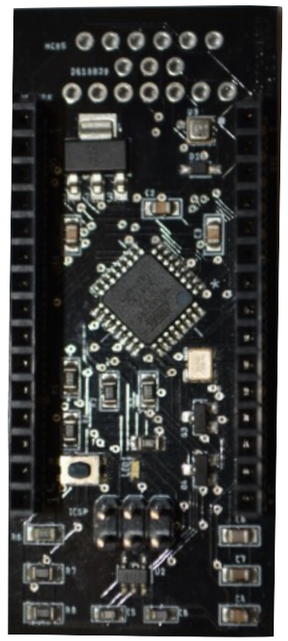
Ashank Singh

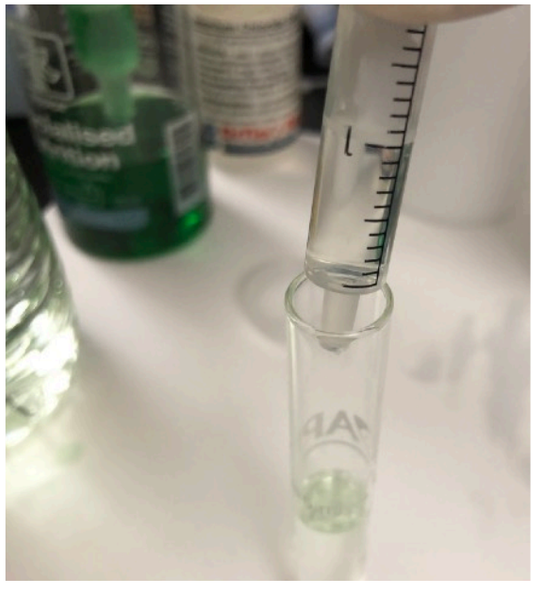
Portfolio

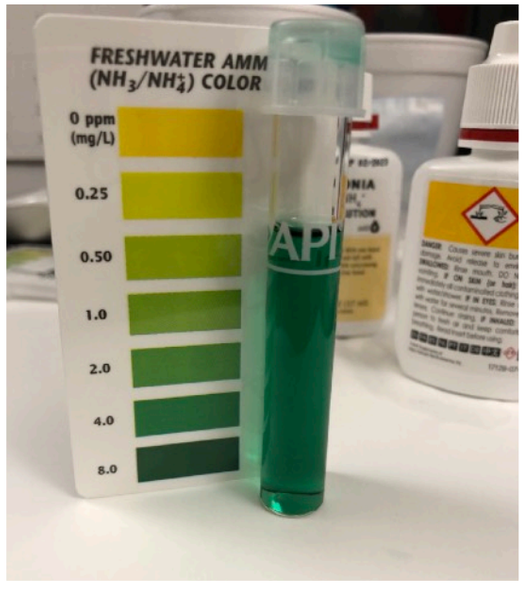


FISH BUDDY

Fish-keeping, Simplified.

