Microcontroller Control System for Heart Valve Bioreactor

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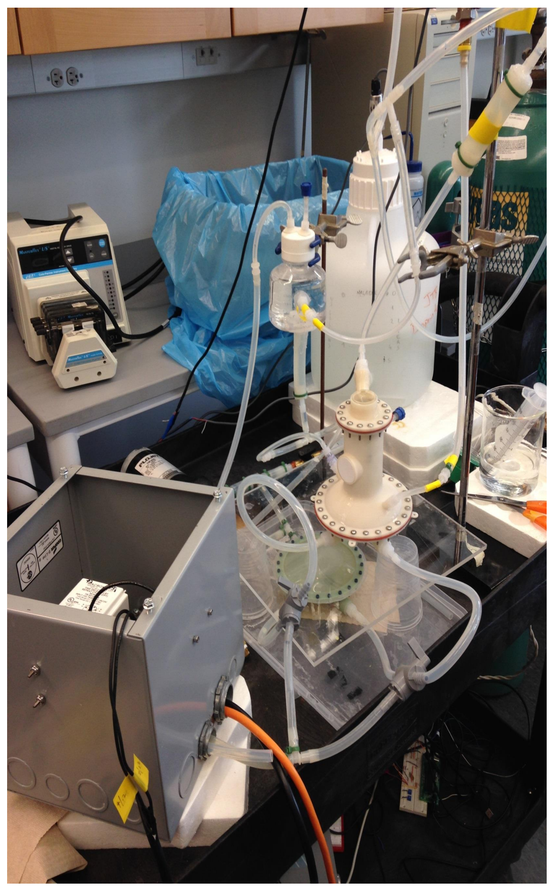
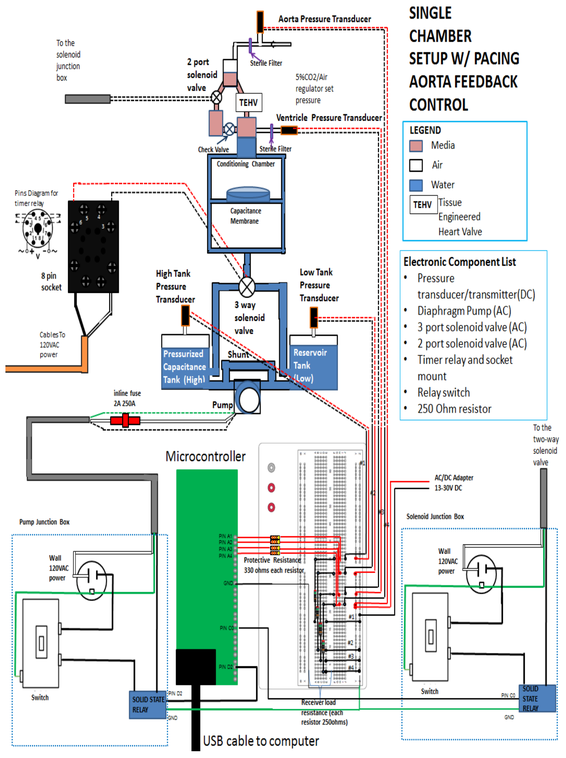
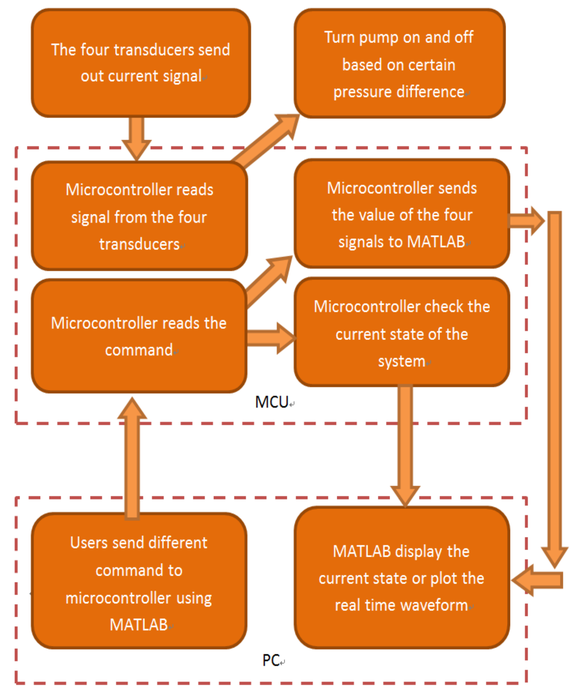
About Heart Valve Bioreactor

