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# Development of an Aquabalance Android Application for Real-Time Monitoring of Water Temperature and pH in Greenhouses

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## ABSTRACT

The rapid development of technology has significantly impacted the agricultural sector, particularly in optimising farming activities in restricted spaces like greenhouses. Monitoring environmental parameters such as water temperature and pH is crucial for successful plant cultivation. This research aims to develop an Android application, Aquabalance, for real-time monitoring of water temperature and pH levels in a greenhouse to improve efficiency and minimise the need for manual monitoring. The system integrates Arduino UNO, ESP8266, DHT22 temperature sensor, and a water pH sensor, achieving accuracy levels of ±0.5°C for temperature and ±0.1 pH for water. The development process utilised the Scrum method, ensuring flexibility and user-centric design. Testing was conducted with two participants—a farmer and a researcher—who assessed key functionalities such as registration, login, and data retrieval. The Android application performed with a 95% success rate, with an average response time of 2–3 seconds for real-time data display. User satisfaction was evaluated on a 1-5 scale, with an average score of 4.7 for usability, navigation, and performance. The results indicate that Aquabalance effectively facilitates greenhouse monitoring, providing real-time, remote access to essential environmental data, ultimately enhancing greenhouse management and reducing time spent on manual monitoring tasks.



## 1. Introduction

The agricultural sector is presently experiencing rapid technological advancements. Technology is accessible in the agricultural sector, from pre-harvest activities to products ready for market. Currently, agricultural activities occur in various locations, including urban areas, narrow land, and large fields. This activity is designed to address the sustenance requirements of urban areas. This technological innovation enhances plant productivity in urban or restricted spaces. Implementing technology is one of the endeavours to enhance the productivity of plants cultivated on a narrow land. (Irawan *et al*., 2021).

Plant cultivation on narrow land can be done optimally in a greenhouse. In the greenhouse environment, parameters for plant cultivation, such as temperature, humidity, water pH, and nutrient supply to plants, can be regulated (Tando, 2019). Greenhouse aims to modify environmental conditions on several parameters, such as temperature, humidity, and water pH, to suit plant growth conditions. Thus, plant production in the greenhouse can be optimized (Sujadi & Nurhidayat, 2019).

At present, the majority of greenhouse environmental monitoring is conducted manually. Environmental parameters within the greenhouse are assessed with manual measurement devices. Manual monitoring possesses numerous disadvantages, notably the inability to conduct real-time observation (Suakanto *et al*., 2024). If the greenhouse is extensive, monitoring using conventional methods will become progressively challenging. This condition requires numerous personnel and an extended observation period (Sawidin *et al*., 2016). In addition, farmers are still required to carry out cultivation activities, including irrigation, maintenance, and fertilization, which demand significant time investment (Astuti *et al*., 2024). Consequently, technology is essential for monitoring environmental conditions in greenhouses to guarantee their suitability for plant growth (Ramadhan *et al*., 2021).

Recent technology advancements enable remote and real-time monitoring with an Android application. The Android monitoring system tracks the temperature and pH levels of the greenhouse water. This monitoring solution is readily accessible from any location using an Android mobile. This application delivers considerable precision and real-time measurements from temperature and pH sensors (Prawitha *et al*., 2022). This technology's development constitutes an application of Internet of Things technology, which is a notion that links an object through an Internet network to enable real-time communication activities (Fibriani *et al*., 2020). Numerous studies have demonstrated that IoT enhances vegetable growing in greenhouses. Research indicates that IoT can effectively monitor in real-time, optimizing vegetable cultivation processes in greenhouses (Kurniawan *et al*., 2021) (Suakanto *et al*., 2024) (Bahariawansyah *et al*., 2019).

The development of Android applications for greenhouse monitoring has significant potential in Indonesia. This is supported by the large number of smartphone users in Indonesia, making application development easy (Cindy Permatasari *et al*., 2023). Developing Android applications for greenhouse monitoring offers high-quality weather forecasting. Applications facilitate data access anywhere without additional devices such as computers or other devices. Furthermore, applications do not require a stable signal to transmit real-time data. Data transmission to the server can be carried out 24 hours a day without loading the Android device. However, many Android applications are still challenging to use. This is due to several factors, including complex designs, excessive features, and a lack of user guidance. Therefore, easy-to-use applications are needed, especially for greenhouse monitoring activities (Saputra & Thamrin, 2025).

This research activity was conducted in a greenhouse in Pagak Village, Beji District, Pasuruan Regency. Pasuruan Regency possesses a strategic position that facilitates the economic advancement of East Java. Pasuruan Regency is on a major highway connecting various towns and regencies, including Surabaya, Malang, Sidoarjo, Jember, and Banyuwangi. Pasuruan Regency's strategic location designates it as a prominent industrial hub in East Java, hosting various industries, from small to medium to large-scale enterprises (Ernawati & Kusuma, 2021). The dry season in Pasuruan Regency necessitates a sufficient supply of vegetables. This condition presents opportunities for establishing agricultural businesses in urban areas through hydroponics. This method offers several advantages, such as enhanced water efficiency, and can be implemented on relatively narrow land while maintaining a satisfactory level of vegetable productivity (Prastio *et al*., 2023).

