IJOEM

Indonesian Journal of Elearning and Multimedia
https://ejournal.1001tutorial.com/index.php/ijoem

OPEN ACCESS

Design and Building of an Automatic Water Filling System on Water Container Media Based on Arduino Esp8266

Alfazri Putra Pradana[1*], Nur Aminudin[2], Fahlul Rizki[3], Dwi Feriyanto[4]

[1,2,3,4]Universitas Aisyah Pringsewu
Lampung, Indonesia
✉ alfazriputralst@gmail.com *

Article Information:
Received January 2, 2024
Revised January 20, 2024
Accepted January 21, 2024

Keywords:
Arduino ESP8266; Automatic Water Filling; Ultrasonic Sensor; Water Reservoir

Abstract

In the era of rapidly developing technology, innovation is important to facilitate human life. Water is the main need for all living things, especially humans, so it needs to be managed efficiently. Water filling in reservoirs is usually still done manually, which can cause a waste of clean water. Manual water filling requires humans to control the pump as needed. However, it often happens to forget to turn off the pump after the reservoir is full, which can cause a waste of water and electrical energy. To solve this problem, the idea is to make an automatic system with Arduino ESP 8266 called "Design of Automatic Water Filling System on Arduino ESP 8266 Based Water Reservoir". This system uses ultrasonic sensors to measure the water level in the reservoir. When the water reaches a certain level, the system will activate the water filling, and the user can monitor the water level in real time through a mobile device. This research aims to design and test this automatic water replenishment system to avoid water waste. The result is expected to be an efficient solution better than the manual system and beneficial in clean water management. This research will answer important questions about this system's design, workings, and test results. The main conclusion of this research is the need for improvements in the design and implementation of automatic water filling systems. Further analysis, adjustments, and retesting are needed to overcome the obstacles encountered.

A. Introduction

Current technological advances make humans continue to think creatively, not only researching new discoveries, but also maximizing the performance of existing technology to make human work easier. Water is a very vital need in the lives of all living creatures, especially humans. Therefore, the use of clean water must be optimized as efficiently as possible (Chowdhary et al., 2020; Kasonga et al., 2021; Saravanan et al., 2021). In general, filling water in reservoirs still uses a manual work system, the operation of which still depends on humans, so it is less efficient and can result in wastage of clean water.

Manual water filling requires human intervention to activate the water pump when the water reservoir is empty, and vice versa, turning off the pump when the reservoir is full. If people forget to turn off the water pump, the water in the reservoir can overflow, which in turn can cause wastage of water and an unnecessary increase in electricity consumption. With the problems mentioned previously, the idea emerged to develop an automatic tool or system that uses Arduino as its base.

Arduino is an open-source electronic prototyping platform based on flexible and easy-to-use hardware and software (Darnita et al., 2021; Fani et al., 2020; Kondaveeti et al., 2021). Arduino is also known as an electronic kit or open source electronic circuit board which contains the main component, namely a microcontroller chip with the AVR type from the Atmel company (Ardiyanto et al., 2021). Arduino consists

How to Cite : Pradana, A. P., Aminudin, N., Rizki, F., & Feriyanto, D. (2024). Design and Building of an Automatic Water Filling System on Water Container Media Based on Arduino Esp8266. IJOEM Indonesian Journal of E-Learning and Multimedia, 3(1), 14–21. https://doi.org/10.58723/ijoem.v3i1.233
ISSN : 2830-2885
Published by : Asosiasi Profesi Multimedia Indonesia

of two main parts, namely the Arduino board, which is the part of the hardware where the object being worked on will be built and the Arduino IDE, a software that runs on the computer to create programs that will run on the Arduino board (Agustanti et al., 2022; Lukman et al., 2023; Roid et al., 2023).

This research will use Arduino ESP8266 so that the research being developed is entitled "Design and Construction of an Automatic Water Filling System in Arduino ESP8266 Based Water Tanks". ESP8266 is a Wi-Fi module that functions as an internet network system that sends data that has been processed by the Arduino UNO to the user so that he can find out data from sensor measurements (Ajreen, 2021; Holovatyy, 2021; Putra & Risfendra, 2021). The ESP8266 has on-board processing and storage capabilities that allow the chip to be integrated with sensors or with certain device applications via input output pins with just a short programming (Firmansyah et al., 2020; Mufida et al., 2021).

