



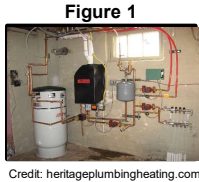
Hot Water Controller

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BACKGROUND

A need has been identified surrounding the safe, reliable, easy, and consistent control of hot water temperature at the end of use in a residential setting. Additionally, this need allows for the opportunity to expand the application of hot water temperature control at the user point to the control of the temperature of the hot water supply leading to potential energy savings.



Problems with "Traditional Heaters"



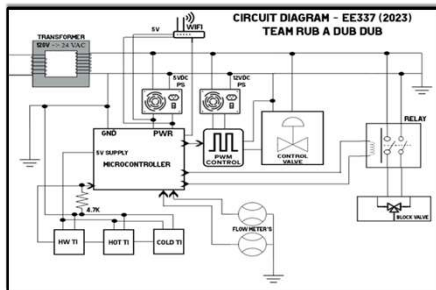
One of the problems with hot water heater systems is that they can only be set to a water temperature once. Once that water is gone it takes time to heat more water, and that can be a problem for people with large families or for people with large hot water demands. (Figure 2) shows a normal hot water heater.

PROPOSED SOLUTION

Our proposed solution (Figure 3) consists of a device that will control hot water using cold water flow. This hot water controller consists of 6 main parts: temperature sensors, flow meters, block valve, flow control valve, microcontroller, and Wi-Fi module.


The user initiates the system by only turning the hot water on. This will cause the block valve to open and the flow control valve will control cold and hot water mixing by using a "quasi-PID" control that opens or closes the valve accordingly to maintain desired the output temperature. To place the system in manual control, the user need only turn on the cold water and the system will operate normally.

Figure 3




SYSTEM DESIGN

WIFI



The ESP32 is an inexpensive WIFI module that connects your computer or phone to the controller to the set temperature (not shown).

Arduino Processor



Arduino provides for flexible hardware configuration. It is open-source software and widely available. Additional advantages allow for a system to operate on a large scale.

Temperature Sensors

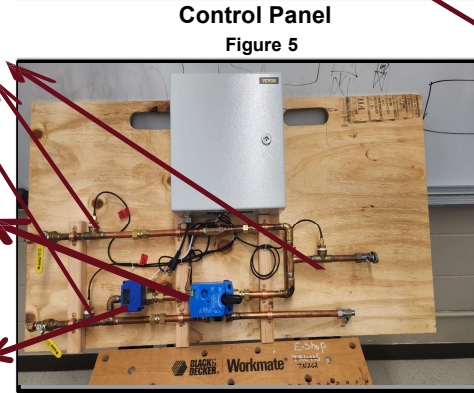
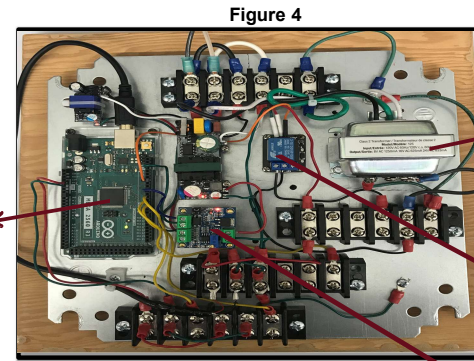
The Temperature sensors read in the temp of the cold, hot, and mixes water and feeds this info to the controller.

Flow Control Valve


The flow control valve is used to control the amount of cold water mixing into hot water for desired temperature.

Block Valve

The block valve provides positive shutoff when the system is not in use or when the user wishes to control the water temperature on their own.



Power Management



This system is powered by 120VAC from the outlet and goes to a 120V/24VAC step-down transformer, 120VAC/12VDC converter, and 120VAC/5VDC converter. The 5V supply powers the Arduino board which subsequently provides 5VDC and 3.3VDC to the systems electronic and instrument components. The 12VDC supplies the 0-10DC the PWM Control sends to the flow control valve.

Relay

The relay provides or interrupts power to the block valve to allow for operation of the system.

PWM Control

Reads the PWM from the controller and converts it to an analog signal that ranges from 0-10V that opens or closes the flow valve incrementally.

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CONTACT INFORMATION

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FUTURE DIRECTION

- Explore HMI options to provide a better user experience
- Implement a memory function to "save" user profile temps
- Convert the Control Panel to a PCB design.

REFERENCES

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