BACKGROUND



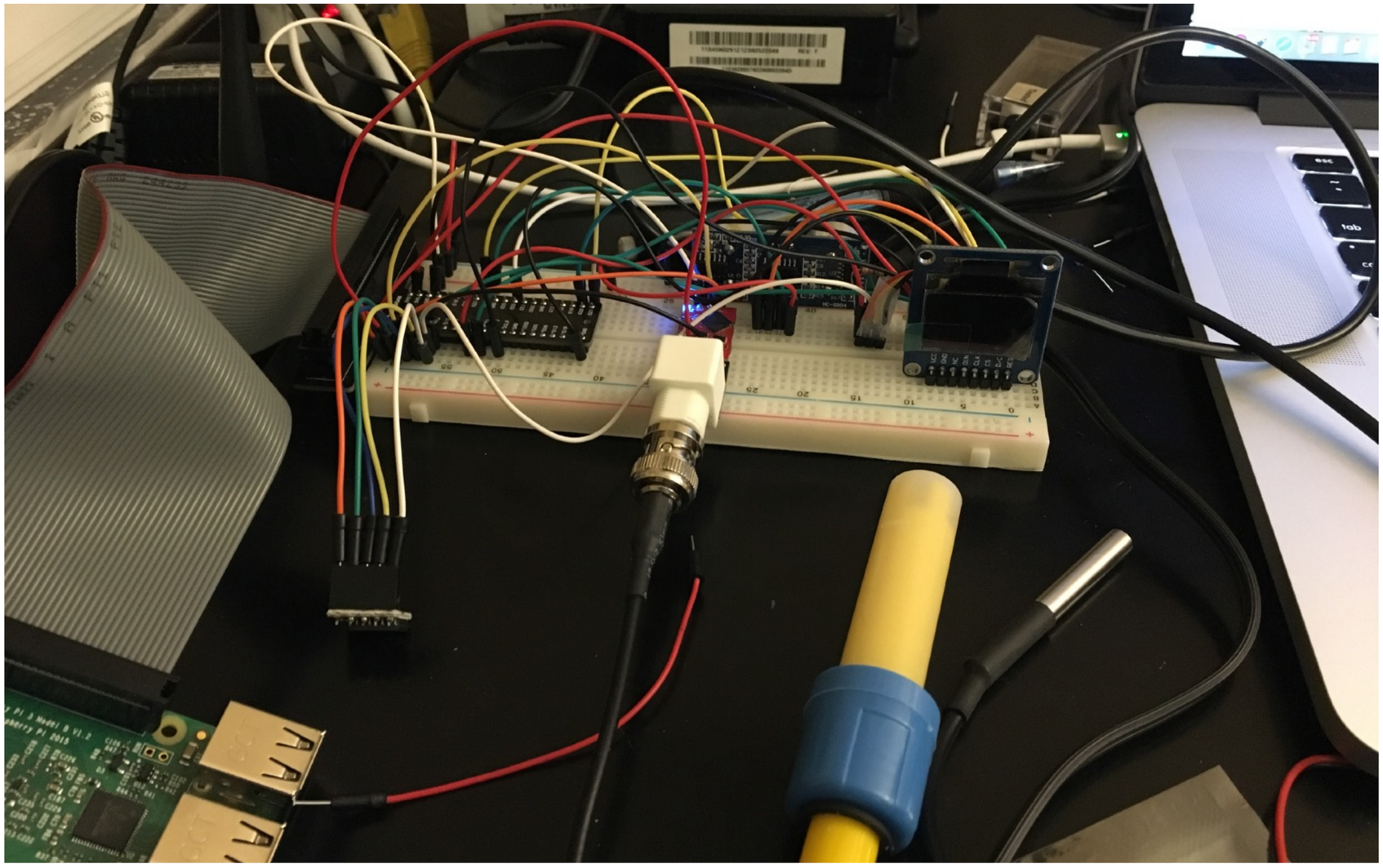


Aquariums are delicately balanced microecosystems.

pH, temperature, TDS (total dissolved solids), nitrate, and ammonia are a few parameters that aquarists frequently monitor.

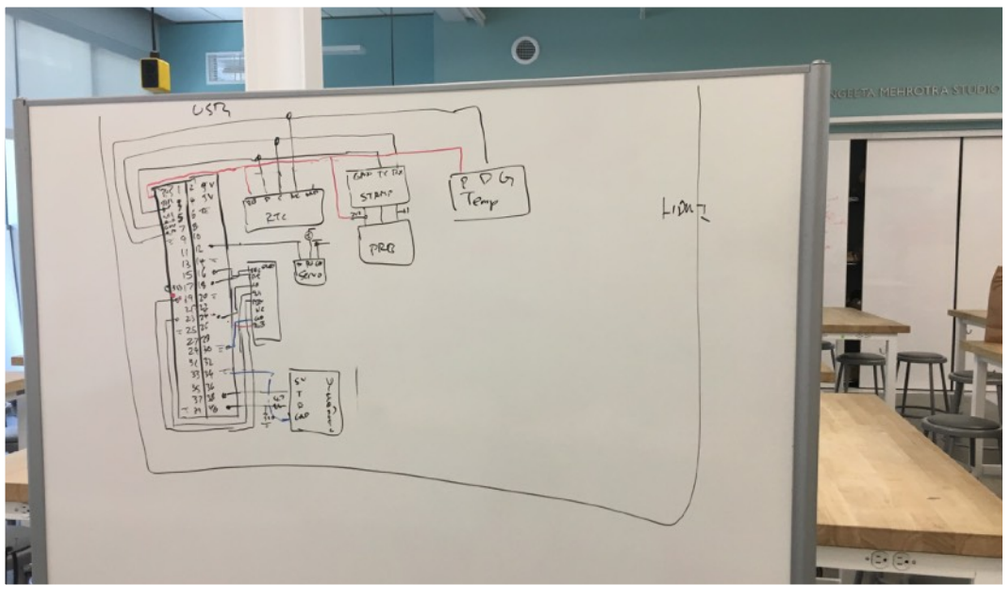
Unchecked parameters can spell disaster for aquarium inhabitants. Emergency maintenance can quickly drive up costs in the aquarium hobby and in the $16 billion aquarium industry.

