

SMART COOLING LOOP FOR A DATA RACK OF THE FUTURE

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Background

Expecting power usage of data racks to as much as triple over the next few years, the 7x24 Exchange, a consortium of data center operators, inquired about methods to increase their ability to regulate heat within a rack. In conversations with data center professionals, we found that a recent product was a rack wide cooling loop which pushed water evenly across each node. In an effort to optimize coolant transmission, the team developed a system capable of manipulating flow rates to match the dynamic heat loads as server usage rises.

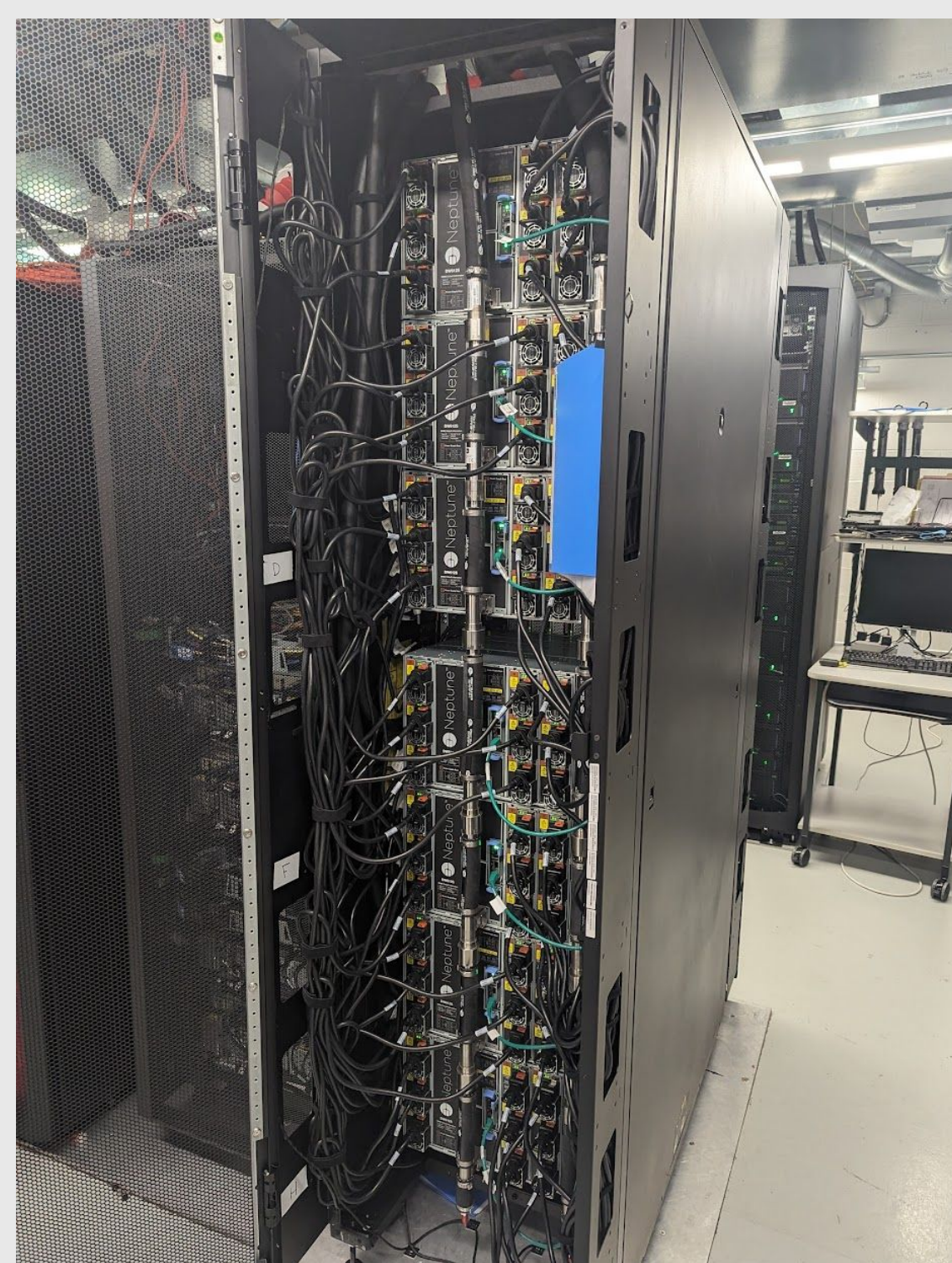


Figure 1:
Lenovo's Neptune
Cooling Loop
In Virginia Tech's
Steger Hall

Objectives

As a proof of concept for the smart cooling loop, a small scale PVC model was constructed with the goal of:

- Understand sensor requirement and usage.
- Recognize cooling necessities for heat loads.
- Coolant flow control.
- Comprehensive and friendly graphical user interface.
- Accurate electronic valve and flow control

Figure 2:
Deliverable and
Demonstration Video



System Design

Users can replicate a server in high power usage by blowing a heat gun on a branch's radiator. Flowing water will transport the heat away and a GUI will show the coolant flow and temperature changes as well as the loops modification.