The developed application is called aquabalance. This application is accessible on all Android-based mobile devices. This application employs water temperature and pH sensors to acquire measurements of ambient conditions within the greenhouse. Variations in pH and temperature significantly influence the growth of vegetables, particularly those cultivated hydroponically (Karim *et al*., 2021) (Riis *et al*., 2012). Consequently, real-time measurements are a critical component of the control system to be designed. The reading results are recorded on the micro-controller and subsequently transmitted to the web server for storage in the server database. The reading results are transmitted over the server to the Android application for real-time access. Several research has been undertaken concerning greenhouse monitoring with Android applications. The study's results indicate that the program can monitor greenhouse conditions in real-time, including temperature, humidity, and pH levels (Ramadhan *et al*., 2021) (Sujadi & Nurhidayat, 2019) (Putra & Faiza, 2022). Nevertheless, research concerning measurements in extensive greenhouse settings has been limited. This study will be carried out in a greenhouse measuring 6 x 12 meters. It aims to develop an Android-based application for monitoring water temperature and pH in a greenhouse. This program aims to enable users to monitor operations to ensure that greenhouse environmental conditions align with optimal plant development conditions. Furthermore, this application allows farmers to minimise greenhouse visits, saving time and costs. This research is expected to contribute to developing hydroponic farming in greenhouses.

## 2. Methodology

The research methodology for this study focuses on developing an Android-based application for real-time monitoring of water temperature and pH levels in a greenhouse. The method follows a systematic and iterative development process, employing an agile methodology (specifically the Scrum method) for the application development phase. The process is broken down into distinct phases to ensure comprehensive analysis, design, implementation, testing, and evaluation.

### 2.1 Needs Analysis

This application is designed to monitor and regulate water temperature and pH levels in a greenhouse environment in real-time using an Android device. The system is composed of both hardware and software components. On the software side, it uses Android Studio for application development, Arduino IDE for microcontroller programming, Fritzing for circuit design, and Adobe Photoshop for creating visual assets. The hardware components consist of an Arduino UNO, an ESP8266 Wi-Fi module, a DHT22 sensor for temperature and humidity, and a water pH sensor for monitoring the pH levels of the water.
The application undergoes testing by two respondents: a farmer and a researcher. Both testers ensure that the system functions correctly under real-world conditions. The testing method involves users interacting with the application and assessing its performance on a scale from 1 (very low) to 5 (very high), based on factors such as ease of use, reliability, and accuracy of sensor readings.

### 2.2 Application Development Method

The development method employed for this project is the Scrum methodology, a widely adopted Agile framework that emphasizes iterative progress through collaboration and flexibility. This approach ensures that the application can adapt to the user's evolving needs during its development process (Pratiwi & Sari, 2024). The key steps in the Scrum process for this application are:

- Needs Analysis: Identifying the functional requirements of the application, such as real-time monitoring of water temperature and pH.
- System Design: Designing the architecture of the application, including both the back-end and front-end components.
- Implementation: Developing the software and integrating the hardware with the mobile interface.
- Maintenance: Ongoing improvements and updates based on user feedback.

The Scrum methodology is particularly well-suited for this project, allowing flexibility and quick adjustments. This method is frequently used in applications requiring continuous updates and rapid adaptation, especially when new features or changes are expected during development. Based on several studies and literature studies that have been conducted, 61.76% of application development is carried out using the Scrum method. This method has high flexibility in dealing with changes that occur during application development in a short time. The application aims to monitor water temperature and pH in real time in a greenhouse. The application is designed using two components: the back-end and front-end. The back-end stores data on water temperature and pH measurements in real time. Meanwhile, the front-end is a UI display designed to be easy for farmers to use in monitoring water temperature and pH in a greenhouse (Saputra & Thamrin, 2025).

### 3.3 Hardware and Software Technical Specifications

- Hardware Specifications

| **Component** | **Specification** |
|---|---|
| Arduino UNO | Microcontroller, Atmega328P chip, 14 digital I/O pins, 6 analog inputs, USB connection |
| ESP8266 | Wi-Fi module, supports 802.11 b/g/n, 3.3V operating voltage |
| DHT22 | Temperature and humidity sensor, range: -40 to 80°C, accuracy: ±0.5°C |
| Water pH Sensor | Measures pH level in water, range: 0-14 pH, ±0.1 accuracy |

- Software Specifications

| **Software** | **Version** | **Purpose** |
|---|---|---|
| Android Studio | Latest version | IDE for Android application development |
| Arduino IDE | Latest version | For programming Arduino UNO |
| Fritzing | Latest version | For designing circuit diagrams |
| Adobe Photoshop | Latest version | For creating UI elements and visual designs |

### 3.4. Sensor Data Processing

The sensor data is processed through the following steps:

- Data Format: The temperature and humidity data from the DHT22 sensor are read as raw digital values, which are converted into Celsius (°C) and percentage (%). The pH sensor provides an analog voltage output converted into a pH value ranging from 0 to 14 using a specific calibration equation.

- Reading Frequency: The system reads data from the sensors every 2 seconds. This frequency ensures that the system captures real-time changes in temperature and pH.
- ESP8266 Communication Protocol: The ESP8266 module communicates with the Arduino UNO over a serial connection and sends data to a server through the MQTT protocol for real-time monitoring. The MQTT protocol is chosen because it is lightweight, making it ideal for IoT applications that require frequent data transmission.

3.5. Trial Details

To evaluate the performance of the system, a trial was conducted with two respondents: a farmer and a researcher. The farmer tested the application for its practical utility in daily operations, while the researcher focused on the technical accuracy and functionality of the system. Both testers were provided with the application and instructed to use it for a period of 2 weeks to monitor the water temperature and pH levels in a greenhouse. Trial Criteria:

- Respondents: 2 (1 farmer, 1 researcher)
- Criteria: The farmer is experienced in greenhouse management, while the researcher has expertise in sensor-based systems and IoT technologies.
- Test Duration: 2 weeks of real-time testing
- Evaluation: Respondents scored the application based on usability, accuracy of readings, and overall satisfaction using a scale from 1 to 5.

3.6 Block Diagram and System Design

The Block Diagram represents the overall architecture of the system, showing how different components interact and exchange data. The system consists of three primary stages: Input, Processing, and Output (Alda, 2023). Each of these stages corresponds to specific hardware and software components that work together to achieve the goal of real-time water temperature and pH monitoring.