The tool created in this research is useful to avoid wasting water. This tool uses an ultrasonic sensor which functions to detect or measure water levels. When the water is full or low, the sensor will receive a signal which is then transmitted to the controller to carry out its duties and can monitor the water level via cellphone. The aim of this research is to design an automatic water filling system in an Arduino ESP8266 based water container, explain how the Arduino ESP8266 based automatic water filling system works, and test the ESP8266 Arduino based automatic water filling system.

B. Research Methods

The type of research is Research and Development (R&D). Research and Development (R&D) is a systematic and planned research approach that aims to create special products and test the effectiveness of these products in their application. In the educational context, R&D is often used to develop and test products and innovations used in the learning process.

In this research, researchers implemented Research and Development (R&D) methods. To facilitate manufacture, reduce expenses, and collect relevant data in the context of research into the manufacture of automatic water reservoir filling systems, the method steps used from the R&D method are as follows:

1. Potential and Problems

Potential and research problems include uncontrolled water evaporation and resulting in wastage of electricity. To overcome this problem, a design tool for automatic water filling using an ultrasonic sensor based on Arduino ESP 8266 was created.

2. Data collection

Information gathering steps are carried out objectively and can be used as a basis for planning special products that are expected to overcome these problems.

3. Product Design

In this research, the researcher created a block diagram as a representation of the product design to be made. The following is a block diagram of this research:

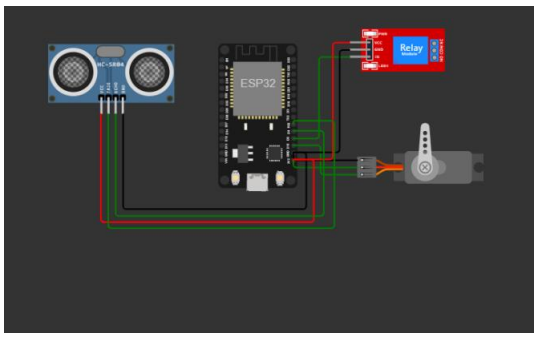

Figure 1. Product Design

4. Design Validation

Design validation is a step in assessing whether the product design, in this case automatic water filling, is more effective or not. The validation process involves direct testing of the product design. Apart from that, analysis was also carried out by referring to various theories to assess the quality of the design of this tool.

5. Design Revision

After the product design in the form of a tool design is evaluated and analyzed by the supervisor, various inputs and findings of weaknesses related to the tool design will emerge. From the results of this evaluation, several changes will be made to improve the quality of the tool. If no revision is needed, the researcher can continue to the next research stage.

6. Product trial

After the design is refined and the tool is created, the next step is to test the product. This product trial can be carried out several times according to analysis needs. The purpose of testing this product is to understand the working principle of this automatic water filling better.

The tool that will be made in this research is an Automatic Water Filling Tool which can make household work easier by making it easier for people to find out if the tool is damaged. So a solution was created to make it easier to find out the damage to this tool.

This research has two things needed, namely software and hardware. The hardware used is an ultrasonic sensor, which is a sensor that functions to detect the height of the water volume if damage occurs. Then the Arduino ESP8266 is the brain whose function is to control the device. Android is useful as a control tool to make it easier to check. Meanwhile, the software used in this research is an Arduino software application for programming and Microsoft Word for making research proposals.

In the research process for making Automatic Water Filling Tools in Water Containers, the following tools are needed:

a. Arduino esp8266
   Used as a controller for an Android-based automatic water filling device.
b. Ultrasonic Sensor
   Ultrasonic sensors are used as a means of detecting water level if it exceeds the automatic water filling device.
c. Relays
   The relay is used as a tool to turn on the water pump.
d. Water reservoir
   Water reservoirs are used for water storage.
e. Adapter
   The adapter is used as a tool to change ac voltage to dc so that a low voltage occurs.
f. Android (cellphone)
   Mobile phones are used to apply and control tools.

C. Results and Discussion

Realization of Product Results

1. Set of tools

The following is a schematic of the automatic water filling system on the water tendonusing an ultrasonic sensor.

