The objective of this project is to create an automated temperature control sub-system of a working aquaponics system.

# Input

* 3 Air sensors (inside greenhouse)
* 2 Air sensors (outside greenhouse)
* 2 Water sensors
* 2 Float sensors (measure water level, inside sump tank)
  + **FloatHigh**: Measures a high point in the sump tank to check for overflow
  + **FloatLow**: Measures a low point in the sump tank to prevent emptying the tank

# Output

* 1 Fan
* 2 Water pumps (inside sump tank)
  + **P1**: Regulates the water inside our system
  + **P2**: Turns on manually to water plants outside the system. Will be turned on automatically too
* 1 Liquid Crystal Display (LCD)
* 1 SD card
* Serial output
* Mosquito lights

# Functionality

## Regulating Water temperature

The sump tank contains two pumps, one for circulation and one for sending water to plants outside the system. It is linked with another tank which is outside the greenhouse. That tank has water in much lower temperature than the system's water.

If the circulation pump is turned off for long enough, the sump tank will raise its level and start sending water to the external tank. When the external tank reaches a level a pump starts sending colder water into the aquaponics system. Turning the external tank's pump on/off is not part of the system that will be implemented.

## Regulating Air temperature

The air temperature will be controlled by a fan. When the fan turns on it sends warm air outside the greenhouse and sends colder outside air in.

## Mosquito Lights

Must turn the mosquito lights on during the night to attract and kill flying insects. We will have a real time clock (with a battery) to get the time of day. When night time comes (we will put an estimate, could be improved in the future) the lights will turn on/off in intervals.

## Logging

The system will log all measurements on an SD card.

## Preventing overflow

The extra pump inside the sump tank is used to manually water plants outside of the system. It will also be used to prevent overflow in the sump tank. The sump tank is connected with an outside system and sends water there when it overflows, but in case the connection is blocked, the extra pump will be used. After the water reaches a level the pump will turn on for some time. It will not turn off when the water drops under the float sensor, because the change will be instantaneous and the pump will turn on/off continuously, risking a damage to the pump.

# Design

Will measure temperature. Can also measure humidity but from 3 air sensors and calculate their average. The final temperature that will be used to decide whether to start a pump will be calculated among other cached values. We will always store 20 values in an array (including current average of 3 temperatures. With every loop of our application we will calculate the average of those 20 values and use the result as internal air temperature (AirTemperature). The same will be done for water temperature (WaterTemperature).

The pumps and fan will work in the following way:

**Fan**: When airTemperature >= airTemperatureThreshold then fan turns on for intervals (i.e. on for fanIntervalOn seconds and off for fanIntervalOff seconds), until airTemperature < airTemperatureThreshold. Else starts in intervals anyway.

**P1:** The pump will **turn off** regardless of temperature when FloatLow = off (***highest priority***). When waterTemperature <= waterTemperatureThreshold then turn pump on for intervals (i.e. on for p1IntervalOn seconds and off for p1IntervalOff seconds) until waterTemperature > waterTemperatureThreshold.

**P2**: When FloatHigh = on turn on for p2IntervalOn and then turn off.

**Mosquito Lights**: Turn on for intervals at a particular hour and turn off at particular hour.

**NOTE: Pumps and fan will have override switches to be manually turned on.**