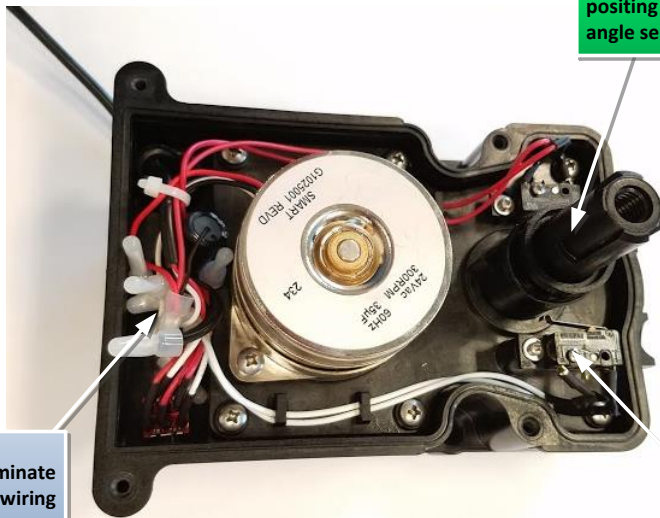




Hayward's electric valve actuator lacks ability to adapt to user preference or changing flow conditions.

Industry Problem:

Electric Valves are used by Pool Automation controllers for fountains and features have fixed limits and can't be adjusted by users to change fountain or waterfall performance. Changes in pump speed, filter media, or interactions between water features cause undesired results.



Add shaft
 positioning /
 angle sensing

Eliminate
 wiring

Solution: Develop a Smart Valve uses system pressure or flow to maintain proper fountain performance

Add sensing and control electronics to turn our fixed position valve to "infinite" valve product that manages water feature to user menu setting

Delete limit
 switches and
 cams

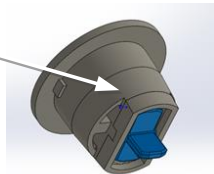
Add uP circuit board with stepper motor drive, select and incorporate shaft position sensing, water flow sensing, serial communications, RS485 drivers, ESD immunity and power supply



Synthesize requirements from our use cases, write an API to add this to Hayward's OmniLogic control automation system. Write downloadable app that runs on our Kinetis K02 processor on MQX operating system. Functions include:

- Shaft position sensing and communication
- stepper motor control
- water flow sensing and communication
- feedback / control loop to maintain constant flow under varying hydraulic conditions, while not wearing out the motor
- Motor fault handling, sensor fault handling
- Automated trending of flow vs position to determine and handle out-of-bounds conditions
- Motor run-time counters

Hayward's
 prototype
 flow sensor



The student team would interact with Jamie Murdock, Chief Electrical Engineer URI '84, Chris Bristow URI '14 and Joe Gundel Sr. Software Egr for Hayward Industries, the world's highest volume swimming pool equipment manufacturer. We will be available for campus visits, webcam / WebEx presentation meetings, and to host North Kingstown, RI factory visits for the team. Hayward will also provide support for modifying product firmware based on the student team's new protocol.

For more info or copies contact Jamie at jmurdock@hayward.com or 401-965-4121
 Linked in profile: google "jamie Murdock Hayward"

Hayward Industries Inc, is the world's largest manufacturer of residential swimming pool equipment. We design, manufacture and market a complete line of residential pool equipment including pumps, filters, gas heaters, heat pumps, hydraulic and robotic electric pool cleaners, pool chemical automation systems, control automation systems and LED color lighting systems. Our new product development efforts use sensing, circuits, firmware and application software to add intelligence and convenience to the pool ownership experience.

Smart water feature valve regulates water flow via sensing and remote commands

Description:

Problem: *Pool Industry has electric valves with cams for valve position limits. User cannot tweak the valve position without using a screwdriver, making adjustment of a jet, fountain or waterfall difficult. Hayward's product managers want an "infinitely controllable" valve so the user can set and tweak the valve position via remote control systems. Even better is the use of sensing to maintain the exact desired effect.*

Opportunity: *Rather than just add position sensing, a "smart" approach (having feedback and control) could drive the valve to intermediate positions using pressure or flow measurement. An algorithm would manage the valve position to user preferences, changes in hydraulic conditions, etc. This "smart" valve actuator will be a big win for Hayward.*

Scope:

- System Engineering tasks include: Develop Product Requirements Document in collaboration with Hayward – topics include:
 - Application Context Diagram, Operating Configurations, User Characteristics, Usability Goals, Electrical / Mechanical Interfaces and Connections, Agency Requirements, Environmental, , Design Life and Reliability. Functional Requirements, User Interface, Capacity and loading, Immunity / Fault Tolerance, Safety Features or Controls, Diagnostic Features – Electrical, DFM/DFT Requirements, Point of Sale Support, Installer Support, Servicer Support, System Condition alerts and alarms, Fault and Error Handling, Diagnostic Features, Firmware Update
 - Synthesize requirements from our use cases, write an API to add this to Hayward's OmniLogic control automation system.
- Hardware tasks include:
 - Create a circuit board housed in the existing housing to drive the motor based valve.
 - Circuits include Kinetis K02 uP, stepper motor driver, select and incorporate shaft position sensing, water flow sensing, serial communications, RS485 drivers, ESD immunity and power supply.
 - Document test cases to validate performance and reliability
 - Document schematic, bill of materials, theory of operation



- Software Tasks include
 - Write downloadable app that runs on our Kinetis K02 processor on MQX operating system. Functions include:
 - Shaft position sensing and communication
 - stepper motor control including a damping digital filter to manage overuse, overshoot, etc of the valve movement to avoid wearout of the valve system
 - water flow sensing and communication
 - feedback / control loop to maintain constant flow under varying hydraulic conditions
 - Motor fault handling, sensor fault handling
 - Automated trending of flow vs position to determine and handle out-of-bounds conditions
 - Motor run-time counters and data recording
 - Document theory of operation, command API
- Performance verification tasks include: tests that confirm signals and waveforms, capacity and performance, power and thermal management, and product functionality
- Product Validation tasks include: connect to Hayward's test pool and demonstrate to Hayward engineers and product managers

Team Description

- All team members share in developing product requirements, architecture and test development
- Hayward staff of Lead EE and Technical Director, staff EE, and Sr. Software Engineer
- 3 EE students who split:
 - Power supply, RS485 interface, and motor driver
 - Position / shaft angle sensing method and design
 - microController circuit development flow sensing interface
- 3 CE students to split:
 - OmniLogic API development and messaging, diagnostics and fault handling
 - Flow based feedback and control with wear-out avoidance management
 - Position sensing and motor control