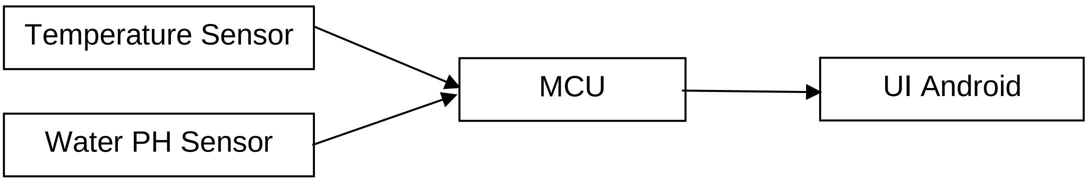



**Figure 1**. Block Diagram

- Temperature Sensor: The diagram indicates that there is a sensor dedicated to measuring the temperature. Typically, this could be a DHT22 or similar sensor used for detecting air temperature or water temperature in the greenhouse.
- Water pH Sensor: This component measures the pH levels of the water, which is crucial for monitoring the conditions of the water in which plants are growing. A typical water pH sensor could be an analog sensor that outputs a voltage corresponding to the pH level.
- MCU (Microcontroller Unit): The MCU, most likely an Arduino UNO or similar microcontroller, processes the data coming from both the Temperature Sensor and Water pH Sensor. The microcontroller takes analog or digital readings from the sensors, processes the information (such as converting analog signals to digital values), and handles the data communication to the next stage of the system.

- UI Android: The Android User Interface represents the mobile application where the user (such as a farmer or researcher) can monitor the real-time data coming from the sensors. The app communicates with the microcontroller through a server or directly (in the case of Wi-Fi modules like ESP8266), providing a visual representation of the temperature and pH levels.

The system design is based on a modular approach that separates the back-end (hardware and server) from the front-end (UI in the Android app).

- Back-End: Handles sensor data acquisition and storage on the cloud server. Sensors are connected to Arduino and send readings to the cloud server via the ESP8266.
- Front-End (Android App): Displays the data to the user. The app connects to the cloud server, retrieves the stored data, and presents it in an easy-to-read format.The interface includes real-time graphs and charts to show temperature and pH levels.

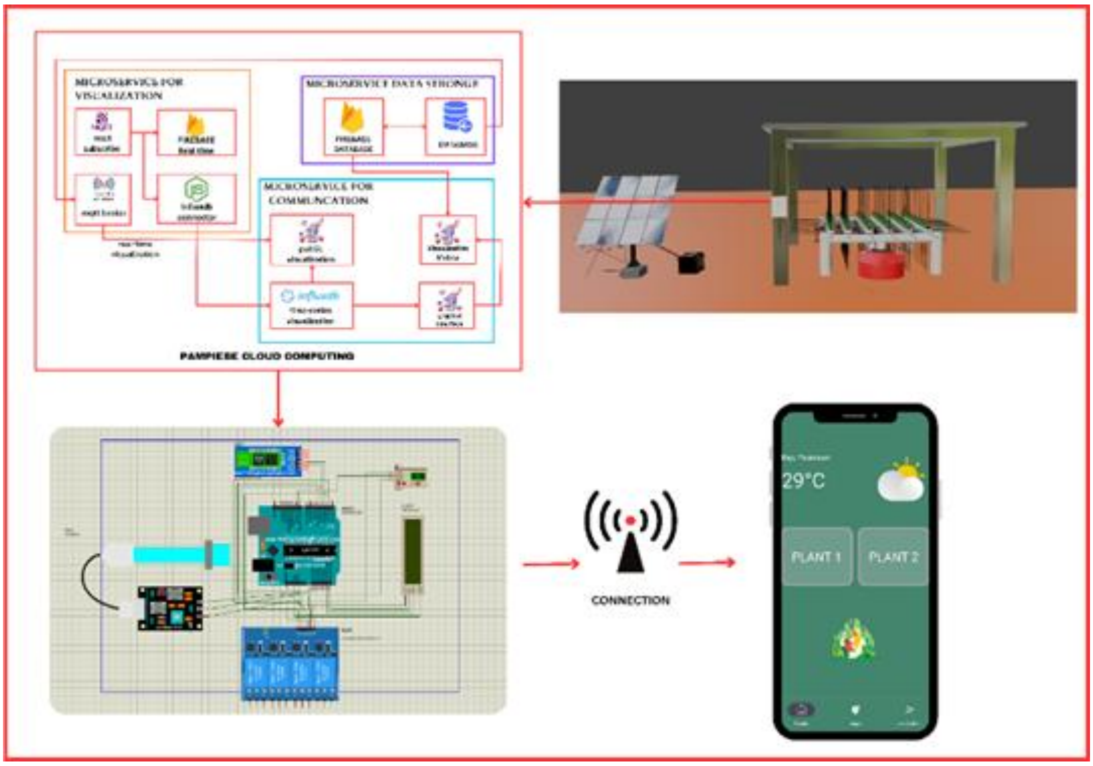



**Figure 2**. Application System Design

The flowchart outlines the step-by-step process involved in monitoring environmental conditions in a greenhouse, specifically focusing on measuring the water pH level and temperature. This process is part of an automated system that ensures accurate and real-time monitoring, crucial for maintaining optimal conditions for plant growth.