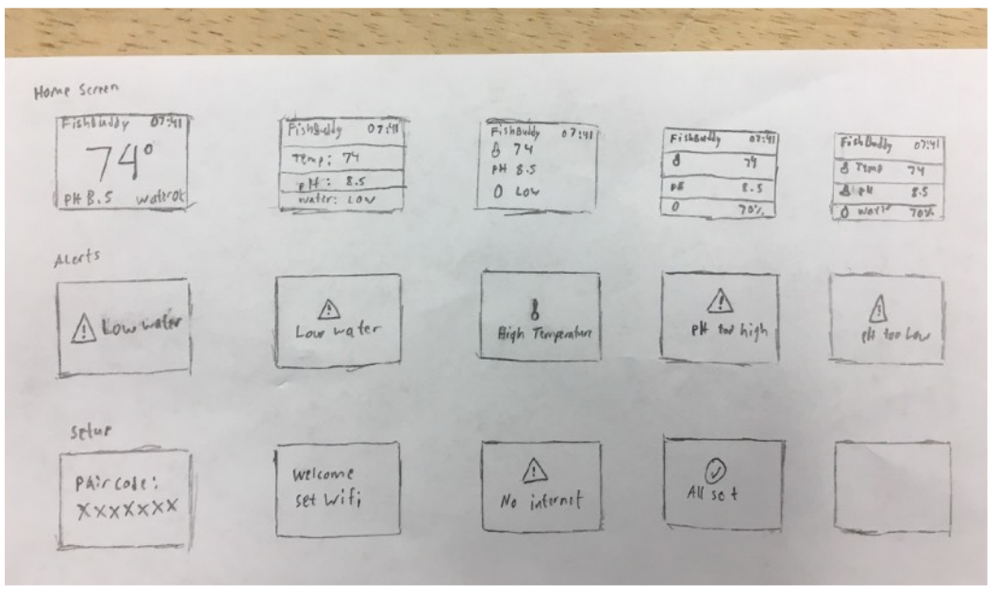
PROTOTYPING

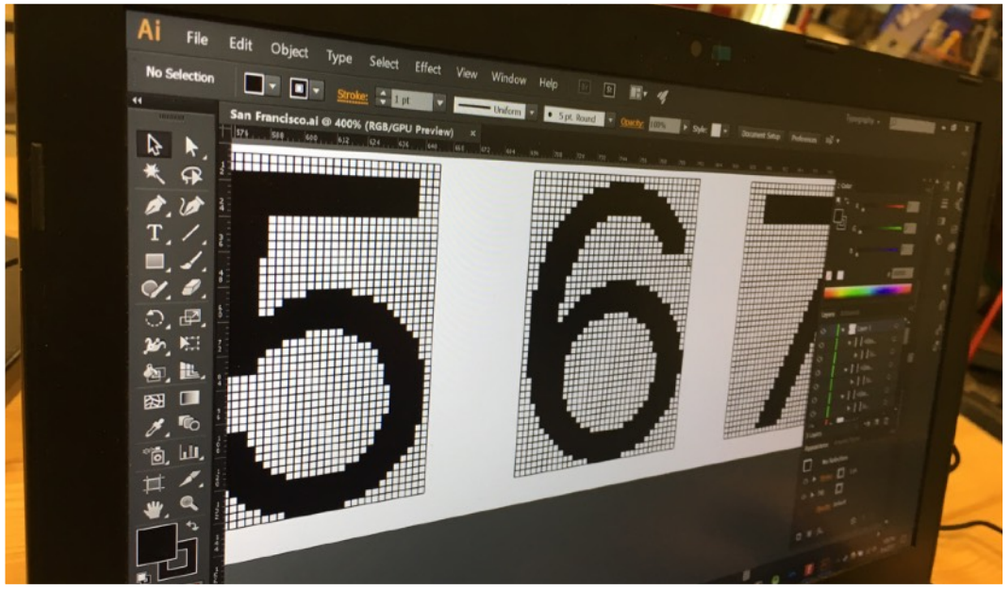


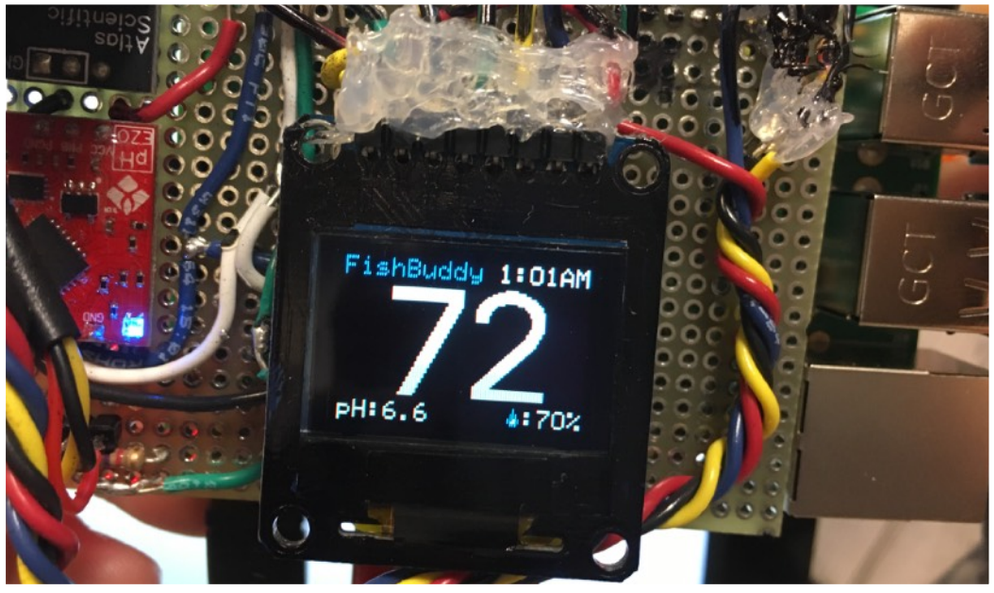
Following two weeks of evaluating users' needs, a cloud-connected approach to monitoring aquariums was necessary. Later prototypes incorporated a Raspberry Pi, a real-time clock, an OLED display and an array of lab-grade sensors.