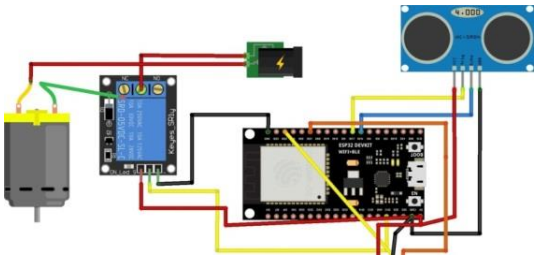

Figure 2. Tool scheme

Information

a. The VCC pin of the ultrasonic sensor and relay is connected to the Arduino ESP 8266 VCC pin on the Arduino board.

b. The GND (ground) pin of the ultrasonic sensor and relay is connected to the GND (ground) pin on the Arduino ESP 8266 board.
c. The ultrasonic sensor echo pin is connected to pin D4 of the Arduino ESP 8266.
d. The ultrasonic sensor trigger pin is connected to pin D3 of the Arduino ESP 8266.
e. The relay output pin is connected to pin D5 of the Arduino ESP 8266.

2. Coding

The Arduino ESP8266 coding using the Arduino IDE application is as follows:

a. Open the Arduino IDE application.
b. Then select the file menu and select the open menu.
c. After that, look for the program that has been prepared and select open.
d. If the desired program is open on the ArduinoIDE then upload the program by selecting the upload menu on the Arduino IDE which is in the top left corner of the application.
e. Wait some time until the program is finished uploading.
f. If the program has finished uploading then the Arduino is ready to use.

The following is a piece of coding used in making a prototype of an automatic water filling system using an Arduino ESP 8266 based ultrasonic sensor.

```
include <WiFi.h>
#include <WebServer.h>
#include <Wire.h>
const char* ssid = "Kucing Santo";
const char* password = "kucingsanto2022";
WebServer server(80);
#define ECHO_PIN 16
#define TRIGGER_PIN 17
#define PUMP_PIN 13
void setup() {
  Serial.begin(115200);
  pinMode(ECHO_PIN, INPUT);
  pinMode(TRIGGER_PIN, OUTPUT);
  pinMode(PUMP_PIN, OUTPUT);

  WiFi.begin(ssid, password);
  Serial.println("Connecting to WiFi");
  while (WiFi.status() != WL_CONNECTED) {
    delay(1000);
    Serial.println("Connecting...");
  }
  Serial.println("Connected to WiFi");
 // Mengambil dan menampilkan alamat IP WiFi
  IPAddress localIP = WiFi.localIP();
  Serial.print("IP Address: ");
  Serial.println(localIP);
  server.on("/", handleRoot);
  server.begin();
}
void loop() {
  server.handleClient();
  digitalWrite(TRIGGER_PIN, LOW);
  delayMicroseconds(2);
  digitalWrite(TRIGGER_PIN, HIGH);
  delayMicroseconds(10);
```

```
  digitalWrite(TRIGGER_PIN, LOW);
  long duration = pulseIn(ECHO_PIN, HIGH);
  int distance = duration * 0.034 / 2;
  if (distance < 15) {
    digitalWrite(PUMP_PIN, HIGH);
  } else {
    digitalWrite(PUMP_PIN, LOW);
  }
}
void handleRoot() {
  String html = "<html><body>";
  html += "<h1>Water Pump Controller</h1>";
  html += "<p>Current distance from water surface: ";
  html += getDistance();
  html += " cm</p>";
  html += "<p><a href=\"/on\">Turn Pump On</a></p>";
  html += "<p><a href=\"/off\">Turn Pump Off</a></p>";
  html += "</body></html>";
  server.send(200, "text/html", html);
}
void handleOn() {
  digitalWrite(PUMP_PIN, HIGH);
  server.send(200, "text/plain", "Pump turned on");
}
void handleOff() {
  digitalWrite(PUMP_PIN, LOW);
  server.send(200, "text/plain", "Pump turned off");
}
int getDistance() {
  digitalWrite(TRIGGER_PIN, LOW);
  delayMicroseconds(2);
  digitalWrite(TRIGGER_PIN, HIGH);
  delayMicroseconds(10);
  digitalWrite(TRIGGER_PIN, LOW);

  long duration = pulseIn(ECHO_PIN, HIGH);
  int distance = duration * 0.034 / 2;
  return distance;
}
```

Product Testing and Discussion

1. Sensor TestingUltrasonic (Water Detection)

The ultrasonic sensor is one of the components used in the automatic water filling prototype. Testing this sensor is carried out by measuring the distance between the water level and a predetermined active distance where the distance to activate this sensor is 1-15cm. If the ultrasonic sensor detects the presence of water at a predetermined distance, the ultrasonic sensor will deactivate the water pump.

