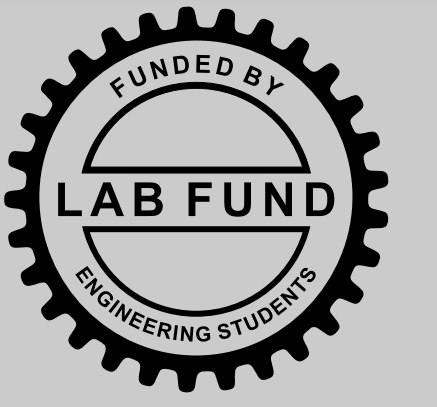


# Automated Precision Hydroponics Control System

Stephan Iskander • Mike Fera • Rahul Eswar • Zaid Al-Shakarchi

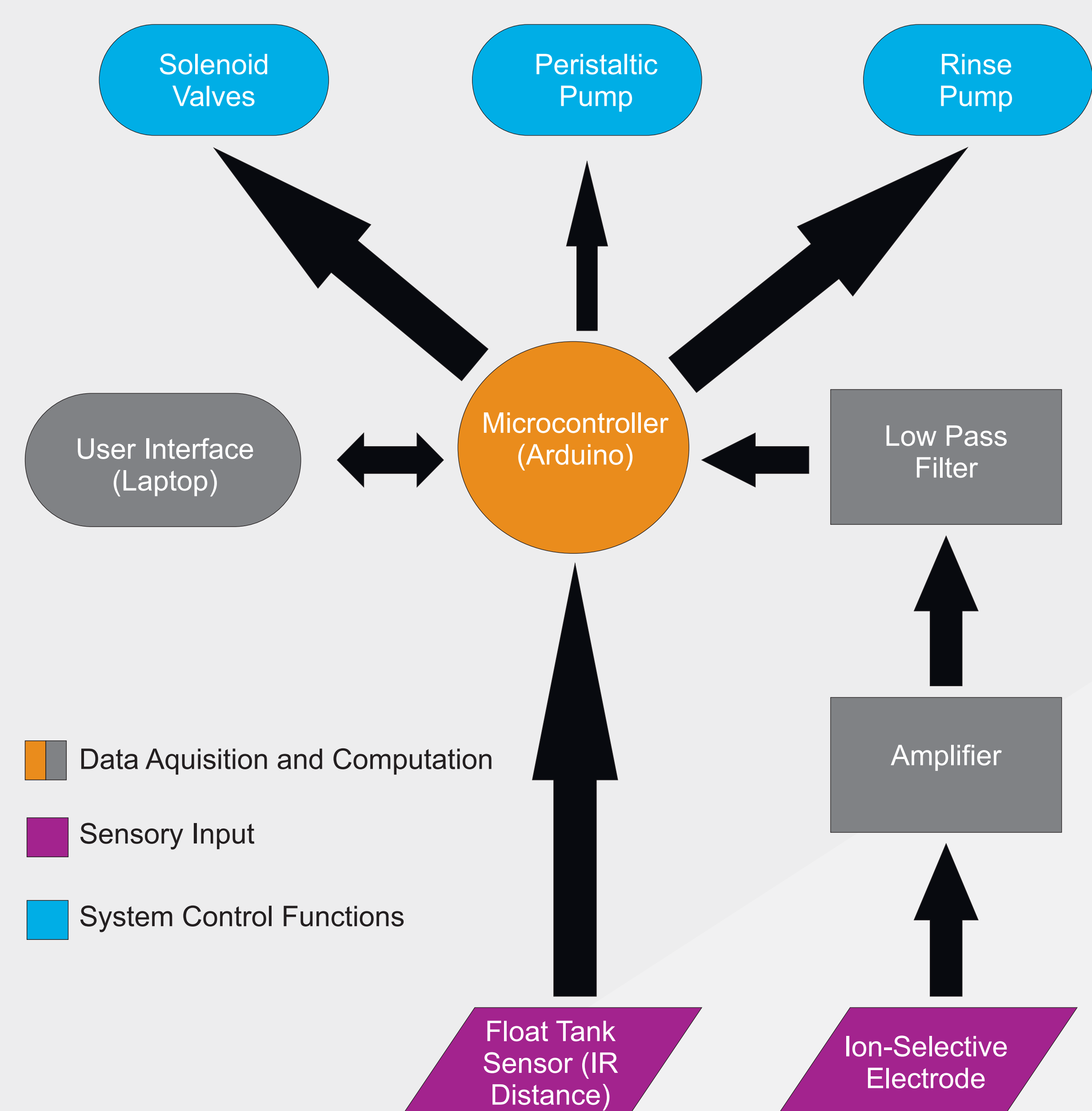


## Problem Definition

- The problem was initiated by senior research scientists at the Ontario Agriculture College (OAC), to assist with nutrient feed adjustment using real-time testing methods
- The Controlled Environment Research Facility at the OAC stresses the need for ion specific testing methods, as specific ion presence can severely effect maximum plant quality and yield [1]
- Most laboratory testing methods follow either pH/conductivity analysis and High Pressure Liquid Chromatography units, which are costly and neither ion-specific or in real-time.
- A lack of ion-specific nutrient control results in suboptimal nutrient levels which then requires periodic system flushing
- Our proof of concept show cases the use of promising ion-selective technology that operates in real-time and accurate enough to efficiently monitor and manage the inflow of nutrients



## Component Flow Diagram



## WELCOME TO OTTOGROW!

Arduino Connection Port:

Desired Concentration (PPM):

Concentration Upper Limit (PPM):

Concentration Lower Limit (PPM):

User Instructions: "Exit" button pressed

Calibration Equation of form  $Y(mV) = A \cdot \log(B \cdot X)$ :

'A' Value:  'B' Value:

Ion Concentration Plot

Plot 0

Concentration (PPM) vs Time

CALIBRATE!

MEASURE CONCENTRATION!

EXIT

## Overall Design Summary

- Ion-selective electrode chosen to monitor desired ion concentration, on-site and in real-time
- Infrared(IR) distance sensor used to monitor main control tank water level to account for water depletion from plants
- Dosing solenoid valves used to dilute and add nutrient to main tank solution such that the set point concentration is maintained
- Peristaltic pump drives samples towards the electrode testing chamber and back to the main tank to reduce waste
- Rinsing pump is used to shower the electrode to ensure no trace contamination between readings and calibration

## Future Recommendations

- Proven to successfully monitor and process ion-specific nutrient data in real-time within a closed loop feedback system
- In order to be feasible within the OAC's hydroponics system, our proof of concept must be scaled up to an array of ISEs and a more sophisticated data acquisition unit
- Further testing required to assure the design can handle the presence of interfering ions
- Long term testing for the design is imperative to assure performance within a laboratory environment

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[1] Bamsey M., Garham, T., Thompson, C., Berinstain, A., Scott, A., & Dixon, M. (2012). Ion-Specific Nutrient Management in Closed Systems: The Necessity for Ion-Selective Sensors in Terrestrial and Space-Based Agriculture and Water Management Systems. *Sensors*, 12(10), 49 – 92.

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