







# Design and Construction of an Automatic Warm Water Media Shower Based on Arduino Uno

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## Abstract

This research aims to design and develop a prototype of an automatic warm water shower using sound sensors and ultrasonic sensors based on Arduino Uno. The research method uses steps from the Research and Development (R & D) Approach. The automatic warm water shower prototype developed allows users to carry out bathing activities more efficiently and comfortably, avoids wasting water due to negligence in closing the tap, and provides an automatic warm water feature. How the automatic warm water shower prototype works using a sound sensor and an ultrasonic sensor based on Arduino Uno. If the ultrasonic sensor detects the presence of an object within a distance of 30 cm, the ultrasonic sensor will activate the solenoid valve which acts as an automatic tap in turning on the tap, but when the ultrasonic sensor does not detect any the presence of an object, the ultrasonic sensor will deactivate the solenoid valve so that the tap will close automatically. If the user wants to take a shower using warm water, the user simply claps his hands and then the sound of the clapping activates the sound sensor, then the sound sensor will activate the water heater which functions as a heater. This research produces prototypes of automatic faucets and automatic hot water showers which show the potential for integrating technology into everyday bathing devices to increase user efficiency and comfort and avoid wasting water.

## A. Introduction

Current technological developments, especially in the field of electronics, have made human thinking increasingly advanced in terms of the application of electronic equipment. One thing that has been developed is electronic technology that can operate household appliances (Nasri et al., 2022). With the latest technological advances, especially in the field of electronics, humans need to make all activities more practical, including in terms of ease and operation (Berlianti & Fibriyanti, 2020; Ningsih & Juwito, 2021; Suparmin et al., 2020).

Bathing is the main method for removing dirt, dust, sweat and microorganisms that stick to the body, thereby maintaining body cleanliness. A house must have a bathroom. The bathroom has an important role as a place to carry out personal activities such as bathing, defecating and urinating (Heo & Jeong, 2021; Kusuma et al., 2024; Mendes et al., 2021). Most bathrooms in households still use dippers and manual showers as tools for bathing so that their use is less efficient because it can result in wastage of clean water and is impractical (Ibáñez-Rueda et al., 2023; Wong et al., 2022; Zhang et al., 2021). In accordance with the regulation of the Minister of Energy and Mineral Resources of the Republic of Indonesia number 15 of 2012 concerning saving the use of ground water which has been explained in article 7 concerning using

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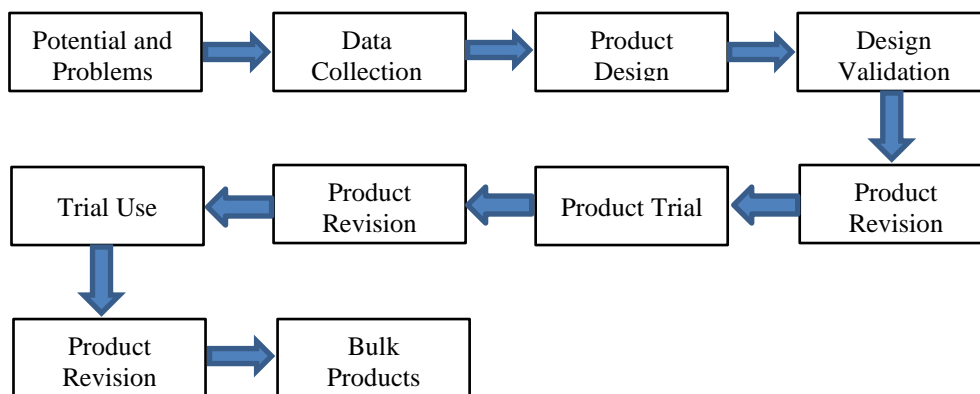
ground water effectively and efficiently for various needs, this can be done by using water according to need, avoiding wasteful use. water, and the use of equipment that can save water usage.

The use of manual showers has been widely used in the hospitality business and upper middle class housing. The manual shower itself still has many shortcomings, namely in its operation it still uses a manual tap, where the manual tap is vulnerable to damage, and if the user forgets to close the tap, the water will continue to flow, resulting in a waste of clean water. Even though it has a warm water feature, to operate it you have to open and close the tap again. Then, in terms of price, the showers sold on the market are quite expensive so only a few households can afford to own them (Arianto, 2022, 2023; Hananto, 2022; Pramudya et al., 2020).

