Water Tank Wudhu and Monitoring System Design using Arduino and Telegram

Ritzkal[1*], Yuggo Afrianto[2], Indra Riawan[3], Fitrah Satrya Fajar Kusumah[4], Dwi Remawati[5]
Universitas Ibn Khaldun, Bogor, Indonesia[1, 2, 3, 4]
STMIK Sinar, Nusantara, Surakarta[5]

***Abstract*—Manual water faucets, which are commonly used in mosques and homes, cannot control water use, resulting in a variety of issues, including water waste when the user forgets to close the water faucet, resulting in water continuously coming out. In addition to filling the water tank, which is also an important factor in saving water, the water reserve in the tank must be properly controlled so that its availability is maintained. Based on the existing problems, a water faucet system was made for ablution and monitoring water tanks using Arduino and Telegram. An automatic ablution water faucet system that can drain water automatically with an ultrasonic sensor as a body movement reader and a solenoid valve as a substitute for a faucet The water pump can help fill the water tank automatically and know how much water is in the tank using an ultrasonic sensor; liquid crystal display and Telegram as recipients of text messages from the results of the condition of water faucets, water pumps, and water levels.**

Keywords*—Arduino; solenoid valves; ultrasonic sensor; pump water

I. INTRODUCTION

Water is one of the things that is very influential in human life and is needed in everyday life [1]+ because water is a source of life for humans in this world [2]. In human life, clean water is one of the natural resources used by humans for consumption or in carrying out their daily activities and the existence of water sources should be maintained [3][14]. One of them is the ablution used by Muslims to worship before worship, which requires cleanliness and sanctity [4]. One of the ablution activities is to use clean water that flows over certain limbs, namely the face, hands, head, and feet [5].

In places of worship such as mosques, there are rooms used for ablution, and the faucets used are mostly still manually operated to regulate the size of the water output [6]. To adjust the size and volume of water output, the user must turn the faucet lever manually, and the faucet is easily damaged because the faucet lever is often rotated. so that it becomes one of the factors contributing to excessive water expenditure or wasteful water use [7]. Places of worship, such as mosques, must have tanks or water containers to store clean water [8]. The water reservoir is not only a storage area but also maintains the smoothness and availability of water for the needs of the mosque [9][15]. Filling water and monitoring water tanks in mosques is still done manually, so it often causes waste due to negligence in turning off the water pump when the tank is full [10].

From the problems above, it can be formulated how to regulate the expenditure of water used during ablution so that there is no waste of spending water and the use of water can be controlled, and how to find out the water level in the water tank [11]. For this reason, an open-source electronic platform is needed that is easy to use, namely Arduino. Arduino technology can assist in making things automatic, so they no longer need to be controlled [12]. One way to overcome this problem is to build an automatic ablution water faucet as a regulator of water expenditure by using an ultrasonic sensor as a distance reader and a solenoid valve as a substitute for a manual faucet. In addition, the controller built using ultrasonic sensors can also work in real time, so it is suitable for controlling ablution water in mosques. The use of the microcontroller on Arduino, which is designed by adding the HC-SR04 ultrasonic sensor, solenoid valve, and water pump, is made into a system that works under the control of the user interface and can adjust the opening and closing of water faucets automatically [13] and aims to control the expenditure of water so that it is not excessive and to make it easier for mosque guards to know the contents of the tank.

II. RESEARCH METHODS

The method in this study is used to carry out a planning stage or describe a workflow in compiling an idea with many stages. The stages used in this research method are as follows:

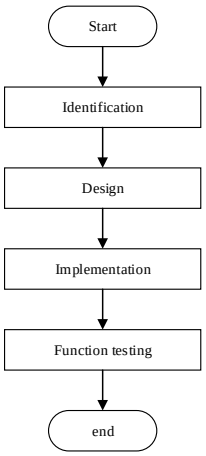

Fig. 1. Research stages

A. Identification

At this early stage, identification of the requirements that will be needed to design a system is carried out. At this initial stage what is done is to analyze why this research was carried

out. This identification stage is divided into two things, namely needs analysis and work method analysis.