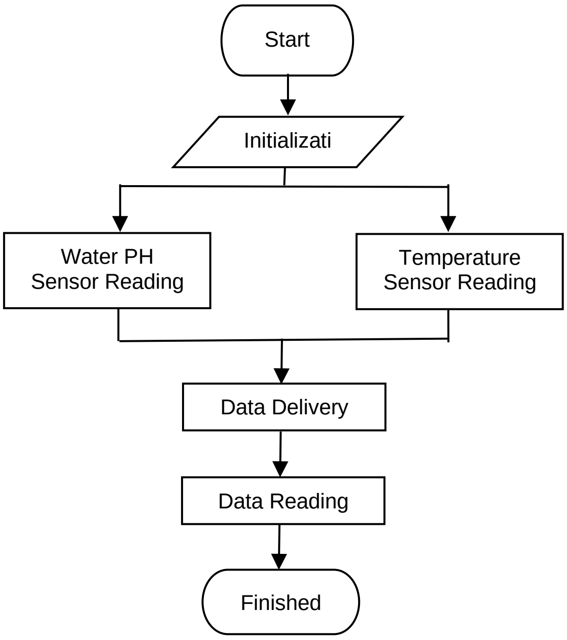



**Figure 3**. Flowchart System

This flowchart illustrates an efficient and systematic approach for real-time water pH and temperature monitoring in a greenhouse or similar environment. The initialisation stage of this system involves reading measurement data from the water's temperature and pH sensors. The reading results are then sent to the MCU (Microcontroller Unit), which consists of Arduino UNO and ESP8266. The reading data is then stored in the server database, which can be accessed in real-time using an Android mobile phone device. The process ensures that accurate data is continuously gathered, processed, and delivered, enabling users to maintain optimal conditions for plant health. Following this well-structured flow guarantees reliable performance and easy integration into automated environmental control systems.

## 3. Results and Discussion

### 3.1 User Interface Aquabalance Application

The Aquabalance program delivers data regarding a greenhouse's water temperature and pH levels. Users must register to utilise this application. After registering, users may access the dashboard menu by logging in. Within the dashboard menu, users can access the menus for plants 1 and 2 and the navigation menu. Figure 4 below illustrates the activity diagram of the Aquabalance application.

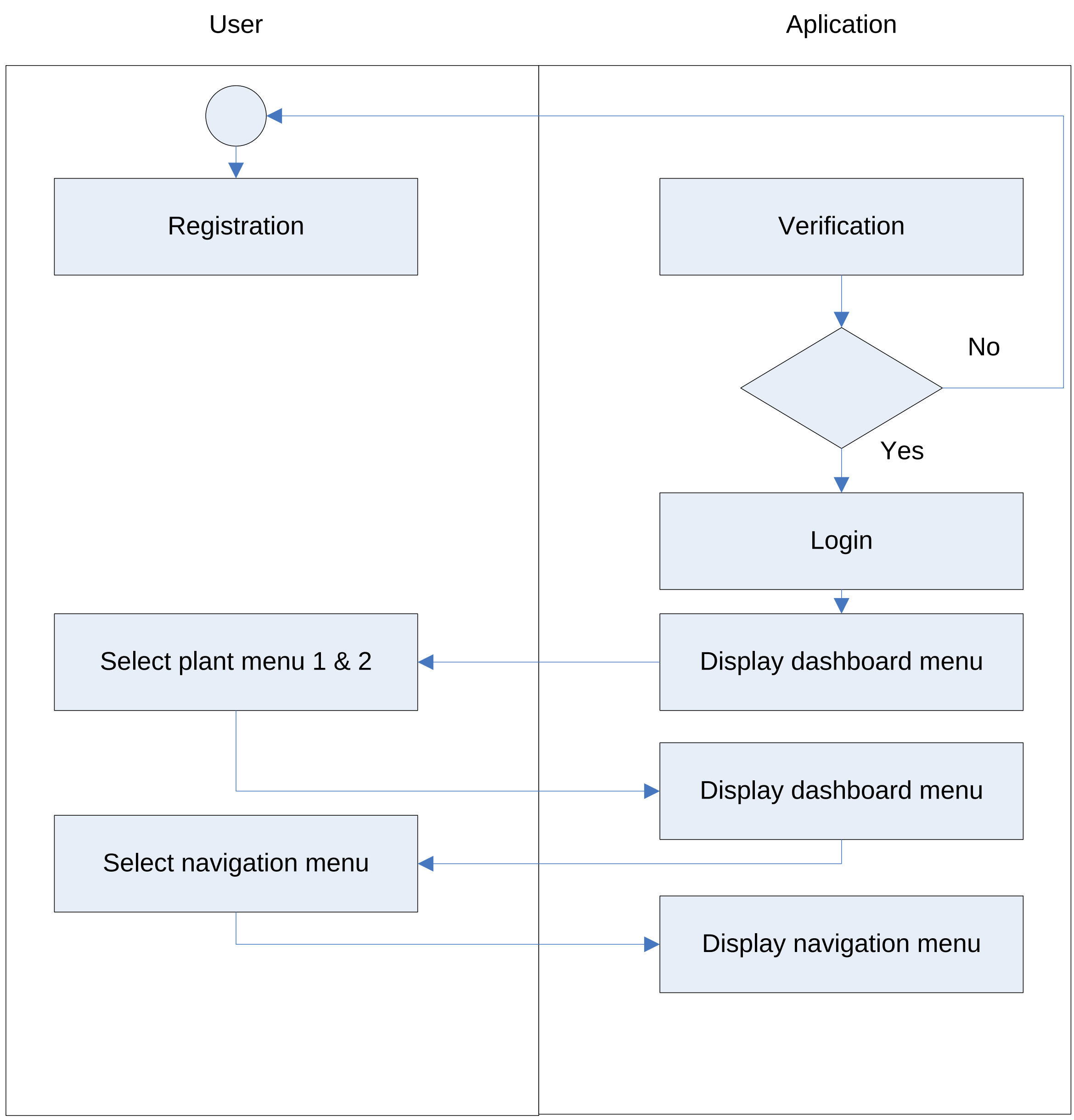
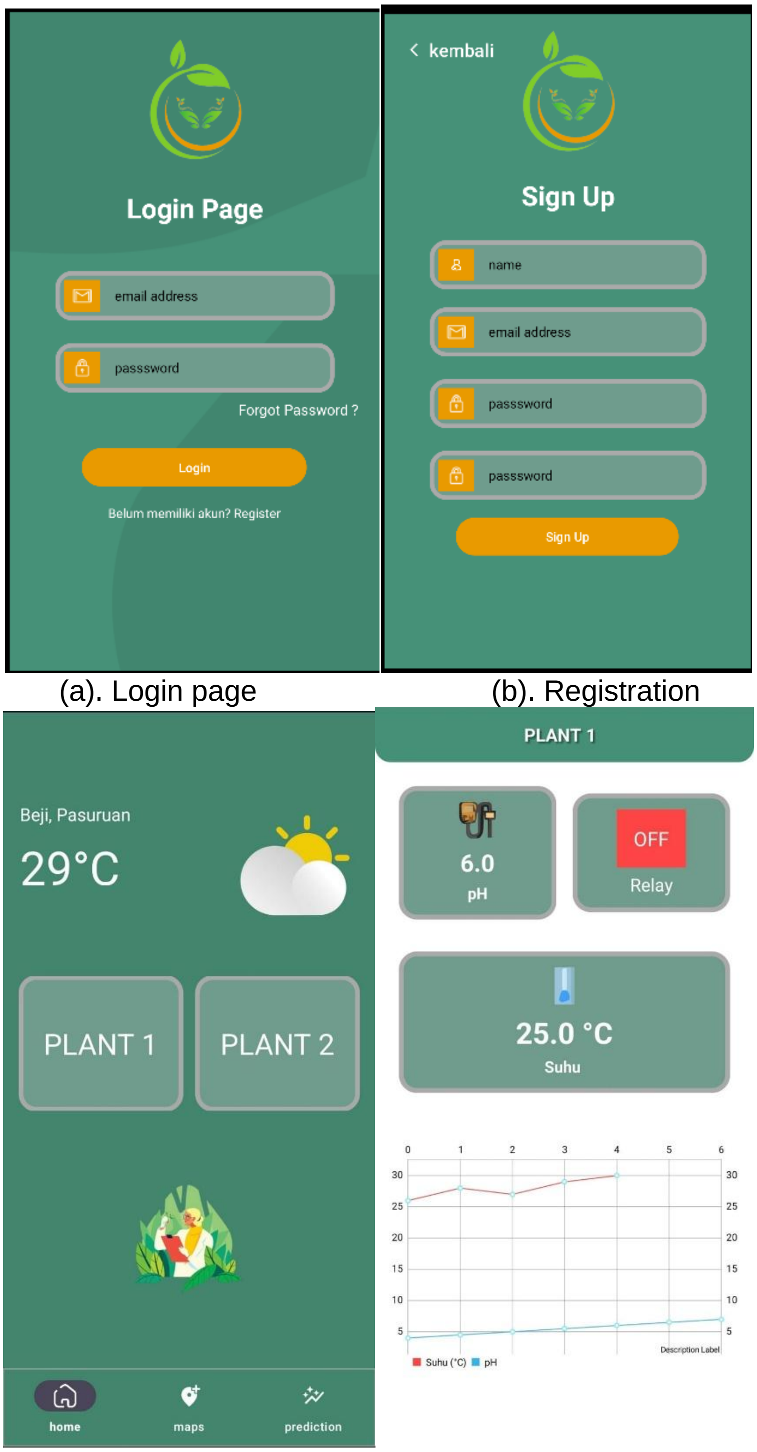



