Journal of Artificial Intelligence and Engineering Applications

Website: https://ioinformatic.org/

15th October 2025. Vol. 5. No. 1; e-ISSN: 2808-4519

Designing an Internet of Things (IoT) Based Automatic Water Reservoir Monitoring and Filling System

Rafiq Alfarez Badres[1*], Huliman[2], Octara Pribadi[3]

[1,2,3]*Informatics Engineering, STMIK TIME, Medan, Indonesia*
alvarezbadres@gmail.com[1*], dr.huliman@gmail.com[2], octarapribadi@gmail.com[3]

Abstract

The development of Internet of Things (IoT) technology today has brought convenience in various aspects of life, one of which is in water resource management. This research aims to design and implement an IoT-based automatic water reservoir monitoring and filling system to make it easier for users to monitor the condition of water reservoirs in *real-time*. The system utilizes the ESP 8266 NodeMCU microcontroller as a control center connected to the HC – SR 04 Ultrasonic Sensor to measure water level The data obtained from the sensor is transmitted to the Firebase *realtime Database* and can be accessed through an Android application that has been designed using Android Studio. The test results show that the system is able to display water level information in real-time on Android apps. In addition, the system can automatically control the water pump based on the water level limit that has been set by the user, as well as allow manual control through the application. With this system, the efficiency in filling the reservoir increases and the risk of reservoir water overflowing or water shortage can be minimized. This system is expected to be a solution for automatic water management in household and small industrial environments, and can be further developed with the addition of more complete water quality monitoring features.

***Keywords**: Internet Of Things, Android, Firebase*

1. Introduction

Over time, the development of technology has progressed very rapidly and is able to provide various conveniences in completing human work. One example is the process of filling water reservoirs which is usually carried out in households and in the company environment. Water reservoirs with a capacity of 1,100 liters are often used in the residential sector and medium-scale enterprises. However, the activities of checking the remaining water and filling the reservoir that are still carried out manually are considered inefficient and time-consuming in the current modern era [1].

Filling water reservoirs that utilize groundwater sources for daily needs is generally done with the help of an electric pump. Once the reservoir is full, the pump is usually switched off manually using a conventional switch. This process often causes two main problems: a reservoir of water shortage due to a delay in starting the pump, or conversely, water overflowing because the pump is turned off too late [2].

Technology that can help users manage the use of reservoirs, especially in terms of monitoring and refilling water, is an automated system that can be monitored in real time. This technology is known as the Internet of Things (IoT), which is the concept of integration between physical devices in the real world and systems that communicate with each other through the internet network [3]. Broadly speaking, IoT systems consist of sensors as a data collection tool, internet networks as communication media, and servers as storage and processing of data for analysis [4].

In order for IoT systems to run properly, a structured method is needed to guide each stage of the process. A number of previous studies have developed realtime-based monitoring systems. One of them was carried out by [5], who designed a generator fuel monitoring system at the Belawan Container Terminal. The system utilizes the NodeMCU ESP 8266 as the control center and the HC – SR 04 waterproof ultrasonic sensor to detect fuel levels in a 15,000-liter tank. As a result, this system is able to overcome manual monitoring constraints more efficiently through IoT implementation.

Another relevant study was conducted by [6], who developed an IoT-based automated fish feeding system. The system utilizes an RTC module as a timer and a servo motor as an actuator. Tests show the system works very well, is responsive to remote commands, and has a servo movement accuracy of up to 100%. The study concluded that the system can be operated efficiently through the Blynk app and has the potential to support optimal fish feed management, as well as have a positive impact on fish growth and health.

Based on the above explanation, the author is interested in designing an Internet of Things *(IoT)* automatic water reservoir monitoring and filling system by using *a NodeMCU* that is integrated with an application and using gallons of water as a miniature reservoir. The author's reason for using miniature as an object is to make the research object cheaper and the efficiency in conducting research is much easier to do Therefore, the author will make a research entitled "Designing an Automatic Water Reservoir Monitoring and Filling System Based on *the Internet of Things (IoT)".*

2. Literature Review

2.1 System Planning

Design is the first step in forming a system, which includes the process of planning, drawing, and sketching the system. At this stage, the various elements that were previously separate are organized into a whole and mutually supportive unit, thus forming the basis for the design of the system to be developed [7].