1) Identification of needs
2) Identify How It Works

B. Design

The design of this study contains the development of the system work analysis stages, which are changed to block diagrams so that researchers can understand the flow and function of the design that will be made. The following are the stages of this research design. The design of the hardware used in the research is carried out; the design is made in the form of a block diagram to illustrate interconnected diagrams.

C. Implementation

The implementation phase implements everything that has been well designed, such as hardware design. The hardware implementation stage includes the implementation of connecting modules and the implementation of Telegram.

D. Function Testing

At this stage, various kinds of tests will be carried out that have been implemented in the previous stage. This stage is carried out by:

1) HC-SR04 Ultrasonic Sensor Function Testing
2) Relay Function Testing
3) Selenoid Valve Function Testing
4) Waterpump Function Testing
5) Ethernet Shield Testing
6) Telegram function testing

III. RESULT

At this point, the findings of this study, titled "Design of the Ablution Water Faucet System and Monitoring the Water Tank Using Arduino and Telegram," will be discussed.

A. Identification

Based on the existing problems, it can be concluded from several system requirements regarding the implementation of the design of the ablution water faucet system and monitoring the water tank using Arduino and Telegram, as previously explained, that several needs were needed, including

1) Identification of needs: At the stage of identifying the needs that will be carried out, there are several hardware devices to support the implementation of research on the design of the ablution water faucet system and monitoring the water tank using Arduino and telegram, as shown in the following table:

TABLE I. IDENTIFICATION OF REQUIREMENTS (HARDWARE)

No.	Identification of requirements (hardware)
1	Arduino Uno
2	Solenoid Valves
3	Ultrasonic Sensor HC-SR04
4	Water Pump
5	5v Relays
6	Liquid Crystal Display
7	Ethernet Shield
8	Jumper Cables
9	Telegram

In Table I, No. 1, Arduino Uno is a system controller and an electronic prototyping platform that is open-source hardware based on hardware and software that is flexible and easy to use [13]. In Table I, No. 2, Solenoid Valve is a valve that is driven by electrical energy which has a coil as its driving force. In addition, the solenoid valve also has a fast opening and closing response [16]. At No. 3, "The HC-SR04 type ultrasonic sensor is a device used to measure the distance from an object and as an object reader" [17]. In Table I, No. 4, the Water Pump is a water pump motor used for aquariums, fish ponds, hydroponics, robotics, or projects making microcontroller-based applications [18]. In Table I, No. 5, Relays are on-and-off switches that are operated electrically and are electromechanical components [19]. In Table I, No. 6, the Liquid Crystal Display can function to display a sensor result value, display text, or display a menu on the microcontroller [20]. In Table I, No. 7, the Ethernet Shield is a module that is used to connect Arduino to the internet [21]. In Table I, No. 8, Jumper Cables are used to connect all components in the circuit on the breadboard [22]. In Table I, No. 9, Telegram is a cloud-based application, which makes it easier for users to access a Telegram account from different devices and simultaneously [23]. Telegram Messenger is a cross-platform messaging application that allows us to exchange messages without SMS fees because Telegram uses the same internet data package for email, web browsing, and so on [24].

2) Identify how it works: In the process of working assistance, it will be explained how the working system works. The following image will explain the analysis of how this system works:

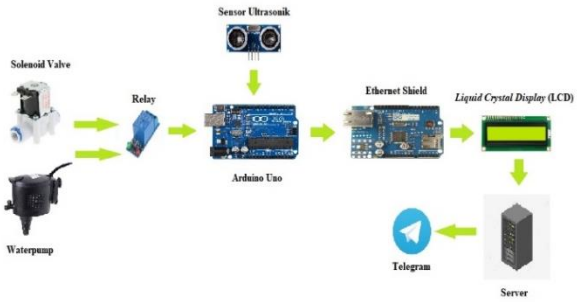

Fig. 2. Working notes

In Fig. 2, explains how the system works, we need to know whether the system we have created is in line with expectations or not. Ultrasonic sensors will be used as input in this research, and data from ultrasonic sensors will be sent to Arduino upon receipt. The relay functions as a limiter on/off the water pump and solenoid valve, while the solenoid valve controls the opening and closing of the faucet. Arduino will process the data and send data output to the LCD in the form of text and numbers. Next, the system will pass the information to telegram via the Ethernet shield network, and then send the information to the server, where the information will be forwarded to a pre-arranged telegram bot, which will automatically route the phone via the telegram messenger.