**Figure 4**. Aquabalance application activity diagram

The user interface is an implementation of an Android application for greenhouse monitoring. An effective user interface should facilitate user interaction with the application (Prawitha *et al*., 2022). Furthermore, an appealing design is crucial in developing a user interface (A. F. A. Lestari *et al*., 2022). The aquabalance application comprises multiple menus that enable users to oversee the greenhouse environment. These menus include login, registration, dashboard, and measurement outcomes. Figure 5 below illustrates the user interface of the aquabalance program




(a). Login page (b). Registration

(c). Dashboard (d). Measure

**Figure 5**. Aquabalance Application UI

On the login interface, the user inputs the username and password. Upon entering the login and password, validation will occur; if successful, the user will be redirected to the dashboard. An error message is displayed upon failure, and a retry is initiated. If the user lacks a username and password, they may register by clicking “Register”. Authentication and registration are essential prerequisites for utilizing the program. This stage facilitates the recording and identification of new and existing program users (Nur Holis Majid *et al*., 2023). Registration enhances the application's security by requiring users to create a unique username and a distinctive password (Marisa Khairina, 2011) (Pondeppa *et al*., 2024).

Upon completion of the login process, the application will lead to the dashboard menu. The dashboard menu presents essential information required for an application. The dashboard menu comprises various components that interconnect with one another (Prasetiya & Susilowati, 2016). The aquabalance application dashboard menu comprises many sub-menu components, including greenhouse environmental data, critical notifications, plant 1 and 2 buttons, and navigation options. User can get greenhouse environmental data in the Plant 1 & 2 menu, including water temperature and pH levels. This system can also issue notifications if parameters deviate from the optimal plant growth conditions.

The application measurements were conducted over a 24-hour period, with data sent in real time. Measurements were taken every 5 minutes for each of Plans 1 and 2. The average temperature and pH in the greenhouse were 26.02 and 6.00, respectively. These water temperature and pH values indicate ideal conditions for mustard greens growth. The temperature and pH measurement results can be seen in Figure 6 below.