Looking at the existing problems, the author has an idea to solve the problems described above, namely making a prototype of an automatic warm water shower using sound sensors and ultrasonic sensors based on Arduino Uno which is able to overcome these problems. This tool can later be applied in the bathroom to make it easier for users to carry out self-cleaning activities, especially bathing, without having to worry about wasting water due to neglect to close the shower tap and has an automatic warm water feature, and in terms of price it is more affordable so that this tool can be owned by all groups. community, this tool is a design for an automatic hot water shower based on Arduino Uno.

## B. Research Methods

This research applies the Research and Development (R&D) method. Research and Development (R&D) is a research approach that focuses on developing specific products and testing their effectiveness (Siregar, 2023; Waruwu, 2024). The following research steps were used:



### 1. Potential and Problems

Researchers analyzed the potential and problems in this research, namely the waste of water and lack of efficiency and lack of comfort from using a manual shower.

### 2. Data collection

Information gathering steps are carried out in a factual manner and can be used as a basis for planning targeted products to overcome these problems.

### 3. Product Design

The product design or development model resulted in a tool that was created, namely an automatic warm water shower which combines a sound sensor system and an ultrasonic sensor which will send a signal to a microcontroller. This electronic circuit works as an automatic warm water shower based on Arduino Uno.

### 4. Design Validation

Design validation is a step to evaluate whether the product design is successful or not, in this case the automatic shower, is more effective or not. This validation is carried out by personally testing the product to assess its design.

### 5. Design Revision

After evaluation and analysis of the product design, which is a tool concept, is carried out, if potential weaknesses in the concept are found, improvements will be made to improve the quality of the prototype.

6. Product trial

After design improvements and tool prototyping are complete, the next step is to carry out a series of product tests. This test can be carried out repeatedly according to analysis needs. The purpose of testing this product is to find out the working principle of this automatic shower.

7. Product revision

The product has improved after evaluating the test results. If there are weaknesses or limitations that arise during use, researchers will evaluate the product's performance in order to make the necessary improvements so that the product can be better.

### C. Results and Discussion

#### *Making a Prototype Automatic Warm Water Shower Device*

In applying the R&D research method, an Arduino-based automatic warm water shower prototype was created, where this prototype required components such as Arduino Uno, Solenoid Valve, ultrasonic sensor, sound sensor, thermostat module, temperature sensor, water heater element and relay module. A warm water shower prototype is provided in the illustration in Figure 1.



**Figure 1.** Water shower prototype

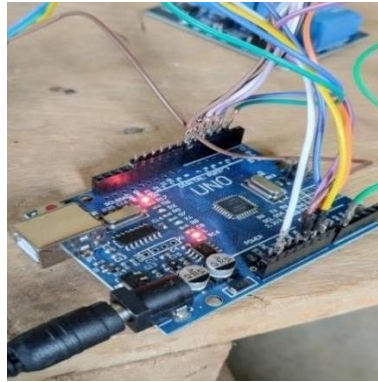
The tool illustrated in Figure 1 is planned to have the ability to control the warm water shower automatically. The purpose of each sensor is as follows, the ultrasonic sensor as input to activate the solenoid valve which acts as an automatic faucet, the sound sensor as input to activate the water heater, thermostat and temperature sensor. Where the water heater works as a heater which plays a role in warming the water that will be used, while the thermostat functions as a temperature regulator which functions to determine how warm or hot the water will be used, and the temperature sensor functions to determine the temperature used and then sends the output to the thermostat module to display temperature being used.

#### *Automatic Warm Water Shower Prototype Testing*

After the Arduino Uno-based automatic hot water shower prototype has been realized, several tests need to be carried out to understand the system's operating mechanism and the functional specifications of the system that has been designed. This test was run to gain an understanding of how the tool should be configured to get maximum benefit from it.

