



Hot Water Recirc-2

Hybrid Cross-Over Zone Valve Continuation

ELECOMP Capstone Design Project 2026-2027

Sponsoring Company:

Taco, Inc.

1160 Cranston Street

Cranston, RI 02920

<https://www.tacomfort.com>

Company Overview:

Taco is a Global manufacturing company headquartered in Cranston, RI that services both the Residential and Commercial/Industrial HVAC and Plumbing markets on a global scale. Products include pumps, valves/accessories, controls and tanks.

Taco has 1000+ employees and 7 manufacturing plants in RI, MA, TX, CA, Canada, Italy, and Czechia. In addition, Taco has an Engineering office in Switzerland and remote Sales employees across both the US and Europe.

Taco is known as a Global leader in the pump industry for hydronic heating and cooling in both Residential and Commercial markets.



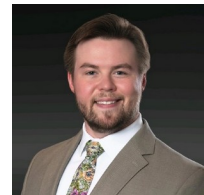
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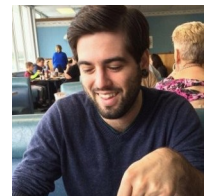


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Project Motivation:

Taco has recently submitted a non-provisional patent for a domestic hot water recirc loop hybrid cross-over valve. This product will be the 3rd generation cross-over valve for Taco. The motivation for this project is to take the prototype for the electronic controls developed by Capstone designers from 2025-2026 class and iterate upon it to bring the next prototype one step closer to being a viable product. New ideas that come out of this project, if patentable, will be added to the existing patent and the students' names will also be added as inventors.

Anticipated Best Outcome:

To have a functional, form-factor appropriate PCB prototype that can control a valve's position given sensor input, communicate wirelessly, and harvest its own operating power from its environment. Running a Domestic Hot Water Recirc loop in a home is optional. This may



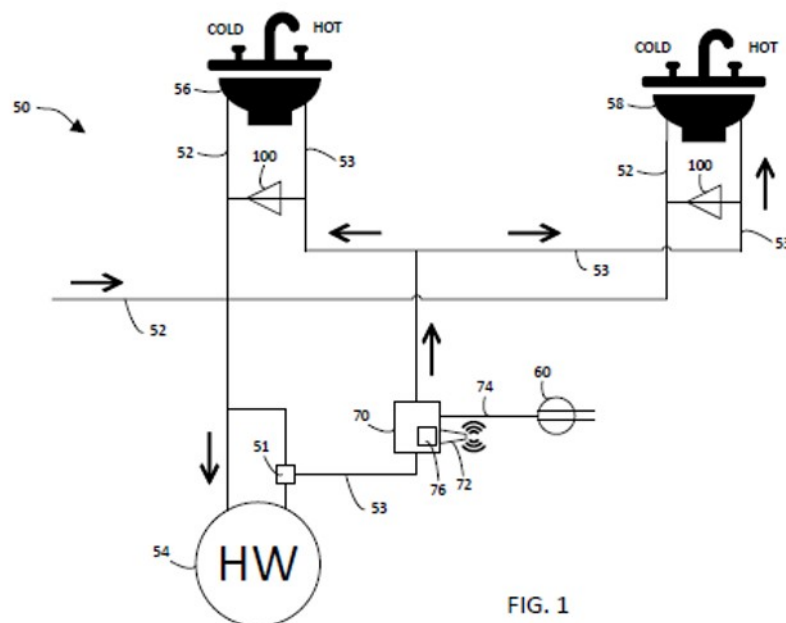
require some Mechanical Engineering skills to work with mounting electronic actuators for valve operation and sensors, and 3D modeling for valve/PCB housings.

Project Details:

Hot Water Recirc loops have become very popular in the plumbing industry to reduce the amount of water wasted by running water until hot water finally arrives at the faucet. These products are especially popular in the West in states like California and Arizona where it's imperative to save on the amount of wasted water.