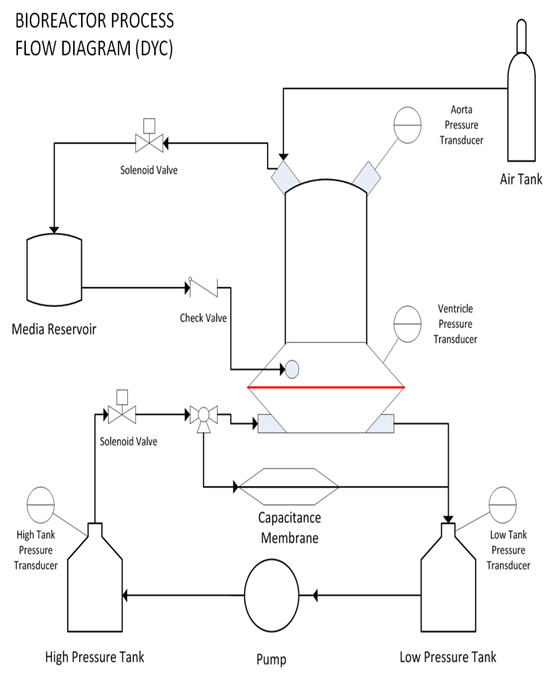
- Heart valves provide the critical function of ensuring one-way blood flow through the cardiovascular system.
- Current clinical options for aortic valve replacement for pediatric patients with congenital heart valve defects are grimly inadequate. Tissue engineering has the potential to address the serious need for heart valve replacements that are more suitable for growing children, by providing a living valve replacement capable of growth and integration.
- The heart valve bioreactor will mimic the cardiac cycle for the invitro conditioning of 3D printed tissue engineered heart valve conduits in order to mechanically stimulate the cells..



How It Works

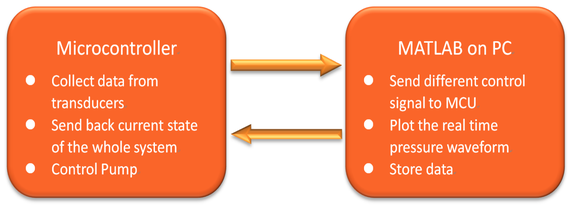






Design and Implement

- Use MATLAB to open serial port to communicate with micro -controller.
- Use MATLAB to send control signal to make microcontroller working in different mode.
- Use built-in ADC of Microcontroller to receive analog signals sent from transducers and send them to the PC through USART.
- Use TRT (Tiny Real Time) to control multi-task on microcontroller.
- Control the pump based on the pressure difference using microcontroller.



Results

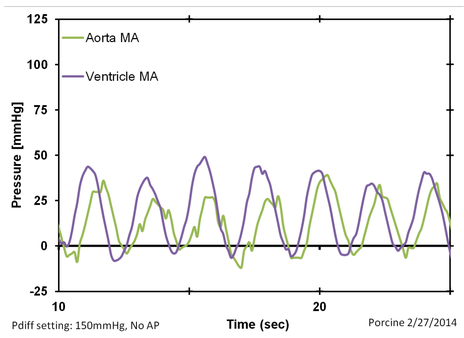


Figure 1 Porcine heart valve pressure

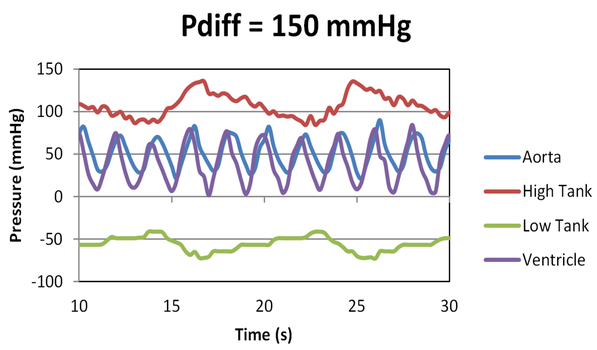
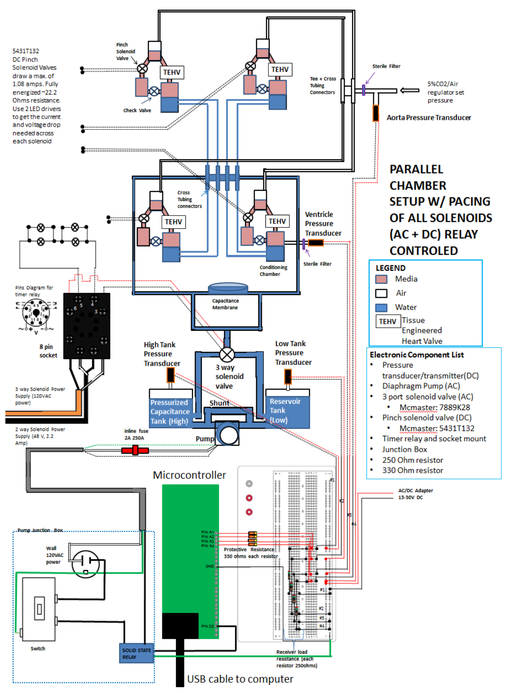


Figure 2 3D printed valve pressure

These two waveforms are plotted based on the data collected by microcontroller. The waveform of 3D printed heart valve is similar to the porcine heart valve.

Future Work

- For the future work, we want to make the bioreactor work in the parallel way.
- Make the current microcontroller system more compact by designing our own prototype board.



Conclusion

We designed a control system for the Butcher lab in BME department using ATmega 1284P microcontroller.

MATLAB is used to collect data and send control signal to control the microcontroller.

MATLAB can plot the real time waveform to monitor the state of the system.

Acknowledgements

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