B. Design

The hardware design stages used in the creation of a system are carried out during this design stage. The design is made in the form of a block diagram to illustrate a connected diagram. The following are several design stages in this study:

1) Hardware design: Based on the functional block diagram contained in Fig. 3, the system is divided into several parts. Sensors as inputs, Arduino as receivers and senders, relays as on/off switches that act as power regulators that enter the solenoid valve, and solenoid valves as the opening and closing of water faucets, LCD (liquid crystal display) as output that displays data in the form of letters and numbers; Ethernet shield as output, i.e., connecting a telegram to the internet.

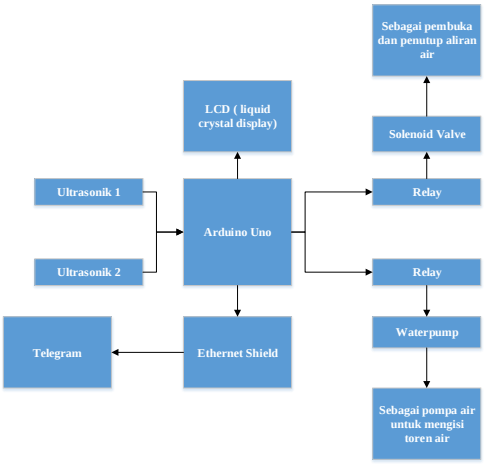

Fig. 3. Block diagram

a) Series of ultrasonic sensors HC-SR04: The type of sensor used is an ultrasonic sensor, type HC-SR04. The sensor used to measure the distance of an object is based on the working principle of sound (ultrasonic). The HC-SR04 Ultrasonic Sensor works by shooting sound (ultrasonic) towards objects in front of it. Then the sound is reflected by the object back towards the sensor. The time taken from the sound of the shot until it is received again is used as a parameter to determine the distance between the object and the sensor.

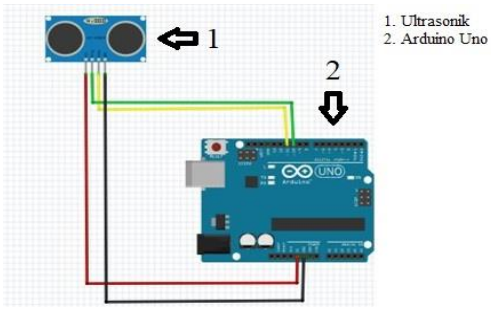

Fig. 4. Ultrasonic sensor circuit

In Fig. 4, this ultrasonic sensor circuit has 4 pins, namely, the GND pin is connected to the GND pin, the VCC pin is connected to the 5V pin, the echo pin is connected to pin 9, and the triangle pin is connected to pin 10.

b) Relay circuit: The relay functions as a switch that is operated electrically and carries out the logic functions of the Arduino Uno. The relay is made up of four different components: an electromagnetic coil, an armature, switch contact points (switches), and a spring. The switches located at the contact points themselves are grouped into two types: normally closed (NC) and normally open (NO). What is meant by "normally closed" is the closed position in the initial state when the relay has not been activated. Whereas what is meant by "normally open" is the open position in the initial state when the relay has not been activated.

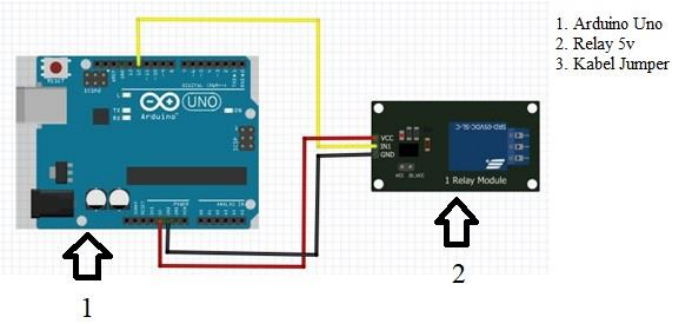

Fig. 5. Series of relay

In Fig. 5, the relay circuit shows that the relay module has 6 pinouts, namely, GND, VCC, IN, NO, NC, and COM. Then the pin is connected to the Arduino, which serves as a connector. Then the GND pin is connected to the GND pin, the VCC pin is connected to the 5 volt pin, and the IN pin is connected to pin 12.