2.2 Internet Of Things (IoT)

IoT is a connection between one or more devices that are interconnected through an internet network, so that these devices are able to communicate and process data independently [5].

2.3 NodeMCU ESP 8266

The ESP 8266 nodeMCU is a microcontroller module designed using the main component in the form of ESP 8266. The ESP 8266 component plays a role in providing WiFi network connectivity, allowing the microcontroller module to connect to wireless networks [5]. The physical appearance of the ESP 8266 NodeMCU module can be seen in Figure 1

Fig.1: ESP 8266 NodeMCU Microcontroller
Source : Khair, et al (2022)

2.4 Arduino IDE

Arduino Uno is a type of Arduino development board that uses the Atmega128 microcontroller. The board is equipped with 14 digital pins, of which 6 can function as PWM outputs, as well as 6 *input analog* pins. In addition, the Arduino Uno also has a 16 MHz crystal oscillator, a USB connection, a power source connector, *an ICSP header*, and *a reset* button. All of these components have covered the basic requirements to perform the microcontroller's functions optimally [8]. The Arduino IDE Software logo is shown in the following figure 2.

Fig. 2: Logo Software Arduino IDE
Sumber : https://www.arduino.cc (2024)

2.5 Water Reservoir

A water reservoir is a container used to store temporary water, which is generally placed in the highest position, such as on the roof of a building. People usually install water reservoirs above their houses with the aim of utilizing the force of gravity, so that the flow of water can flow more rapidly. To meet the needs of clean water, people generally rely on supplies from PDAM or groundwater sources such as wells. In urban areas, the water supply to reservoirs generally comes from the PDAM network and borewells [1].

2.6 Firebase

Firebase is a service provided by Google to provide convenience for application developers in the development process, especially on the *backend* side. Firebase or known as *Backend as a Service* (BaaS) is a solution offered to speed up the developer's work process by reducing the need for manual *backend* management . Through this platform, developers can focus more on developing application features without having to spend a lot of time and effort building *backend* infrastructure. Firebase also provides a variety of *libraries* for various client platforms, such as Android, iOS, JavaScript, Java, Objective-C, and Node.js, which allows system integration to be easier and more efficient. In the development of this system, the Firebase features used include *Authentication*, *Realtime Database*, *Cloud Storage*, and *Cloud Messaging* [9].

3. Research Methods

3.1 Problem Analysis

In this subchapter, analysis related to the problems that are the basis for the development of IoT-based water reservoir monitoring and filling systems will be discussed. The analysis includes an explanation of the condition of the object, the process in progress, the weaknesses and advantages of the existing system, as well as suggestions for improvements to overcome the limitations of the previous system. This study aims to provide an overview of the need for a system that is more efficient, practical, and in accordance with current technological developments.

3.2 Analysis of processes that run appropriately in the field

In this analysis, the process that is currently running in the field related to filling water reservoirs will be explained. The process takes place using a manual method based on mechanical buoys without the support of IoT technology.

The following is a *Flowchart* of the current process method system can be seen in figure 3 below:

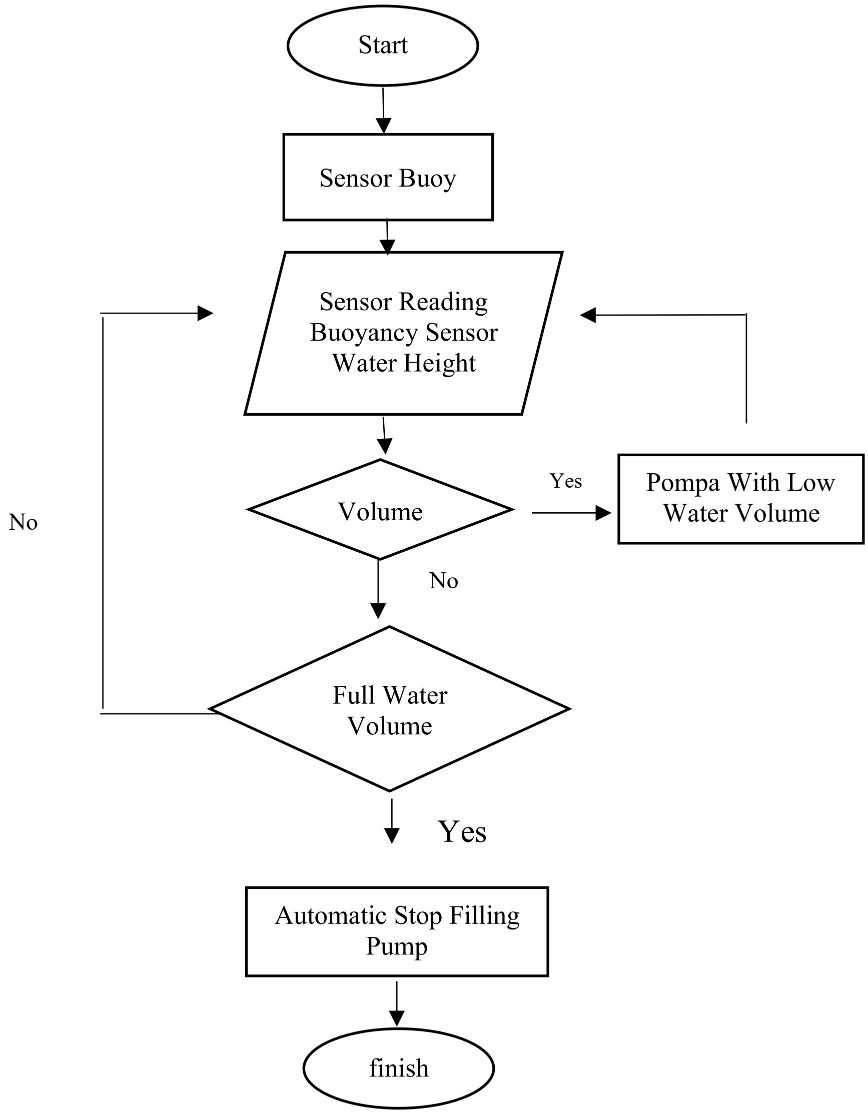

Fig. 3: Reservoir Filling Flowchart Using Buoy Sensor

In the *Flowchart* above, it can be seen that the filling of reservoir water is carried out automatically using the buoyancy sensor by utilizing the moisture in the reservoir when the water volume in the reservoir is low, the buoy will drop so that it opens the tap valve so that it will automatically fill the reservoir, if the water volume is at full point then the water tap valve will be closed so that the pump will automatically stop. This filling system does not can be monitored in *real time*, reservoir owners must see the water manually if they want to know the water volume

3.3 Developed Methods

Based on the above explanation, the researcher designed a system that makes it easier for reservoir users to monitor the volume of water, the system designed by the researcher uses IoT technology and uses the method available on the *solenoid valve faucet* in the method of filling the water where this method will be applied to the ESP 8266 microcontroller, and using the android application as a media *interface* in monitoring water levels, and allowing users to fill reservoirs manually, with features in the application that have been designed by researchers.

3.4 System Planning

In making a system, a design is needed as a medium that will help researchers in making systems, both *hardware* and *software. Flowchart* is needed to be able to know the flow of the system to be designed, when the system starts working, the microcontroller will receive and send data, the data received by the microcontroller comes from the altitude sensor, namely HC, *turbidity* sensor, and the application, the data will be sent to *the Database*, all of these components are interconnected, as well as the application that will send and receive data to the *Database*. After the microcontroller receives data through the sensor and application, the microcontroller reads the program that has been set, where the program aims to control and read the data on the *hardware*, *the system flow flowchart* described above can be seen in Figure 4 below:

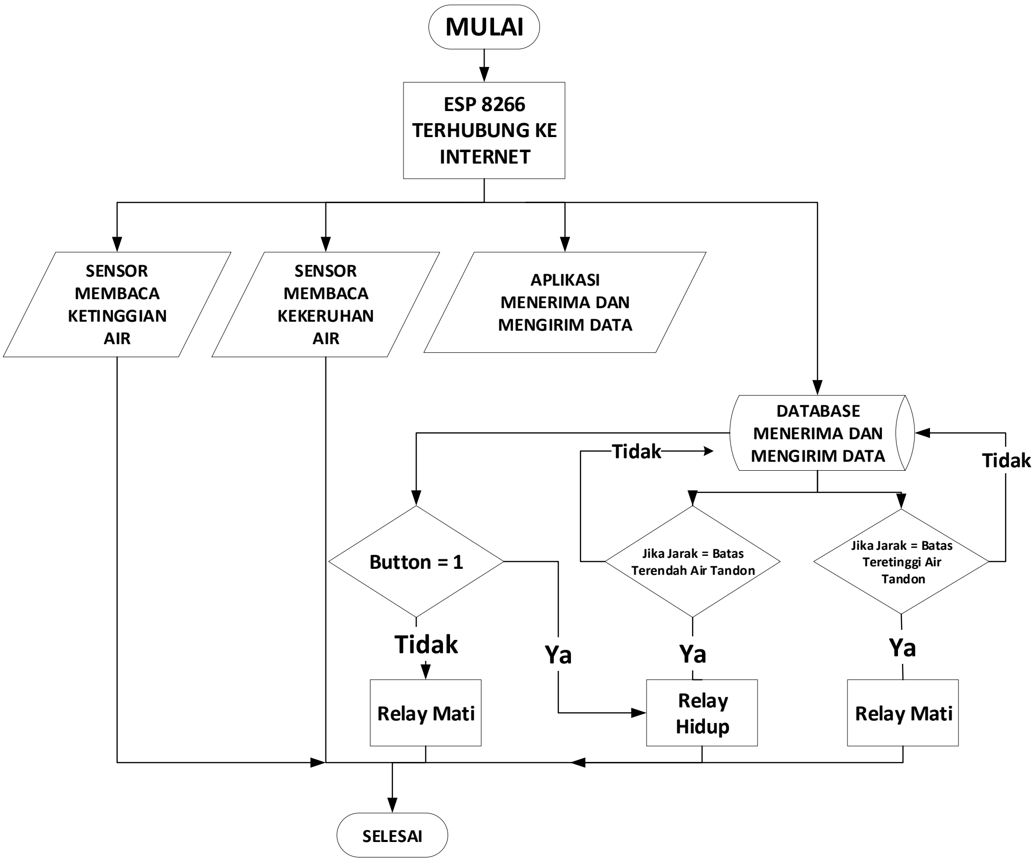

Fig. 4: Flowchart of IoT-Based Reservoir Monitoring and Filling System

4. Result And Discussion

The author conducted tests on the system that has been designed. This test aims to see whether or not the plans that have been made are in accordance with what has been planned beforehand. In this study, the author created an automatic monitoring and filling system for water reservoirs based on *the Internet of Things* (IoT) by utilizing the HC -SR 04 sensor, and *turbidity* sensor and a 12 v DC pump. The results of research and testing carried out by the author. can be seen below:

4.1 Splasher

this page serves as the initial opening animation of the RaMon applicationThe animated image can be seen in figure 5 below:

Fig. 5: Splash Screen Pages

4.2 Software Home Page

this page serves as a page that displays the menu of the RaMon app The image of the main page can be seen in figure 6 below:

Fig. 6: Main Page

4.3 Tandon Monitoring Page

This page serves as a page that displays the results of monitoring from the *hardware* The image of the monitoring page can be seen in figure 7 below:

Fig. 7: Monitoring Page

4.4 Water Level Setting Page

This page serves as a page that is in charge of configuring the water level limit and the lowest limit of water as the water pump controller. The image of the water level setting page can be seen in figure 8 below:

Fig. 8 : Configuration Page

4.5 Guide Page

This page serves as a page that tells the application user how to use *the hardware* and *software*
The image of the Guide page can be seen in figure 9 below:

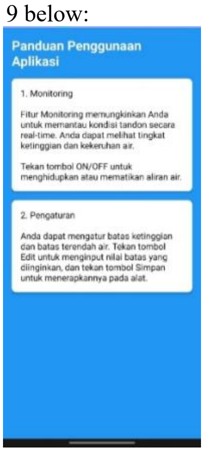

Fig. 9: Guide Page

4.6 Hardware

Below are the results of the hardware design that has been carried out by the researcher which can be seen in figure 10 below:

Fig. 10: Guide Page

5. Conclusions and Suggestions

5.1 Conclusion

Based on the above research, the researcher concluded that:

1. Android applications connected to Firebase Realtime Database are able to display water level data, water turbidity levels, and pump status in real-time, making it easier for users to monitor the condition of the water reservoir remotely.
2. The system is able to automatically refill water based on a predetermined water level limit and can be controlled manually through the Android app, increasing efficiency and reducing the risk of reservoirs overflowing or water shortages.
3. The implementation of this IoT-based monitoring and reservoir filling system has proven to be effective in overcoming the limitations of the previous manual system which still relies on direct inspection by users.