PROTOTYPING



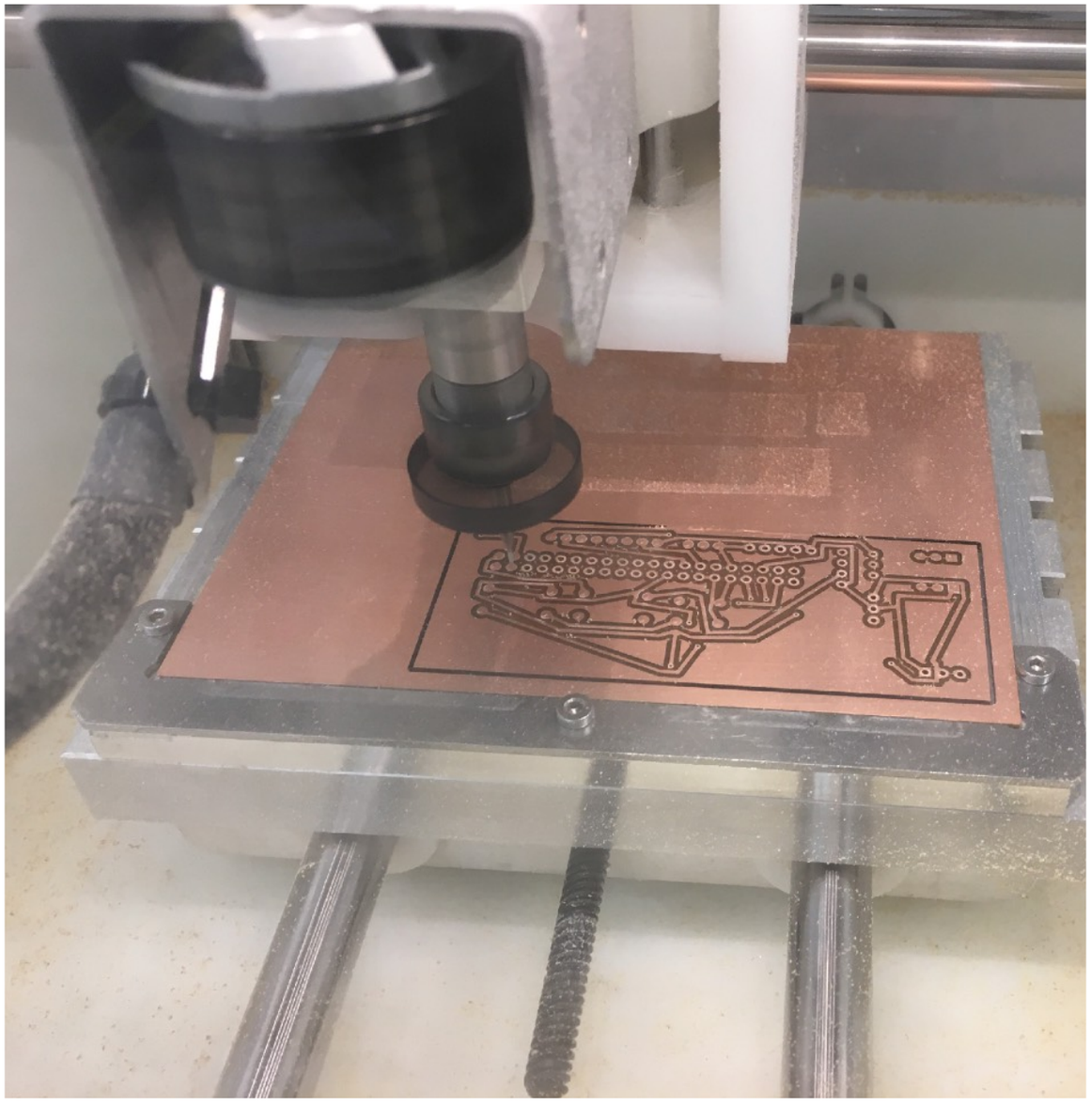


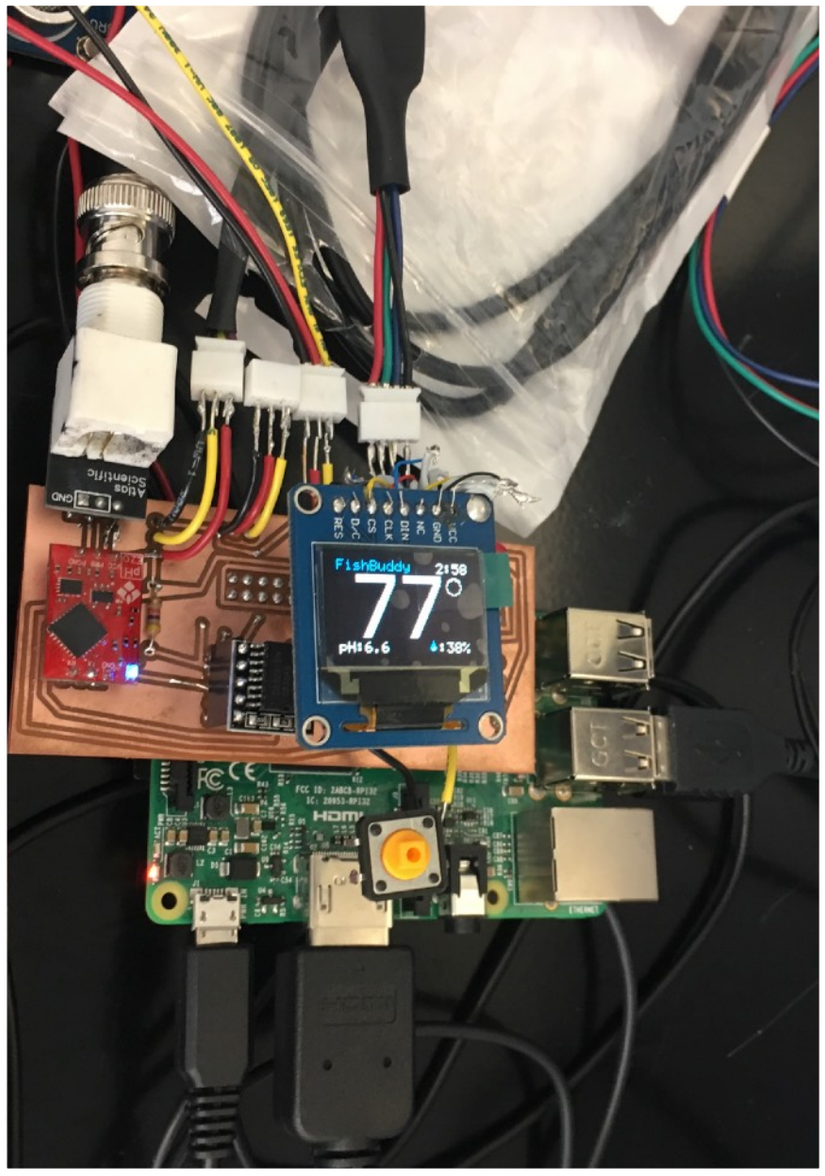




After finalizing the functionality of the device, miniaturization soon became a priority. Components were hand-soldered on a perfboard to reduce their footprint. The readability constraints of a 1 inch OLED display were addressed by designing a user interface optimized for the display's 128 x 64px resolution and by creating a custom sans serif font: FishBuddy Sans.