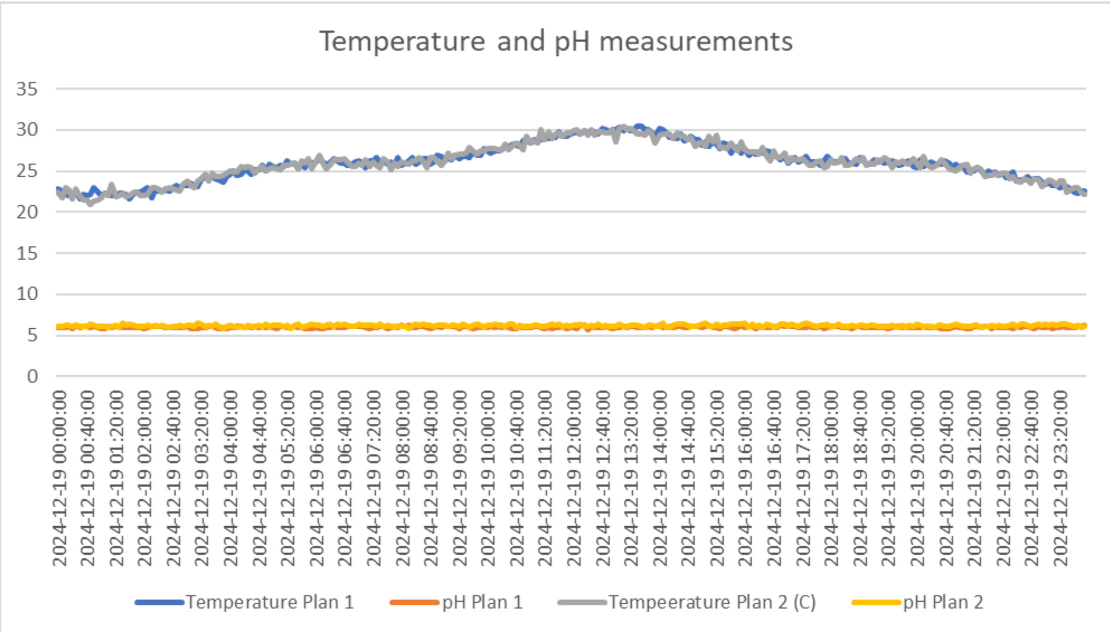



**Figure 6**. Temperature and pH measurements

## 3.2 Application Testing

Application testing is conducted to ascertain whether the application operates as intended. Multiple participants, comprising researchers and hydroponic farmers, conducted the assessment. Testing is conducted to verify that the application functions as planned. (Prasetio & Wellem, 2022). The valuer then assigns a score between 1 (very low) and 5 (very high).(Saver *et al*., 2021). Application testing aimed to identify and reduce the possibility of failures in the generated software. (Novalia & Voutama, 2022). Testing is conducted using a consistent approach, commencing from the registration phase to evaluating each menu on the dashboard. Overall, the test findings indicate that applications installed on Android mobile devices function effectively according to the specified scenario within the aquabalance program. The assessment test results and outcomes of the aquabalance application test are presented in Table 1 and 2 below.

**Table 1**. Assessment Test Results

| No | Aspect | Valuer | |
|---|---|---|---|
| | | I | II |
| 1. | Open the app | 5 | 4 |
| 2. | Register | 4 | 4 |
| 3. | Log in | 4 | 4 |
| 4. | Accessing the plant menu | 3 | 4 |
| 5. | Access the navigation menu | 5 | 5 |

**Table 2**. The Outcomes of The Aquabalance Application

| No | Function Testing | User Actions or Inputs | Expected Results | Results Obtained | Conclusion | Previous Research Contribution | New Contribution |
|---|---|---|---|---|---|---|---|
| 1 | Open the app | Click on the app | The application opens and enters the login/register menu | The application can be opened and enter the login/register menu | Valid | Previous research on mobile app usability emphasizes a seamless opening process (Smith, 2022). | The application opens quickly without delays, enhancing user experience as compared to similar apps which face loading issues. |
| 2 | Register | Click on the register button | The app displays the register page | The app can display the register page | Valid | Register functionality in mobile apps has been highlighted as crucial for user engagement (Johnson, 2021). | The register page is intuitive and user-friendly, compared to older systems that often confuse users during sign-up. |
| 3 | Log in | Enter user data and password | The app displays a dashboard page | The app can display the dashboard page | Valid | Logging in functionality is essential for data-driven apps (Lee & Kim, 2023). | This app ensures smooth login with fast verification, distinguishing it from apps that struggle |

| No | Function Testing | User Actions or Inputs | Expected Results | Results Obtained | Conclusion | Previous Research Contribution | New Contribution |
|---|---|---|---|---|---|---|---|
| | | | | | | | with delayed login times. |
| 4 | Accessing the plant menu | Click on the plant 1 & 2 buttons | The application displays the plant page along with the results of temperature and water pH measurements | The app can display the plant page along with the results of temperature and water pH measurements | Valid | Research on agricultural apps shows the importance of real-time data display for user decision-making (Martinez, 2020). | The app offers real-time measurement results, enhancing its usability for agricultural monitoring, which previous studies indicated was often not implemented effectively. |
| 5 | Access the navigation menu | Click the navigation button | The app displays a navigation map page | The app can display navigation map pages | Valid | Navigation features in apps have been linked to improving user task efficiency (Thomas, 2021). | The navigation menu in this app is optimized for clarity, outpacing other apps that have overly complicated or sluggish map functionalities. |

Based on testing the aquabalance android application, starting from testing opening the application, registration process, login, accessing the main menu, and accessing the navigation menu. Overall, the application that has been developed has functioned well at every stage. This testing stage is crucial in developing Android applications. The application has performed effectively, and no operational faults were noted with the aquabalance application. Previous studies have shown that the testing stages are also carried out at the application development stage. The research evaluates the content stage and the viability of the user interface (D. I. Lestari *et al*., 2023; Ramadhan *et al*., 2021; Agung *et al*., 2022).