5.2 Suggestion

1. The development of integration features with smart home devices, such as Google Home or Alexa, so that the monitoring and filling system of water reservoirs can be integrated directly with the smart home ecosystem to improve user comfort.
2. The addition of a power backup system using a battery (Uninterruptible Power Supply / UPS) so that the device can still monitor and send data to the application even if there is a power outage, so that system functions continue to run without interruption.
3. The addition of additional water quality sensors such as pH sensors or water temperature, to expand the function of the system to be able to monitor water quality comprehensively, not only height and turbidity.

References

[1] A. Karmakar, S. S. Roy, F. Vercauteren, and I. Verbauwhede, "Efficient finite field multiplication for isogeny based post quantum cryptography," [1] R. Setyawan, A. A. N. Amrita, and K. Oka Saputra, "Rancang Bangun Sistem Penampungan Air Menggunakan Tandon Atas Secara Otomatis Berbasis Mikrokontroler," *J. SPEKTRUM*, vol. 8, no. 1, p. 254, 2021, doi: 10.24843/spektrum.2021.v08.i01.p28.

[2] A. Rasyid and T. Sugiarso, "Rancang Bangun Alat Sensor Ketinggian Air Dan Monitoring Kejernihan Air Pada Tandon Dengan NodeMCU ESP 8266," *J. Teknol. Inf.*, vol. 9, no. 2, pp. 116–125, 2023, doi: 10.52643/jti.v9i2.3767.

[3] A. K. Rindra, A. Widodo, F. Baskoro, and N. Kholis, "Sistem Monitoring Level Ketinggian Air Pada Tandon Rumah Tangga Berbasis Iot (Internet Of Things)," *J. Tek. Elektro*, vol. 11, no. 1, pp. 17–22, 2021, doi: 10.26740/jte.v11n1.p17-22.

[4] Darmin and Budi Isdiyanto, "Sistem Monitoring Pengisian Air Otomatis Berbasis Web Server Menggunakan Nodemcu dan Sensor Ultrasonik," *ISTA Online Technol. J.*, vol. 2, no. 2, pp. 21–33, 2021, doi: 10.62702/ion.v2i2.39.

[5] R. Khair, R. P. Sitompul, and E. Ayuningsih, "Penerapan Teknologi Internet of Things (IOT) pada Alat Pendeteksi Bahan Bakar Genset di Terminal Peti Kemas Belawan," pp. 517–523, 2022.

[6] Risman, R. Rachman, and T. Arifin, "Sistem Monitoring Dan Kontrol Pemberian Pakan Ikan Berbasis Iot Menggunakan Blynk," *Responsif*, vol. 17, no. 1, pp. 44–50, 2024.

[7] I. Suwandi, Z. Rachmat, and Wahyuddin, "Perancangan Sistem Informasi Inventaris Barang Di Smp Negeri 1 Tanasitolo Kabupaten Wajo," *J. Bisnis Digit. dan Enterp.*, vol. 1, no. 1, pp. 8–16, 2023, [Online]. Available: https://ojs.amiklps.ac.id

[8] Y. Triafandy, A. B. Pulungan, and H. Hamdani, "Kendali Solar Tracker Menggunakan Selenoid Valve sebagai Pengendali Aliran fluida," *JTEIN J. Tek. Elektro Indones.*, vol. 1, no. 2, pp. 174–178, 2020, doi: 10.24036/jtein.v1i2.66.

[9] S. T. Nurhayati, M. Irwan, and P. Nasution, "*Database* Management System Pada Perusahaan," *J. Akunt. Keuang. dan Bisnis*, vol. 1, no. 2, pp. 62–64, 2023, [Online]. Available: https://jurnal.ittc.web.id/index.php/jakbs/index