c) I2C LCD circuit: The I2C LCD layer is used as an output to display data controlled by Arduino and has a size of 16x2. Because it produces a good display of characters and a lot, LCD is the easiest display medium to observe. On a 16x2 LCD, it can display 32 characters: 16 characters on the top line and 16 characters on the bottom line. Lcd16x2 employs a special driver that allows the 16x2 lcd to be controlled via I2C lines. Through i2c, the LCD can be controlled using only 2 pins, namely SDA and SCL.

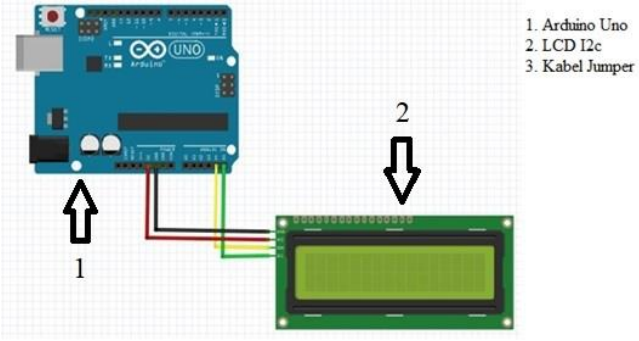

Fig. 6. I2C LCD (liquid crystal display)

Fig. 6 shows that the i2c LCD has 4 pins, namely, the GND pin connected to GND, the VCC pin connected to the 5 volt pin, the SDA pin connected to pin A4, and the SCL pin connected to pin A5.

d) Relay circuit with solenoid valve and waterpump: The relay module connects the solenoid valve and water pump to the Arduino. The Arduino's 5 volt pin is connected to the relay module's VCC pin, and the Arduino's GND pin is connected to the relay module's GND pin. Connect the relay module to the positive lead of the 12 volt DC supply and the positive lead of the solenoid valve, and attach the negative lead of the 12 volt DC supply to the negative lead of the solenoid valve. It's the same with the solenoid—how to connect the relay module with the water pump is also the same as with the solenoid. That is the only difference between them and their respective functions.

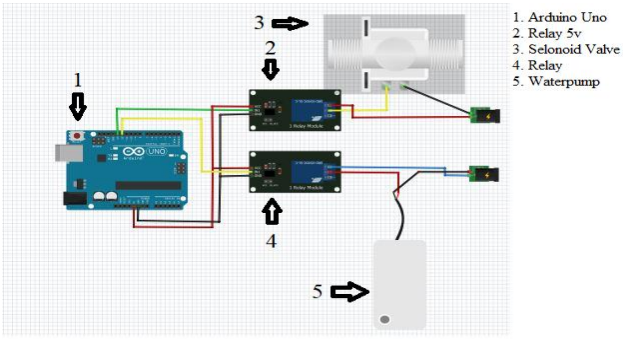

Fig. 7. Relay circuit with solenoid valve and water pump

In Fig. 7, the function of the relay module with the solenoid is to act as a valve control switch on the solenoid. The function of the relay module with the water pump is the on/off switch for the pump controller.

e) Arduinno circuit with Ethernet shield: In Fig. 8, the last output component is the Ethernet shield. This board is installed directly on the Arduino Uno by stacking it on top. The SPI.h and Ethernet.h libraries manage communication between the Arduino Uno Board and the Ethernet Shield.

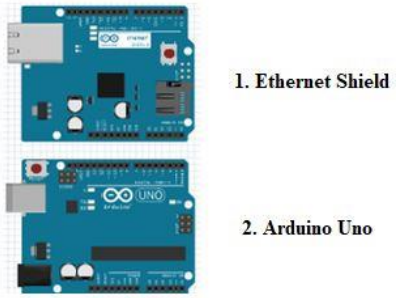

Fig. 8. Arduino uno circuit with Ethernet shield

2) Network topology design: The network topology design shows that the Ethernet shield connected to the switch has, of course, been programmed according to the programming instructions that have been made.