## 4. Conclusion

In conclusion, this study demonstrates the successful design and implementation of an Android application for monitoring greenhouse environments. Using software and hardware components, the application effectively tracks critical parameters, such as temperature and pH levels. It offers a practical solution for remote and real-time monitoring, reducing the need for manual checks and improving overall greenhouse management efficiency. The system aligns with the established scenario, proving reliable and user-friendly. Future research could expand the system's capabilities by integrating additional sensors, such as humidity sensors, and incorporating automated control features to optimize the greenhouse environment further. These enhancements would contribute to more efficient and sustainable agricultural practices.

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## References

Agung, G., Andar, A., & Santiyasa, I. W. (2022). Penerapan Usability Testing sebagai Alat Evaluasi Aplikasi Android ARInBa ( Augmented Reality Instrumen Musik Bali ) Aplikasi ARInBa ( Augmented Reality Instrumen Musik Bali ) merupakan aplikasi android berbasis AR yang diciptakan untuk menampilkan objek . *Prosiding Seminar Nasional Universitas Ma Chung*, 154–167.

Alda, M. (2023). Pengembangan Aplikasi Pengolahan Data Siswa Berbasis Android Menggunakan Metode Prototyping. *Jurnal Manajemen Informatika (JAMIKA)*, *13*(1), 11–23. https://doi.org/10.34010/jamika.v13i1.8216

Astuti, W. T., Wati, A. A., Fadila, A. R., & Verisandri, A. L. A. (2024). Penguatan Teknologi Sektor Pertanian, Kesehatan, dan Sosial Budaya di Desa Madurejo dan Desa Sumberharjo. *Bakti Budaya*, *7*(1), 30–49. https://doi.org/10.22146/bakti.9456

Bahariawansyah, A. S., Susrama, I. G., & Akbar, F. A. (2019). Perancangan Alat Pengendalian Lingkungan Greenhouse Berbasis Blynk. *Jurnal Penelitian Politeknik Penerbangan Surabaya*, *6*(1), 12–22.

Cindy Permatasari, Achmad Syarief, & Wegig Murwonugroho. (2023). Pengembangan Desain Antarmuka Pengguna Aplikasi Mobile Learning Berbasis Moodle Untuk Smartphone (Studi Kasus: Ixcert.Id). *Jurnal Seni Dan Reka Rancang: Jurnal Ilmiah Magister Desain*, *6*(1), 61–78. https://doi.org/10.25105/jsrr.v6i1.18723

Ernawati, L., & Kusuma, H. (2021). Jurnal of Economic and Social Empowerment. *Journal of Economic and Social Empowerment*, *I*(Ii), 69–74.

Fibriani, I., Widjonarko, Bayu, A., & Ciptaning, P. (2020). Analisa Sistem Monitoring Greenhouse Berbasis Internet of Things ( IoT ) Pada Jaringan 4G LTE. *Jurnal SinarFe7*, *3*(1), 231–236.

Irawan, M. S., Setiawan, A. B., & Arifuddin, R. (2021). Sistem Monitoring pH Untuk Tanaman Strawberry Dengan Sistem Aeroponik. *Jurnal FORTECH*, *2*(1), 24–28. https://doi.org/10.32492/fortech.v2i1.236

Karim, S., Khamidah, I. M., & Yulianto. (2021). Sistem Monitoring Pada Tanaman Hidroponik Menggunakan Arduino UNO dan NodeMCU. *Buletin Poltanesa*, *22*(1), 75–79. https://doi.org/10.51967/tanesa.v22i1.331

Kurniawan, A., Sulitiadi, S., & Ristiono, A. (2021). Monitoring Iklim Mikro pada Greenhouse Secara Real Time Menggunakan Internet of Things (IoT) Berbasis Thingspeak Microclimate Monitoring of Greenhouse in Real Time Using Thingspeak-Based Internet of Things (IoT). *Jurnal Teknik Pertanian Lampung*, *10*(4), 468–480. http://dx.doi.org/10.23960/jtep-l.v10.i4.468-480

Lestari, A. F. A., Wijaya, A., Fahrudin, R., & Kusnadi, K. (2022). Perancangan Desain User Interface (UI) pada Website Cirebon Media dengan Metode User Centered Design (UCD). *Jurnal Grafis*, *1*(1), 76–85. https://jurnal.cic.ac.id/index.php/jurnalgrafis/article/view/73%0Ahttps://jurnal.cic.ac.id/index.php/jurnalgrafis/article/download/73/67

Lestari, D. I., Amintarti, S., & Ajizah, A. (2023). Pengembangan Media Pembelajaran Materi Pteridophyta Kelas X SMA Berbasis Hasil Penelitian Di Kebun Wisata Durian Banjarbaru Dalam Bentuk Aplikasi Android. *JUPEIS : Jurnal Pendidikan Dan Ilmu Sosial*, *2*(4), 92–99. https://doi.org/10.57218/jupeis.vol2.iss4.849

Marisa Khairina, D. (2011). Analisis Keamanan Sistem Login. *Jurnal Informatika Mulawarman*, *Vol. 6 No.*(2), 64–67.