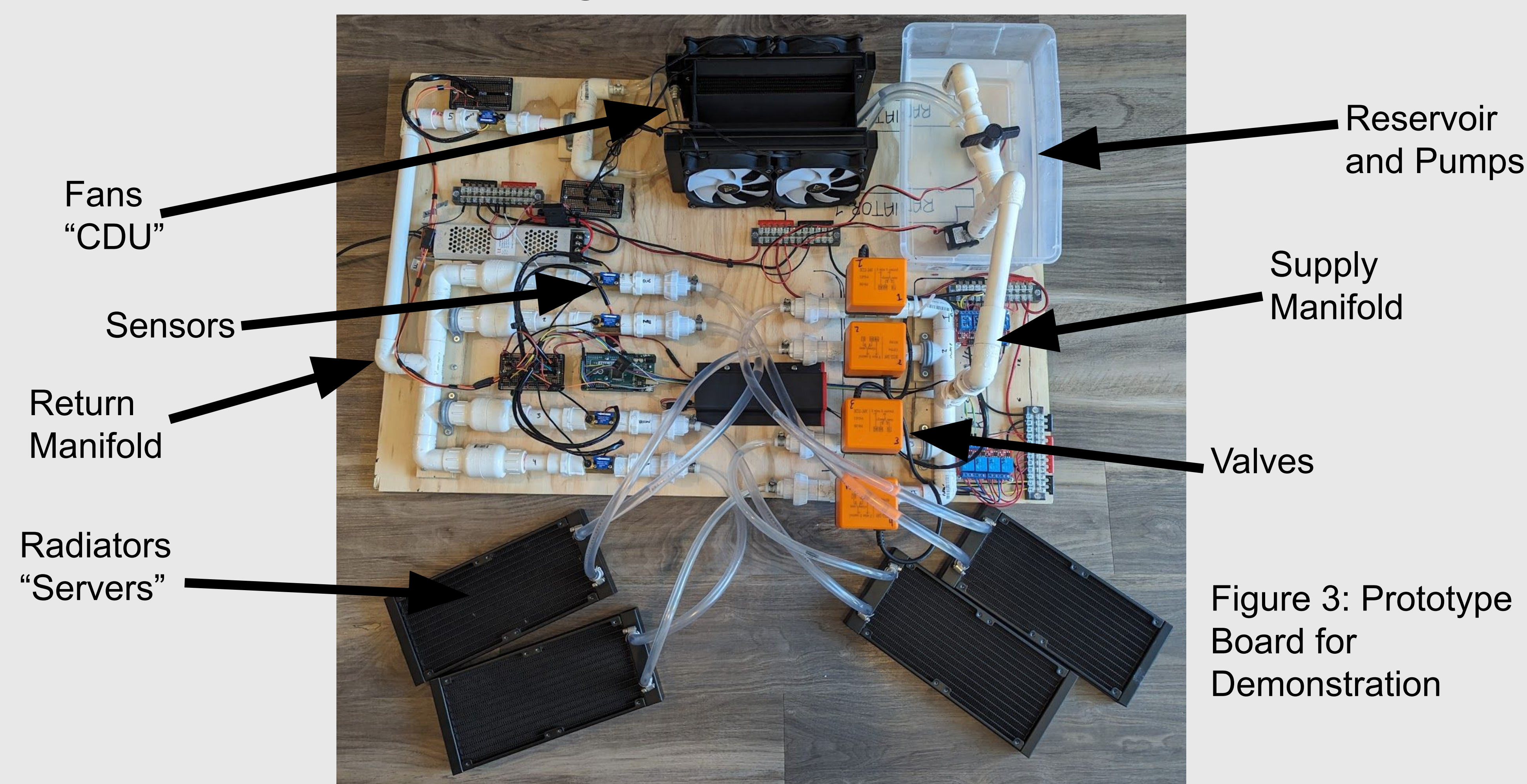


Figure 3: Prototype
Board for
Demonstration

Conclusion

- Power usage and heat dissipation will be an issue for any data center over the next few decades.
- Data centers with CRAC systems or chilled water infrastructure can easily install direct-to-chip cooling loop system
- Usable floor space in data centers will decrease due to Coolant Distribution Unit (CDU) placement (1 CDU : ~6 Racks)
- Modularity should be an important design consideration for ease of use.