FABRICATION

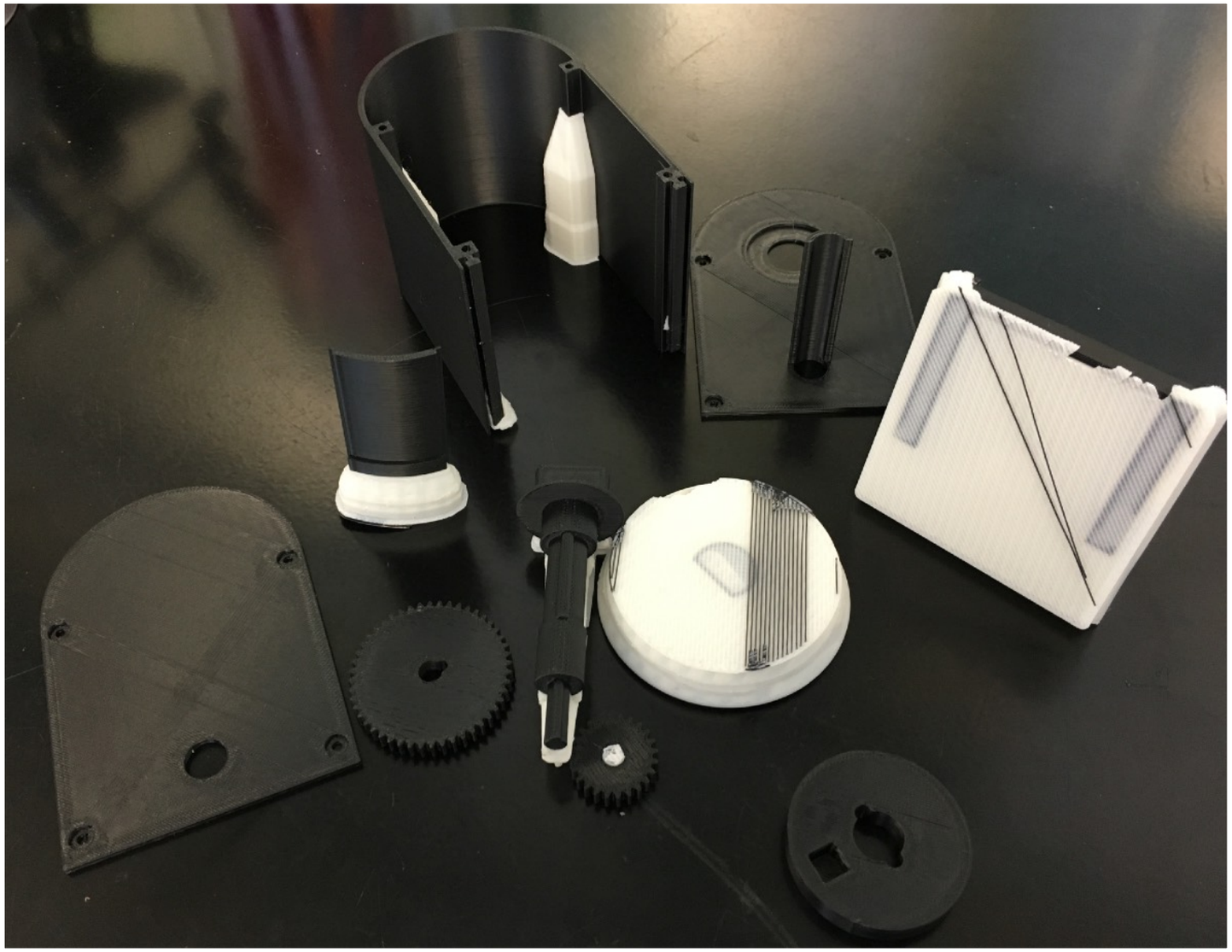




Hand-soldered perfboards could only go as far in the miniaturization of the electronics.

To fit the enclosure of the final prototype, a 2 layer copper PCB was milled using a CNC.

FABRICATION



A Stratasys Fortus 380mc was employed to print the enclosure and the gear mechanism of the feeding unit with a tolerance of ± .127 mm using ABS plastic. (The white pieces are NaOH-soluble support structures.)