Novalia, E., & Voutama, A. (2022). Black Box Testing dengan Teknik Equivalence Partitions Pada Aplikasi Android M-Magazine Mading Sekolah. *Syntax : Jurnal Informatika*, *11*(01), 23–35. https://doi.org/10.35706/syji.v11i01.6413

Nur Holis Majid, Andi Warnaen, & Kartika Budi Utami. (2023). Perancangan Aplikasi Media Penyuluhan Pertanian (SI APP) Berbasis Android Menggunakan Metode Rekayasa Perangkat Lunak Air Terjun (Waterfall). *Jurnal Triton*, *14*(1), 45–65. https://doi.org/10.47687/jt.v14i1.278

Pondeppa, B., Sowmyadevi, T., & Sowndarya, S. (2024). MOBILE APP APPLICATION TO REGISTER BIOMETRIC. *International Research Journal of Education and Technology*, *6*(12), 1650–1653.

Prasetio, F. B., & Wellem, T. (2022). Perancangan Dan Implementasi Aplikasi Android Untuk Layanan Informasi Pariwisata. *IT-Explore: Jurnal Penerapan Teknologi Informasi Dan Komunikasi*, *1*(2), 114–132. https://doi.org/10.24246/itexplore.v1i2.2022.pp114-132

Prasetiya, H. P., & Susilowati, M. (2016). Visualisasi Informasi Data Perguruan Tinggi Dengan Data Warehouse Dan Dashboard System. *Jurnal Teknik Informatika Dan Sistem Informasi*, *2*(3). https://doi.org/10.28932/jutisi.v2i3.504

Prastio, R. P., Megantoro, P., Galih Satrio, J., Nurkhotib, I., Atthama, N., Sukmawan, I. H., Rachman, R. N., & Mutiarso, I. R. (2023). Capacity Expansion and Installation of Surge Protection Device in Solar Power Plant System for Hydroponics Farmer. *Jurnal Layanan Masyarakat (Journal of Public Services)*, *7*(1), 151–160. https://doi.org/10.20473/jlm.v7i1.2023.151-160

Pratiwi, I., & Sari, S. Y. (2024). AMANDA (Your Plant Monitoring Application) Implementation Android Application Program Project Management Using Agile Scrum Method and Trello. *E3S Web of Conferences*, *517*, 1–13. https://doi.org/10.1051/e3sconf/202451702001

Prawitha, W. M., Sulistyanto, M. P. T., & Wasum, W. (2022). Aplikasi Berbasis Android untuk Monitoring dan Pengontrolan Pertanian Pintar. *Jurnal Pendidikan Sains Dan Komputer*, *2*(01), 103–112. https://doi.org/10.47709/jpsk.v2i01.1360

Putra, G. M., & Faiza, D. (2022). Pengendali Suhu, Kelembaban Udara, dan Intensitas Cahaya pada Greenhouse untuk Tanaman Bawang Merah Menggunakan Internet Of Things(IOT). *Jurnal Pendidikan Tambusai*, *5*(3), 11404–11419. http://arshave24.blogspot.com/2017/12/internet-of-things-iot.html

Ramadhan, A. D., Astutik, R. P., & Surya, Y. A. (2021). Sistem Kontrol dan Monitoring Greenhouse Hidroponik pada Tanaman Sawi Berbasis Aplikasi App Invertor. *SinarFe7*, *4*(1), 23–28. https://journal.fortei7.org/index.php/sinarFe7/article/view/7

Riis, T., Olesen, B., Clayton, J. S., Lambertini, C., Brix, H., & Sorrell, B. K. (2012). Growth and morphology in relation to temperature and light availability during the establishment of three invasive aquatic plant species. *Aquatic Botany*, *102*, 56–64. https://doi.org/10.1016/j.aquabot.2012.05.002

Saputra, M. A., & Thamrin, H. (2025). PENGEMBANGAN APLIKASI MONITORING DAN KONTROL UNTUK. *Jurnal Ilmiah Informatika (Scientific Informatics Journa)*, *10*(1), 1–14.

Saver, J. L., Chaisinanunkul, N., Campbell, B. C. V., Grotta, J. C., Hill, M. D., Khatri, P., Landen, J., Lansberg, M. G., Venkatasubramanian, C., & Albers, G. W. (2021). Standardized Nomenclature for Modified Rankin Scale Global Disability Outcomes: Consensus Recommendations from Stroke Therapy Academic Industry Roundtable XI. *Stroke*, *52*(9), 3054–3062. https://doi.org/10.1161/STROKEAHA.121.034480

Sawidin, S., Engelin Melo, O., & Marsela, T. (2016). Monitoring Kontrol Greenhouse untuk Budidaya Tanaman Bunga Krisan dengan LabView. *Jurnal Nasional Teknik Elektro Dan Teknologi Informasi (JNTETI)*, *4*(4). https://doi.org/10.22146/jnteti.v4i4.169

Suakanto, S., Putra, S. A., Wijaksana, S. N., & Raharjo, A. (2024). *PENERAPAN INTERNET OF THINGS ( IoT ) DALAM UPAYA PENINGKATAN PRODUKTIVITAS TANAMAN HIAS PADA GREENHOUSE DI DESA KAYU AMBON KECAMATAN LEMBANG KABUPATEN BANDUNG BARAT*. *7*, 1–8.

Sujadi, H., & Nurhidayat, Y. (2019). SMART GREENHOUSE MONITORING SYSTEM BASED ON Computer Science | Industrial Engineering | Mechanic Engineering | Civil Engineering Computer Science | Industrial Engineering | Mechanic Engineering | Civil Engineering. *Jurnal J-Ensitec*, *06*(01), 371–377.

Tando, E. (2019). Review : Pemanfaatan Teknologi Greenhouse Dan Hidroponik Sebagai Solusi Menghadapi Perubahan Iklim Dalam Budidaya Tanaman Hortikultura. *Buana Sains*, *19*(1), 91. https://doi.org/10.33366/bs.v19i1.1530