs on and off. This enables the user to effectively manage the temperature and humidity monitoring system and take necessary actions based on the data obtained.

Creates a Mit App Inventor application view

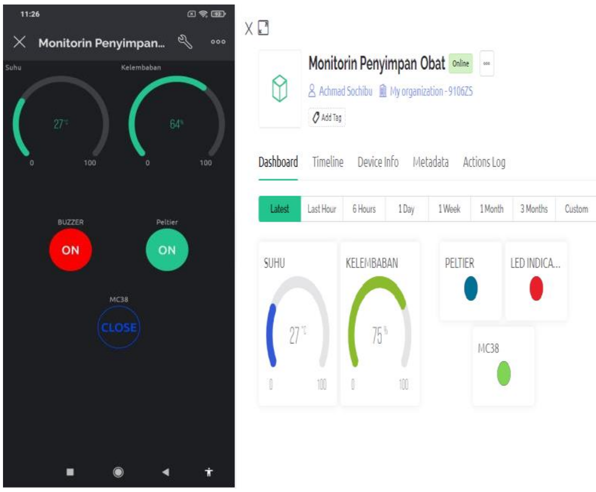

Figure 8. Indicates the view of the Mit App Inventor application.

Display on the Mit App Inventor application. After experimenting with the Blynk application, then create an interface on the Inventor Mit App. Apart from Blynk, it can also be monitored through the MIT APP Inventor application so that the appearance can be designed according to creations that display temperature, peltier, temperature graphs, and humidity graphs. The picture above explains the MIT APP Inventor Temperature and Humidity Value of 63% and a temperature value of 27 ^{O}C, then also displays an indicator on the door when it is open and the peltier is on, which indicates the indicator light is green. Then it also displays a graph of temperature and humidity that shows the amount of output produced.

In the MIT App Inventor application, the view created can display various elements such as temperature, peltier, and temperature and humidity graphs. In figure 9, it can be seen that the MIT App Inventor application displays temperature and humidity values of 63% and 27°

C, respectively. In addition, this application also displays an indicator on the door when it is opened and the peltier is on, indicated by a green indicator light. In addition, the MIT App Inventor application also displays temperature and humidity graphs, which provide information about the amount of output produced by the system. This graph allows the user to see trends in temperature and humidity changes over time. By using the MIT App Inventor application, users can have a more personalized look and customize their designs according to their needs and preferences. This allows users to monitor and analyze temperature and humidity data more intuitively through the provided graphical display.

Figure 9. Indicates an OLED LCD screen in the medicine storage room.

The OLED LCD display on the device displays the MIT APP Inventor Temperature and Humidity Value of 62% and a temperature value of 23 ^{O}C, as well as the condition of the Peltier indicator in the off condition where the temperature is below 25 ^{O}C and the condition of the door being closed

The OLED LCD display also displays the condition of the Peltier indicator. In this case, the Peltier indicator is off, indicating that the temperature is below 25°C. This indicator provides the user with visual information regarding Peltier status and the current temperature. The OLED LCD display also provides information regarding the condition of the door. In this example, it says that the door is closed. This gives the user the understanding that the door to the drug storage room has been properly closed. The OLED LCD display on the device plays an important role in providing visual information to the user regarding temperature and humidity values, Peltier conditions, and door status. This information helps users meet and understand the condition of the drug storage room in real time.

Figure 10. Indicates view on Mit app inventor from the next try

Table 1. Indicates a comparison of testing tools

Experiment 1		**Experiment 2**	
Display	**Information**	**Display**	**Information**
Temperature	63%	Temperature	63%
Moisture	27 ^{O}C	Moisture	23 ^{O}C
Door	Red	Door	Green
Cooling	Red	Cooling	Green

The display on the mit app inventor from the next experiment displays the MIT APP Inventor temperature and humidity value of 63% and a temperature value of 23^{O}C, then also displays an indicator on the door when it is closed and the peltier is on, which indicates the indicator light is red.