This project is proprietary and has IP already submitted around this concept. The patent will be given to the students to work from after signing an NDA with Taco. The technologies that will be utilized in this design include BLE, data measurement, power generation, valve actuation, iOS and Android App development and the firmware required to run and communicate to the entire system.

Overall system concept: Maintain the temperature at each fixture in the most efficient manner to preserve both water and power.





Hardware/Electrical Tasks:

- PCB schematic design
- PCB layout design
- Hardware debugging/testing
- Energy harvesting technology research

Firmware/Software/Computer Tasks:

- Firmware written to control hybrid cross-over valve operation
- Firmware written to control power generation
- Firmware written for communication via Bluetooth to system circulator pump
- Firmware written for communication via Bluetooth to Mobile App

Composition of Team:

- 2x Electrical Engineers
- 1x Computer Engineer

Skills Required:

Electrical Engineering Skills Required:

- Component selection/sourcing
- Hardware debugging/testing
- PCB schematic design (Circuit Maker/Altium/KiCad preferred)
- PCB layout design (Circuit Maker/Altium/KiCad preferred)
- CAD modeling knowledge preferred
- Software knowledge preferred
- MATLAB knowledge preferred
- Highly motivated

Computer Engineering Skills Required:

- Proficient in C/C++
- Familiar with VSCode and/or Arduino IDE
- Knowledge of BLE
- Hardware knowledge preferred
- Git knowledge preferred
- Highly motivated



Anticipated Best Outcome's Impact on Company's Business, and Economic Impact

Getting a working prototype of the concept with a feasibility analysis to determine if the product will be feasible to go to market with from a functional, cost, and manufacturing point of view would be greatly impactful. The potential to increase Taco's market share in this business sector is aligned with our strategic goals as a company and could add a significant amount of dollars to our Top line revenue.

Broader Implications of the Best Outcome on the Company's Industry:

With a good business case, this could open the market to a new technology that could save a significant amount of water and energy in homes and businesses across the US and the world.



Appendix A: AI Use Policy – Hot Water Recirc-2: Hybrid Cross-Over Zone Valve Continuation

Allowed

- Students may use AI tools for
 - ☒ brainstorming support
 - ☒ concept development
 - ☒ literature and publicly available documentation review
 - ☐ software development
 - ☐ debugging
 - ☒ data analysis
 - ☐ test development
 - ☐ non-proprietary paragraph editing
 - ☐ non-proprietary single-slide formatting
 - ☐ preparation of project deliverables
 - ☐ note taking or transcription of meetings
 - ☐ Others: _____

Not Allowed

- Using AI in violation of university policies, applicable laws, or course-specific rules identified by capstone instruction team and project-specific rules identified by the technical directors.
- Entering proprietary, confidential, personally identifiable, security-sensitive, NDA-covered, or otherwise restricted information into an AI system without authorization.
- Submitting AI-assisted work without understanding, reviewing, verifying, and appropriately disclosing its use.
- Submitting entire documents or presentations to an AI system for editing or formatting.
- Code generation.
- Any unchecked items from the allowed list above.

Requirements

- If any use is allowed, AI tools may only be used to enhance, but not replace, students' technical



reasoning, engineering judgment, and understanding. Students must be able to explain, justify, and defend all submitted designs, code, analyses, test results, documentation, and conclusions.

- During the first two weeks of the project, the student team shall work with the Technical Directors to: identify any proprietary or confidential information that may be involved in the project; determine what information may or may not be shared with AI systems; identify the AI tools, models, accounts, and configurations approved for project use; and document any project-specific restrictions or approval requirements.
- Students shall transparently document the uses of AI using the URI CYPHER AI Usage Marking guidelines (<https://web.uri.edu/cypher/ai-marking/>). A workshop is planned for September to familiarize students with these guidelines.
- Students retain full professional responsibility for all design decisions, analyses, implementations, testing, documentation, presentations, and final deliverables, regardless of whether AI tools contributed to the work.