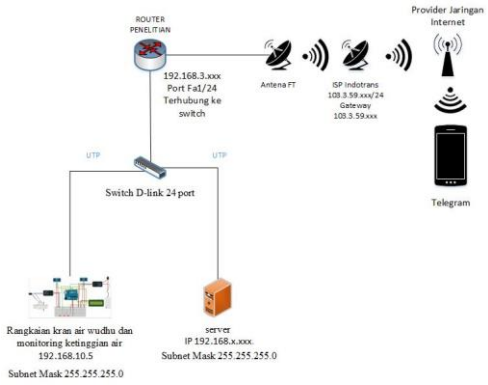

Fig. 9. Network topology design

Fig. 9 is a network design that will be made with a series of tools. To connect the Arduino Uno to the Cisco switch, given the IP address 192.168.x.x./24, use a UTP cable. The CISCO switch is connected to the Mikrotik router with the IP address 192.168.x.xxx/24. Mikrotik router with public IP 103.3.59.xxx connected to ISP Indotrans.

C. Implementation

In Fig. 10 and 11 at the implementation stage, includes the assembly or installation of all components that are carried out before being implemented in a real system. In addition, the following hardware combinations are implemented in series: HC-SR04 ultrasonic sensor, 5V relay, solenoid valve, water pump, I2C LCD, 12V adapter, Ethernet shield. The following implementation stages will be carried out using a workflow system.

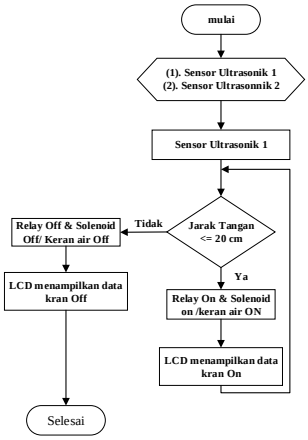

Fig. 10. Water faucet system workflow

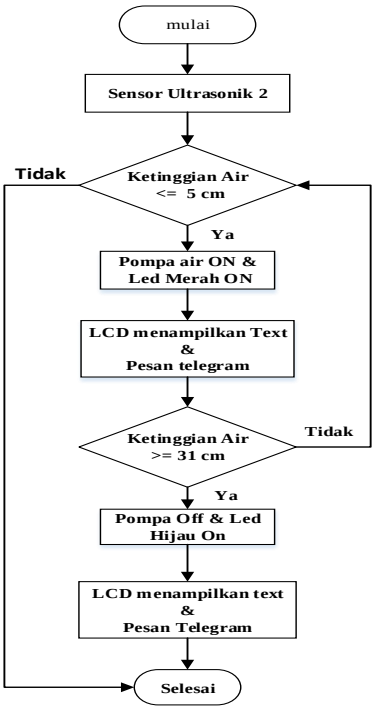

Fig. 11. Water level monitoring system workflow

D. Function Testing

At this function-testing stage, namely testing the function of the design tool for the ablution water tap system and monitoring the water tank using Arduino and Telegram, This test is carried out so that the tool is made in accordance with the expected goals.

The following are the stages of testing the function of the design circuit for automatic ablution faucets and water monitoring using Arduino Uno and ultrasonic sensors.

1) Ultrasonik sensor function testing: In Fig. 12, at the testing stage of the ultrasonic sensor function, the faucet is a test of the ultrasonic sensor when it detects an object approaching. When the sensor detects an object nearby, the relay will be on, and when the solenoid valve is also on, water will flow.

Fig. 12. Ultrasonik sensor testing

2) Relay function testing: In Fig. 13 at this stage, testing the function of the relay is carried out when the relay functions as an on and off switch for the solenoid valve and water pump. When relay one is on, the solenoid valve is on; when relay one is off, the solenoid valve is off; and if relay two is on, the water pump is on; when relay two is off, the water pump is also off.