1. Arduino UNO Testing

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



**Figure 2.** Arduino UNO Trial

## 2. Ultrasonic Sensor Testing

The ultrasonic sensor is a component used in the automatic hot water shower prototype. This sensor functions as a detection tool on the prototype. Testing of sensors is carried out with the aim of measuring the level of precision and accuracy of the sensor. Testing this sensor is carried out by bringing body parts such as the hands, torso and other body parts closer to a predetermined active distance where the distance to activate this sensor is 1-30cm. Indicators if the ultrasonic sensor detects the presence of an object at a predetermined distance are the light on relay 1 and the opening of the solenoid valve tap.



**Figure 3.** Ultrasonic sensor testing

To test the range of the sensor can be seen from the following table:

**Table 1.** Ultrasonic sensor distance measurements

No	Object Distance to Sensor (cm)	Condition Solenoid Valve
1	10	Open
2	25	Open
3	30	Open
4	35	Closed
5	40	Closed

## 3. Testing the ky-037 sound sensor

This test aims to find a value that is accurate or exceeds the predetermined threshold value, namely 500Hz. The sensor test is carried out by clapping both hands, then the sound of the clapping will be received by the KY-037 sound sensor microphone, which if the clapping sound is accurate, is 500Hz or If it exceeds, the sound sensor will be active, the relay indicator lights 2,3, and 4 will turn on as the output of the sound sensor.



**Figure 4.** Testing the ky-03C sound sensor

### ***Overall Testing of Tools***

In testing the entire device, it begins by applying voltage to the Arduino and solenoid valve. If the indicator light on the Arduino is on then you can confirm that the Arduino has received voltage. To find out whether the solenoid valve has received voltage or not, it can be indicated by vibrations on the solenoid valve. If it vibrates, it means the solenoid valve has voltage. If the ultrasonic sensor detects a predetermined object, relay indicator 1 will turn on, and if the sound sensor detects a predetermined sound wave, relay indicators 2,3 and 4 will turn on.



**Figure 5.** Testing of the entire tool

### ***Revise tool usage to improve product performance***

After carrying out several experiments, there was an error in the relay used. The error that occurred was that when the solenoid valve was given a voltage of 220v, it would cause the relay to turn on/off by itself. This resulted in the system that had been previously created not being able to work normally so that the prototype that was created could not function. Therefore, to overcome this problem, the relay was replaced. Figure 4.6 Relay replacement

### ***Advantages and Disadvantages of the warm water shower prototype***

The automatic hot water shower prototype has advantages and disadvantages in use, including:

#### **1. Excess**

The advantages of the warm water shower prototype are:

- a) In terms of water utilization, this tool is very helpful and effective because the faucet only flows water when the sensor detects the presence of an object.
- b) It has an automatic warm water feature which to activate it just claps both hands.

#### **2. Weakness**

The weaknesses of the warm water shower prototype are:

- a) In designing this tool, when the solenoid valve receives 220v input, it can sometimes interfere with the working system of the relay.
- b) It requires strong water pressure so that the water comes out of the solenoid valve quickly.

Based on the achievements that have been obtained from the tool design and manufacturing process, there are several suggestions for further development. Namely, further research is expected to use more than one ultrasonic sensor or use other sensors because to be more effective in reading objects, it is hoped that this prototype can be developed into a functional tool and can be applied practically in appropriate environments.

#### D. Conclusion

Based on the design achievements and experimental results of the Arduino Uno-based Automatic Hot Water Shower Prototype, it can be concluded that:

1. In designing this system, components such as a solenoid valve as a tap, an Arduino as a controller, an ultrasonic sensor as a distance detector, a sound sensor as a clapping sound detector, a relay module as a switch, a water heater element as a heating device, a thermostat as a temperature controller, and a temperature sensor are required. as a display of the temperature indicator used.
2. In designing an automatic warm water shower prototype based on Arduino Uno, the working system of this prototype is that when the ultrasonic sensor identifies or detects an object within a distance of 30 cm, the sound sensor will activate the solenoid valve which acts as an automatic faucet. Then, if the user wants to use the warm water feature, the user gives a command in the form of clapping, where the sound of the clapping of the hands will be received by the sound sensor which then activates the thermostat module, water heater and temperature sensor.

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