Figure 5: Steger
Hall's first coolant
distribution unit

Moving Forward

Future work includes:

- Scaling design to make it capable of dealing with more nodes and higher power.
- Replicating CDU to increase cooling beyond two radiators to maximize efficiency.
- Improve the GUI to allow operator more control, access to information, and diagnostics

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User Interface and Controls

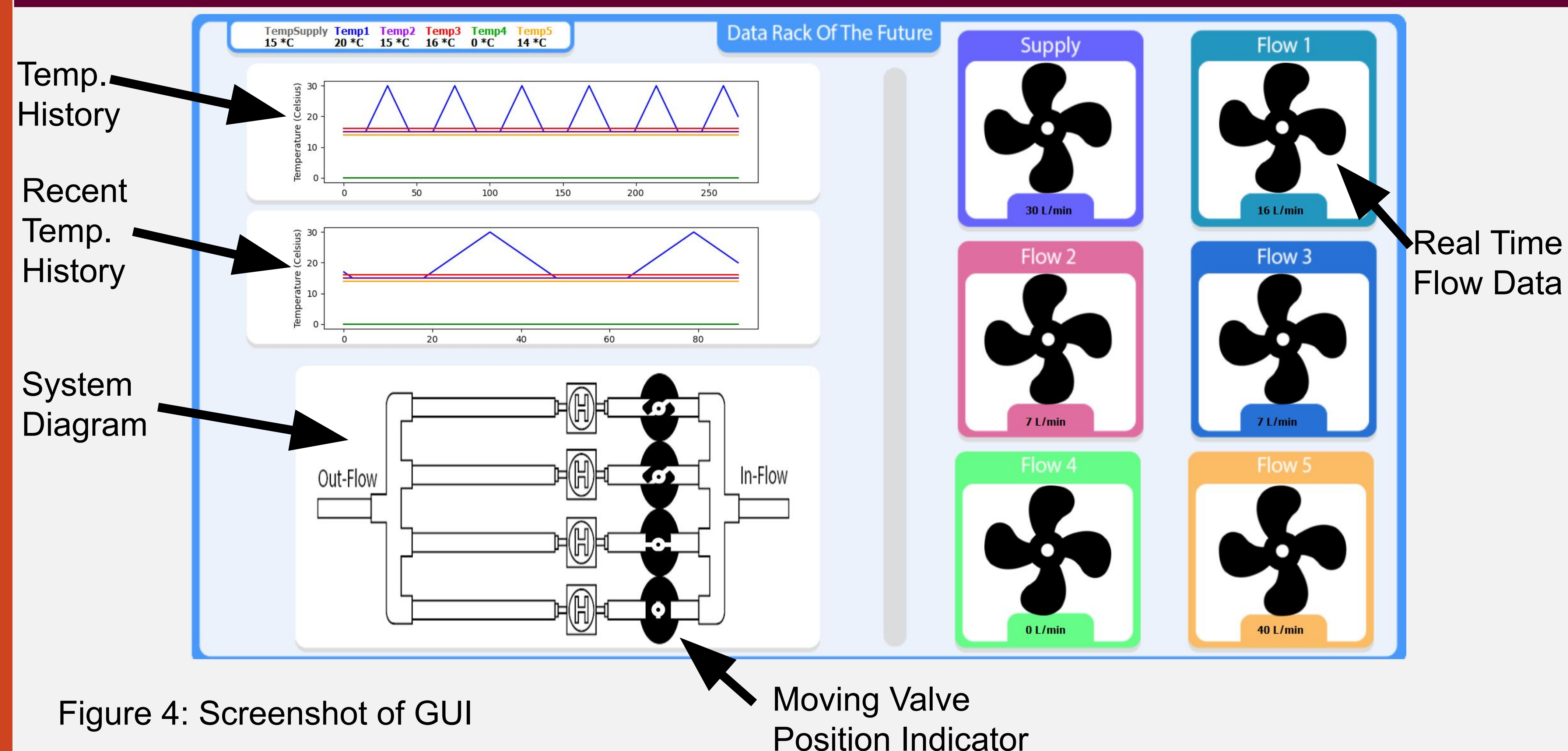


Figure 4: Screenshot of GUI

Moving Valve
Position Indicator