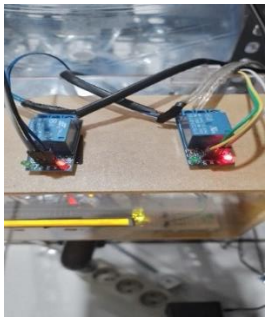

Fig. 13. Relay function testing

3) Solenoid fungsi solenoid valve: In Fig. 14, at this stage of testing the function of the solenoid valve, the solenoid valve functions when the relay is on and the solenoid valve is also on. Then, when the relay is off, the solenoid valve is closed. A solenoid valve functions as a substitute for a faucet, whose function is to open and close the flow of water automatically.

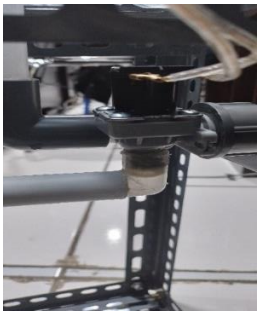

Fig. 14. Solenoid valve testing

4) Waterpump testing: In Fig. 15, at this stage of testing the function of the water pump, the water pump functions as an increase in water pressure and also as a water filler for the tower. The water pump will turn on if the ultrasonic sensor

detects the water in the tank is low or is about to run out. And the water pump is dead if the water in the tank is full.

Fig. 15. Water pump testing

5) Ethernet shield testing: In Fig. 16, this Ethernet shield test, it is done to find out whether the Ethernet shield is connected or not to the internet network so that it can send water level data and control faucets and pumps to see it with the serial monitor on Arduino.

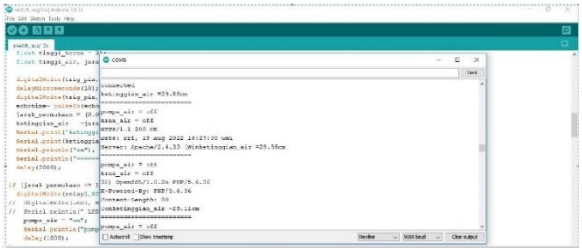

Fig. 16. Ethernet shield function testing

6) Telegram testing: In Fig. 17, this stage is carried out to test the function on Telegram. This test is conducted as a notification. This system will send a telegram message in the form of a text on the state of the water tap, water pump, and water level data obtained and will be saved in the database using the ablution water faucet to find out how much content is in the water tank that has been used. The system will send telegram messages in the form of text on the state of the water taps, water pumps, and water level data so that the data obtained will be saved in the database that has been created and can be viewed.

Fig. 17. Telegram testing

7) Overall tool test results: The image depicts the state of the ablution water faucet and the monitoring of the water tank with Arduino and Telegram. The ultrasonic sensor that is right at the water faucet functions as a gesture reader. When the hand is under the water faucet with a distance of 20 cm, the relay will be on and the solenoid valve will open the valve so that water comes out automatically when the hand is right under the water faucet. If the distance between the hand and the ultrasonic sensor is greater than or equal to 20 cm, the relay will be off and the solenoid valve will be closed. Furthermore, the ultrasonic sensor located above the water tank functions as a reader of the water level contained in the tank. If the water level in the water tank is less than 5 cm, then the relay is on and the water pump will turn on to fill the water tower. If the water level rises above 30 cm, the water pump will shut down. Then, in the next stage, the system will send a message to the LCD and a telegram in the form of a text of water taps, water pumps, and water level data.