Figure 3. Ultrasonic Sensor Testing

No	Distance of object to sensor (cm)	Water pump condition
1	30	Dead
2	35	Life
3	40	Life

2. Arduino ESP 8266 Testing

Testing is carried out by providing input voltage to the Arduino ESP 8266 using a 12 volt or 9 Volt adapter. If the indicator light on the Arduino ESP 8266 is on, then you can be sure that the Arduino ESP 8266 is connected to voltage. Below is an image showing the results of this test.

Figure 4. Arduino ESP 8266 trial

3. Relay Testing

Relays operate based on electromagnetic principles which are used to actuate switch contacts. In this way, a relatively small electric current (low power) can connect or disconnect higher voltage electricity. If the indicator light on the relay is on, it can be confirmed that the relay is connected to a voltage source. The image below shows the results of this test.

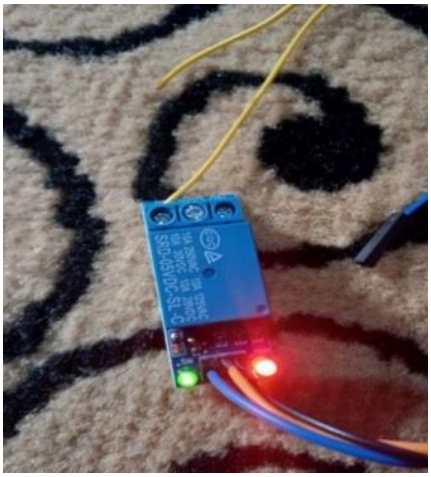

Figure 4. Relay trial

4. Water Pump Testing

This mini submersible water pump is equipped with a brushless DC motor that operates at a DC 5V voltage and is capable of producing a flow of 120L/hour. One of the main advantages of this mini water pump is the low noise level when used and the high level of safety when operating in water. Water pump testing is carried out by providing a voltage of 5V. If the water pump vibrates then you can be sure the water pump is on.

Based on the results of the research that has been carried out, the author puts forward recommendations including using more appropriate equipment to prevent errors in developing the system and using more than one ultrasonic sensor or using other sensors. This prototype can be developed into a functional tool and can be practically applied in appropriate environments.

D. Conclusion

The aim of this research is to design an automatic water filling system using Arduino ESP 8266 technology in water reservoirs, with the aim of overcoming the problem of wasting water which often occurs when manually filling. Although this research has the potential to optimize the use of clean water and increase efficiency, although based on the research results, there are several findings that require special attention: 1) Implementation Limitations: The research results show that the implementation of the Arduino ESP 8266 based automatic water filling system did not work as expected. There are technical problems or errors in design or implementation that affect system performance; 2) Testing Constraints: During the testing phase, this research experienced several obstacles that limited data collection and comprehensive evaluation. This can affect the accuracy of test results; 3) Need for Improvement: The main conclusion of this research is the need for improvement in the design and implementation of automatic water filling systems. Further analysis, adjustments, and retesting are needed to overcome the obstacles encountered.

E. Acknowledgement

Thank you to all parties who have contributed to this research activity.

References

Agustanti, S. P., Hartini, H., Nurhayani, N., & Hartanto, D. D. (2022). Aplikasi Mikrokontroler Arduino Uno Dalam Rancang Bangun Kunci Pintu Menggunakan E-Ktp. *Jusikom : Jurnal Sistem Komputer Musirawas*, *7*(1), 74–88. https://doi.org/10.32767/jusikom.v7i1.1611

Ajreen, M. (2021). Based Temperature and Humidity Mointoring System Using Aurdino Uno and ESP8266 WiFi Module. *SSRN Electronic Journal*, 1–6. https://doi.org/10.2139/ssrn.3918308

Ardiyanto, A., Arman, & Supriyadi, E. (2021). Alat Pengukur Suhu Berbasis Arduino Menggunakan Sensor Inframerah Dan Alarm Pendeteksi Suhu Tubuh Diatas Normal. *Sinusoida*, *23*(1), 11–21. https://doi.org/10.37277/s.v23i1.1016