In the results of this study, the display on the MIT App Inventor application shows some important information. First, the temperature and humidity values measured using the sensor are displayed as 63% for humidity and 23^{O}C for temperature. This provides an overview of the temperature and humidity conditions in the drug storage room. In addition, the MIT App Inventor application display also displays an indicator on the door when the door is closed, as well as the peltier status, which indicates that the peltier is on. The door indicator indicating that the door is closed provides information about the state of the drug storage room, which is secure and locked. In addition, the peltier status, which indicates that the peltier is on, indicates that the temperature in the drug storage room may be higher than the desired limit. This may indicate that it is necessary to take appropriate temperature control measures to maintain optimal temperature conditions for stored medicines. Overall, the views on the MIT App Inventor application provide useful information about temperature, humidity, door status, and Peltier conditions in drug storage room monitoring systems. This allows users to monitor and take necessary actions to maintain optimal drug storage conditions.

This research has several advantages that distinguish it from previous studies. First, this research specifically focuses on monitoring the temperature and humidity of drug storage rooms, not just drug storage in general. Second, by applying Internet of Things (IoT) technology, this research is able to provide accurate, real-time monitoring and better data integration. Third, research contributes to improving the safety and quality of drugs by maintaining proper temperature and humidity in storage rooms and avoiding physical or chemical damage to drugs that could threaten their effectiveness. Lastly, this research has greater implications for clinical practice and medication management, aiding better decision-making in maintaining drug quality and effectiveness and improving overall patient safety.

CONCLUSION

It can be concluded that in this study, researchers used the WeMos D1 ESP8266 microcontroller, which is equipped with WiFi, to connect to the Buzzer internet network. With the addition of the DHT11 sensor, the tool is able to measure the temperature and humidity of the drug storage room, while the MC-38 door sensor is used to detect the presence of the room door. Temperature and humidity measurement data are sent to the Blynk IoT and MIT servers using the Inventor application.

In this study, the displayed temperature and humidity values were 60% and 28°C, and this information can be seen on the OLED screen, Blynk Web Dashboard, Blynk Mobile Dashboard, and MIT APP Inventor. In addition, the door sensor shows a closed state when the door is closed and an open state when the door is opened. The buzzer will sound if the temperature exceeds 25°C, and the Peltier will function when the temperature is above 25°C and turn off when the door is opened. However, the drawback of this research is that Peltier did not work as expected

By using this configuration, researchers have successfully implemented a system that can monitor temperature, humidity, and the state of the drug storage room door in real-time. However, the deficiencies identified indicate that there is room for further improvement in the use of Peltier technology in such systems. The main contribution of this research is to create solutions that can improve monitoring and control of drug storage conditions. By using IoT technology, this system can provide accurate and continuous monitoring as well as real-time information to pharmacy managers to take the necessary actions.

The limitation of this research is the Peltier performance, which may not be optimal. Problems that prevent Peltier from achieving the expected performance need to be identified and corrected. It may require further testing, better component selection, or even exploration of alternative cooling technologies to improve system performance. Suggestions for further research are Evaluate and improve Peltier's performance: Conduct further research to identify and fix issues that prevent Peltier from performing as expected. Further testing, a better selection of components, or perhaps the use of alternative cooling technologies can be useful steps in improving system performance.

REFERENCES

[1] F. Akbar and S. , "IMPLEMENTASI SISTEM MONITORING SUHU DAN KELEMBAPAN RUANGAN PENYIMPANAN OBAT BERBASIS INTERNET OF THINGS (IoT) DI PUSKESMAS KECAMATAN TAMAN SARI JAKARTA BARAT," *Jurnal Sosial dan Teknologi (SOSTECH),* vol. I, no. 9, pp. 1021-1028, 2021.

[2] I. Karlida and I. Musfiroh, "SUHU PENYIMPANAN BAHAN BAKU DAN PRODUK FARMASI DI GUDANG INDUSTRI FARMASI," *Farmaka,* vol. XV, no. 4, pp. 58-67, 2017.