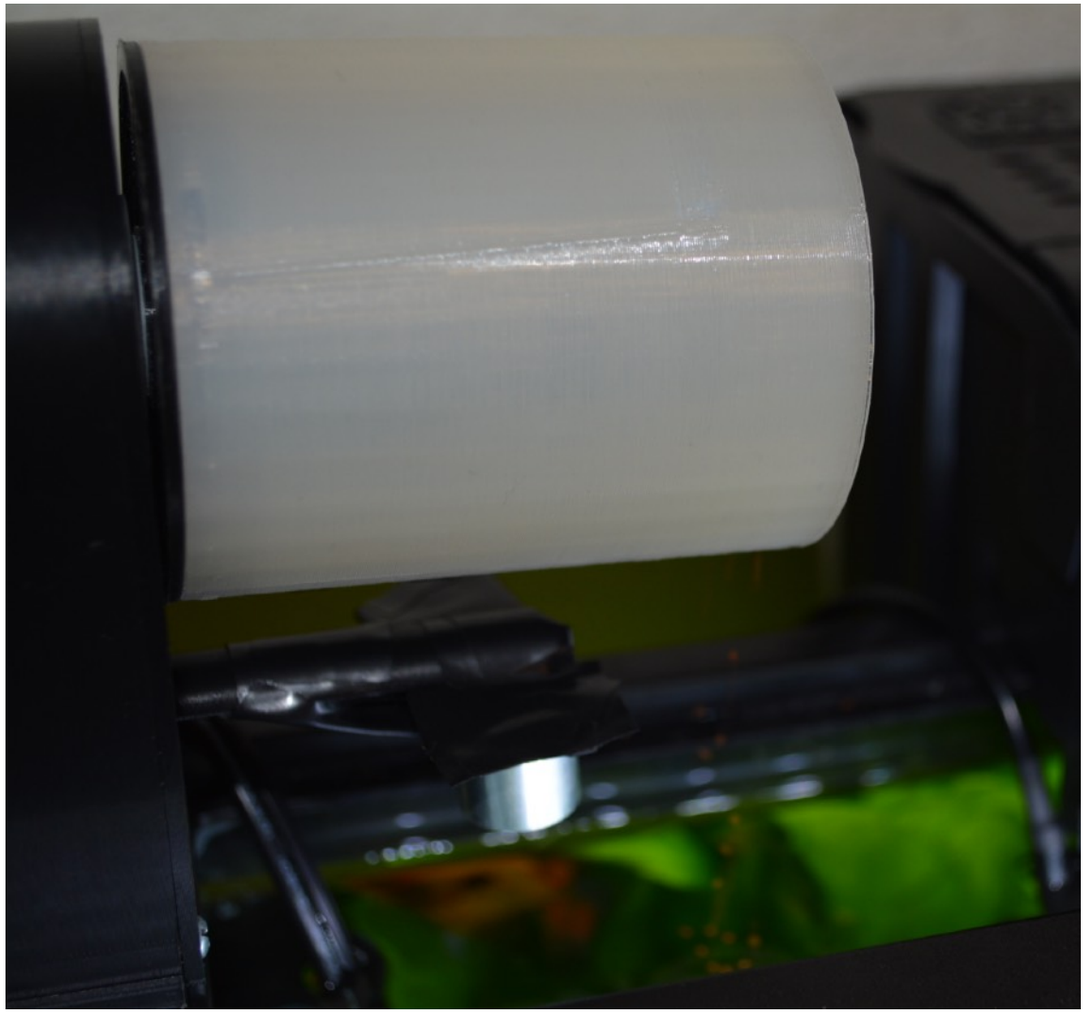
FINAL FORM

In its final form, FishBuddy is powered by a blackbox that functions as a server which streams the aquarium's vitals to a companion app. The blackbox analyzes water parameter trends and makes suggestions when it senses something wrong. It even sends emergency text messages to trusted contacts. The blackbox also integrates with an adjustable feeding mechanism that only dispenses as much as the fish can eat within three minutes.

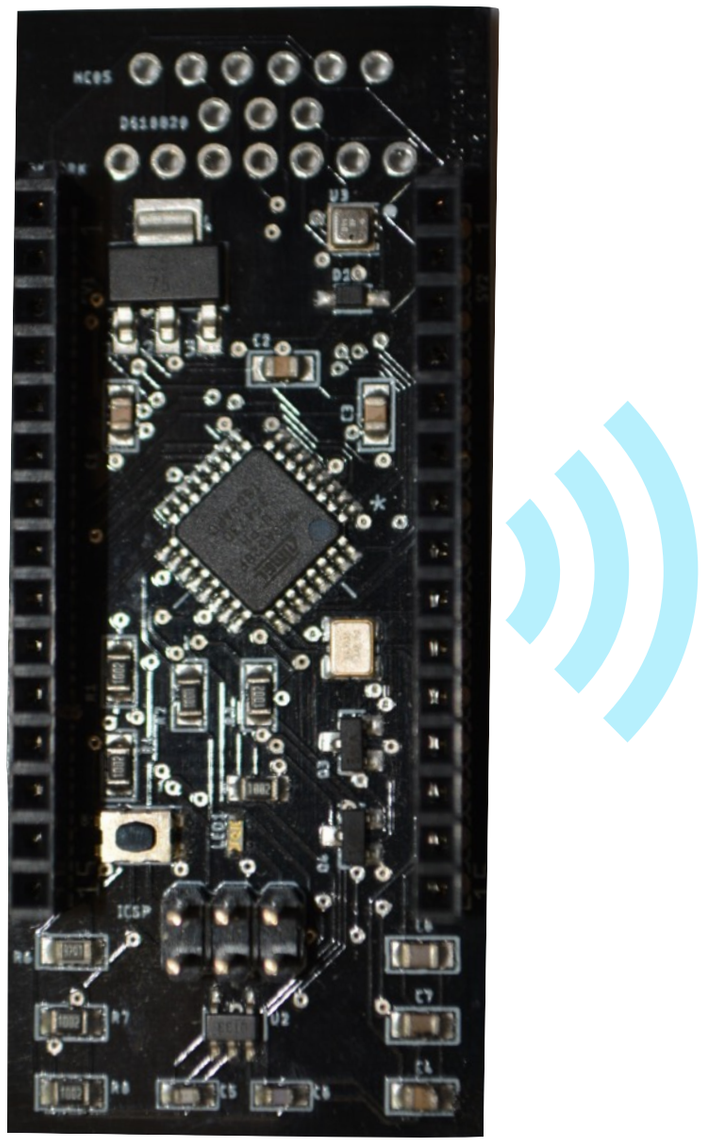
AN ECOSYSTEM IN HARMONY

Combining a blackbox, a feeder, and an iOS app, FishBuddy is an ecosystem in perfect harmony.

FISH-KEEPING, SIMPLIFIED.



FishBuddy lets its users rest easy as it keeps the fish fed and keeps a steady eye on the aquarium's vitals.
In many ways, FishBuddy is the ultimate intersection of nature and technology.