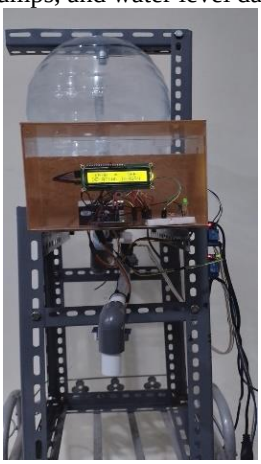

Fig. 18. Overall tool test results

IV. CONCLUSION

The conclusions that can be drawn from the results of the tests and discussions that have been carried out regarding the design of the ablution water faucet system and monitoring the water tank using Arduino and telegram. A system has been designed for the application of automatic ablution water taps that can automatically dispense water with the HC-SR04 ultrasonic sensor as a body motion reader and a solenoid valve as a substitute for a faucet that functions as the opening and closing of the water flow. Monitoring the water level in the water tower with the HC-SR04 ultrasonic sensor as a water tap can detect when the contents of the tower are about to run out and alert the level reader in the water tank and a water pump as a water filler can find out the water level in the tank via telegram. After conducting research with the ablution water faucet system and monitoring the water tank using Arduino and telegram, suggestions were made for better development, including 1) In conducting further research, it is expected to be possible to use more than one solenoid valve. 2) It is hoped that further research will monitor via the web and have a database for storing water level data in the tank. 3) For further research, you can expect to use a buzzer when the water in the tank has run out.

REFERENCES

[1] M. Amin, "Sistem Cerdas Kontrol Kran Air Menggunakan Mikrokontroler Arduino dan Sensor Ultrasonic," J. Nas. Inform. Dan Teknol. Jar., vol. 2, pp. 1–5, 2020.

[2] H. N. Azhari, "Air Dalam Tafsir Al-Azhar (Kajian Ayat Siklus Air dengan Pendekatan Hidrologi)," Skripsi - Inst. ILMU AL-QUR`AN JAKARTA, 2021, [Online]. Available: http://27.123.222.2/handle/123456789/1395%0Ahttp://27.123.222.2/bitstream/123456789/1395/3/17210838_Publik.pdf

[3] Chrismondari, A. D. Kurniawan, D. Irfan, and Ambiyar, "Dispenser Otomatis Menggunakan Sensor Ultrasonik dan Arduino Uno," J. Inf. Technol. Comput. Sci., vol. 3, no. 2, pp. 227–233, 2020.

[4] M. Rizal, U. Ungkawa, and M. Premitasari, "Efisiensi Penggunaan Air Pada Sistem Mobil Wudhu," J. Ilm. Teknol. Infomasi Terap., vol. 7, no. 1, pp. 1–8, 2021, doi: 10.33197/jitter.vol7.iss1.2020.444.

[5] R. Shaputra, "Kran Air Otomatis Pada Tempat Berwudhu Menggunakan Sensor Ultrasonik Berbasis Arduino Uno," Sigma Tek., vol. 2, no. 2, p. 192, 2019, doi: 10.33373/sigma.v2i2.2085.

[6] D. M. Sani, "KRAN AIR (Dwikie Mahendra Sani)," 2019.

[7] J. Cybertech et al., "RANCANG BANGUN ALAT UNTUK MENGUKUR VOLUME TANGKI AIR PADA DEPOT AIR MINUM MENGGUNAKAN TEKNIK SIMPLEX BERBASIS," no. x, 1978.

[8] Y. A Manurung, "Pembuatan Kran Pencuci Tangan Otomatis dan Hand Dryer Menggunakan Sensor Touch Berbasis Arduino Uno," 2021.

[9] M. A. Shodiqin and W. D. Kurniawan, "Analisis Sistem Pengendalian dan Pengawasan Level Tangki Air Berbasis Arduino Uno dan Internet of Things," J. JPTM, vol. 09, no. 02, pp. 44–53, 2020.

[10] A. Bintoro and U. Malikussaleh, "SISTEM MONITORING AIR PADA TANGKI BERBASIS INTERNET OF THINGS (IOT) BLYNK APP," no. July 2022, 2023.

[11] D. Nugroho, D. Wahyu Prasetyo, and B. Arifin, "Rancang Bangun Pengendalian Tegangan Menggunakan Kontrol Pid-Arduino Pada Prototipe Mini Plant Mikrohidro," vol. 24, no. 2, pp. 101–115, 2022.

[12] Wahyu woro lestari, H. Yuana, and S. Kirom, "Rancang Bangun Alat Cuci Tangan Otomatis Berbasis Arduino Untuk Mencegah Penyebaran Covid-19," JATI (Jurnal Mhs. Tek. Inform., vol. 6, no. 1, pp. 38–44, 2021, doi: 10.36040/jati.v6i1.4304.