[3] K. Prawiroredjo and A. . A. M. Khalifa, "MODEL SISTEM PENGENDALIAN SUHU DAN KELEMBABAN RUANGAN PRODUKSI OBAT BERBASIS NODEMCU ESP32," *Jurnal Teknik Elektro, Teknologi Informasi dan Komputer,* vol. VI, no. 1, pp. 13-25, 2021.

[4] S. . H. Sasono, A. . S. Nugroho, E. Supriyanto, . E. Wasito and A. Hasan, "IoT Smart Health for Monitoring and Control of Temperature and Humidity of Vaccine and Drug Storage based on Android at Health Center," *JAICT, Journal of Applied*

Information and Communication Technologies, vol. VII, no. 2, pp. 119-124, 2022.

[5] I. Syukhron, R. Rahmadewi, S.T.,M.T and I. S. , "Penggunaan Aplikasi Blynk Untuk Monitoring dan Kontrol Jarak Jauh pada Sistem Kompos Pintar Berbasis IoT," *ELECTRICIAN – Jurnal Rekayasa dan Teknologi Elektro,* vol. XV, no. 1, pp. 1-11, 2021.

[6] R. Ashikur, M. I. Md., R. I. Md., S. S. Muhammad and N. Sheikh, "Developing IoT Based Smart Health Monitoring Systems: A Review," *International Information and Engineering Technology Association,* vol. XXXIII, no. 6, pp. 435-440, 2019.

[7] B. M. Pampapathi, M. Chandana, K. Supritha, M. Pooja and K. Supriya, "Survey on IOT Based Medical Box for Elderly People," *International Journal of Advanced Trends in Computer Science and Engineering,* vol. X, no. 3, pp. 1867-1871, 2021.

[8] H. S. Sindung, K. Sri, S. Eko and D. P. Intan, "Sensor Data Analysis On Monitoring And Control System Of Temperature And Humidity Based On Android In Soybean Seed Storage Room Using Nodemcu," *JAICT, Journal of Applied Information and Communication Technologies,* vol. III, no. 1, pp. 1-8, 2018.

[9] R. and A. Muhammad, "The effect of temperature and humidity of storage on maize seed quality," *IOP Conf. Series: Earth and Environmental Science,* pp. 1-6, 2020.

[10] J. Royam and K. G. Suresh, "Monitoring and Control of COVID Vaccine Storage Temperature Using IoT and Machine Learning," *IEEE International Students' Conference on Electrical, Electronics and Computer Science,* 2022.

[11] A. P. . U. Moechammad , A. Abdul, Winarno and H. Bambang, "Server Room Temperature & Humidity Monitoring Based on Internet of Thing (IoT)," *Journal of Physics: Conference Series,* pp. 1-8, 2019.

[12] S. Peerasak, N. Nuttapun and N. Nitigan, "Smart Farm Monitoring via the Blynk IoT Platform : Case Study: Humidity Monitoring and Data Recording," *International Conference on ICT and Knowledge Engineering (ICT&KE),* 2018.

[13] K. R. N. F. N. K. M. K. P. M. R. Gupta, " IoT Based Automation and Solution for Medical Drug Storage: Smart Drug Store," *International Conference on Computing, Communication, and Intelligent Systems (ICCCIS),* vol. X, no. 2, pp. 358 - 362, 2019.

[14] P. L. M. W. A. P. &. A. A. Negara, "Design and Implementation of IoT-Based Monitoring System for Temperature and Humidity in Cold Storage Room," *International Journal of Information Technology and Electrical Engineering,* vol. IX, no. 5, pp. 358-363, 2020.

[15] S. M. a. S. S. A. Ray, "An Internet of Things (IoT)-Based Framework for Smart Healthcare System Using Fog Computing," *IEEE Internet of Things Journal,* vol. VII, no. 11, 2020.