Chowdhary, P., Bharagava, R. N., Mishra, S., & Khan, N. (2020). Role of Industries in Water Scarcity and Its Adverse Effects on Environment and Human Health. *Environmental Concerns and Sustainable Development*, 235–256. https://doi.org/10.1007/978-981-13-5889-0_12

Darnita, Y., Discrise, A., & Toyib, R. (2021). Prototype Alat Pendeksi Kebakaran Menggunakan Arduino. *Jurnal Informatika Upgris*, *7*(1), 3–7. https://doi.org/10.26877/jiu.v7i1.7094

Fani, H. Al, Sumarno, S., Jalaluddin, J., Hartama, D., & Gunawan, I. (2020). Perancangan Alat Monitoring Pendeteksi Suara di Ruangan Bayi RS Vita Insani Berbasis Arduino Menggunakan Buzzer. *Jurnal Media Informatika Budidarma*, *4*(1), 144–149. https://doi.org/10.30865/mib.v4i1.1750

Firmansyah, R., Yusuf, M., Saputra, P. P. S., Prasetyo, M. E., Mochtar, F. M., & Kurniawan, F. A. (2020). IoT Based Temperature Control System Using Node MCU ESP 8266. In *International Joint Conference on Science and Engineering (IJCSE 2020)* (Vol. 196, pp. 401–407). https://doi.org/10.2991/aer.k.201124.072

Holovatyy, A. (2021). Development of IoT Weather Monitoring System Based on Arduino and ESP8266 Wi-Fi Module. In *IOP Conference Series: Materials Science and Engineering* (Vol. 1016, pp. 1–10). https://doi.org/10.1088/1757-899x/1016/1/012014

Kasonga, T. K., Coetzee, M. A. A., Kamika, I., Ngole-Jeme, V. M., & Momba, M. N. B. (2021). Endocrine-disruptive chemicals as contaminants of emerging concern in wastewater and surface water: A review. *Journal of Environmental Management*, *277*, 1–10. https://doi.org/10.1016/j.jenvman.2020.111485

Kondaveeti, H. K., Kumaravelu, N. K., Vanambathina, S. D., Mathe, S. E., & Vappangi, S. (2021). A systematic literature review on prototyping with Arduino: Applications, challenges, advantages, and limitations. *Computer Science Review*, *40*, 1–28. https://doi.org/10.1016/j.cosrev.2021.100364

Lukman, R., Fernando, Y., & Jayadi, A. (2023). Perancangan Alat Pakan Bebek Otomatis Terjadwal Berbasis Arduino Uno Dengan Penjadwalan Android. *Jurnal Informatika Dan Rekayasa Perangkat Lunak*, *4*(1), 10–21. https://doi.org/10.33365/jatika.v4i1.2454

Mufida, E., Adriansyah, M. I., Ihsan, N. M., & Anwar, R. S. (2021). Perancangan Alat Pendeteksi KWH Meter Berbasis Arduino Uno R3 dan ESP8266. *INSANtek: Jurnal Inovasi Dan Sains Teknik Elektro*, *2*(1), 28–34. https://doi.org/10.31294/instk.v2i1.442

Putra, A. T., & Risfendra, R. (2021). Penggunaan Aplikasi Ubidots untuk Sistem Kontrol dan Monitoring pada Gudang Gula Berbasis Arduino UNO. *JTEIN: Jurnal Teknik Elektro Indonesia*, *2*(1), 40–48. https://doi.org/10.24036/jtein.v2i1.120

Roid, F., Aulia, R., & Muthalib, M. A. (2023). Perancangan Alat Perekam Data Penggunaan Energi Listrik Pada KWH Meter Untuk Rumah Tinggal 4 Ampere Berbasis Arduino Uno. *Jurnal Teknik Elektro Dan Komputasi (ELKOM)*, *5*(1), 85–94. https://doi.org/10.32528/elkom.v5i1.9170

Saravanan, A., Kumar, P. S., Jeevanantham, S., Karishma, S., Tajsabreen, B., Yaashikaa, P. R., & Reshma, B. (2021). Effective water/wastewater treatment methodologies for toxic pollutants removal: Processes and applications towards sustainable development. *Chemosphere*, *280*, 1–15. https://doi.org/10.1016/j.chemosphere.2021.130595