[13] A. Rahman Hakim, "Perancangan Dan Implementasi Keran Air Otomatis Dengan Sensor Ultrasonik Berbasis Arduino," Comasie J. , vol. 1, pp. 92–101, 2019.

[14] U. Y. Syafarida, D. R. Jati, and A. Sulastri, "Analisis Hubungan Konstruksi Sumur Gali dan Sanitasi Lingkungan Terhadap Jumlah Bakteri Coliform Dalam Air Sumur Gali (Studi Kasus: Desa PAL IX, Kecamatan Sungai Kakap)," J. Ilmu Lingkung., vol. 20, no. 3, pp. 437–444, 2022, doi: 10.14710/jil.20.3.437-444.

[15] faizal Fatturahman and I. Irawan, "Monitoring Filter Pada Tangki Air Menggunakan Sensor Turbidity Berbasis Arduino Mega 2560 Via Sms Gateway," J. Komputasi, vol. 7, no. 2, pp. 19–29, 2019, doi: 10.23960/komputasi.v7i2.2422.

[16] A. Prasetya, "Implementasi Dispenser Pintar Berbasis Internet Of Things Untuk Pemantauan Jumlah Air Minum Guna Menjaga Kesehatan Pada Tubuh Manusia Implementation Of Smart Dispenser Based On Internet Of Things For Monitoring The Amount Of Dringking Water To Maintain He," vol. 8, no. 6, pp. 3026–3035, 2022.

[17] F.- Puspasari, I.- Fahrurrozi, T. P. Satya, G.- Setyawan, M. R. Al Fauzan, and E. M. D. Admoko, "Sensor Ultrasonik HCSR04 Berbasis Arduino Due Untuk Sistem Monitoring Ketinggian," J. Fis. dan Apl., vol. 15, no. 2, p. 36, 2019, doi: 10.12962/j24604682.v15i2.4393.

[18] Moch. Bakhrul Ulum, Moch. Lutfi, and Arif Faizin, "OTOMATISASI POMPA AIR MENGGUNAKAN NODEMCU ESP8266 BERBASIS INTERNEToOF THINGS (IOT)," JATI (Jurnal Mhs. Tek. Inform., vol. 6, no. 1, pp. 86–93, 2022, doi: 10.36040/jati.v6i1.4583.

[19] W. Wendanto, D. J. N. Salim, and D. W. T. Putra, "Rancang Bangun Sistem Keamanan Smart Door Lock Menggunakan E-KTP (Elektronik Kartu Tanda Penduduk) Dan Personal Identification Number Berbasis Arduino Mega R3," Go Infotech J. Ilm. STMIK AUB, vol. 25, no. 2, p. 133, 2019, doi: 10.36309/goi.v25i2.111.

[20] F. Bima Prakarsa and Edidas, "Rancang Bangun Alat Sortir Panen Ikan Lele Berbasis Arduino UNO R3," J. Pendidik. Tambusai, vol. 6, no. 1, pp. 1202–1218, 2022.

[21] M. A. Syamsul Arifin, R. Pebriansyah, and B. Santoso, "Prototype Penerapan Internet of Things pada Sistem Informasi Penggunaan Air Rumah Tangga Di BLUD UPT SPAM Kabupaten Musi Rawas," J. Sustain. J. Has. Penelit. dan Ind. Terap., vol. 8, no. 2, pp. 82–90, 2019, doi: 10.31629/sustainable.v8i2.1466.

[22] D. A. N. Wemos and D. Mini, "PROTOTYPE SISTEM MONITORING DAN PENGENDALI SMART HOME BERBASIS IoT DENGAN MENGGUNAKAN ARDUINO NANO DAN WEMOS D1 MINI TUGAS AKHIR," 2022.

[23] F. Fitriansyah and Aryadillah, "Penggunaan Telegram Sebagai Media Komunikasi Dalam Pembelajaran Online," Cakrawala-Jurnal Hum., vol. 20, no. 2, pp. 111–117, 2020.

[24] A. O. Fofid, "Modul Rumah Pintar Berbasis Internet of Thing Dengan Menggunakan Telegram," 2021.