SENSORLINK

BACKGROUND

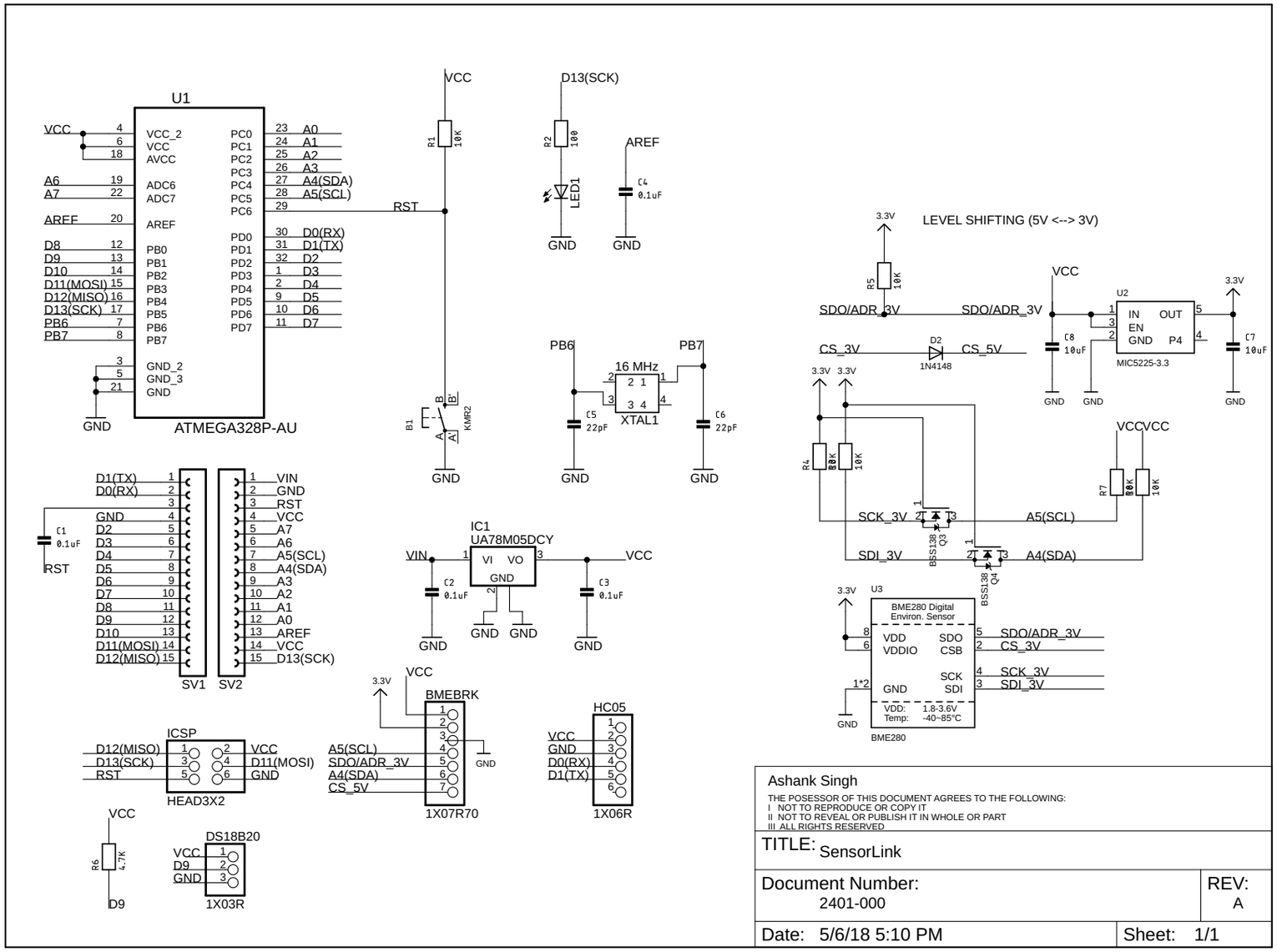
Smart thermostats bridge HVACs with the digital world and use aggregated data to make decisions that reduce energy consumption.

Frequently, a less than ideal placement of vents makes certain rooms less comfortable than the other rooms at home.

Current thermostats on the market only consider the room's temperature and fail to account for the humidity of each room.

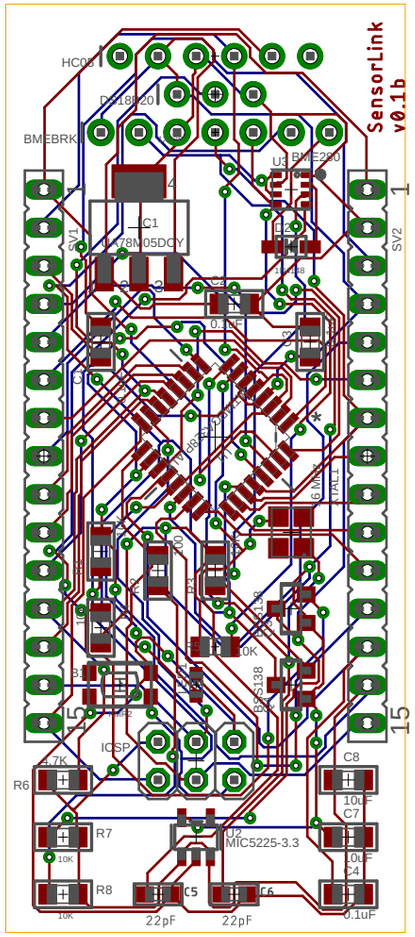
Clearly, there needs to be a way to augment existing thermostats with humidity data from each room!

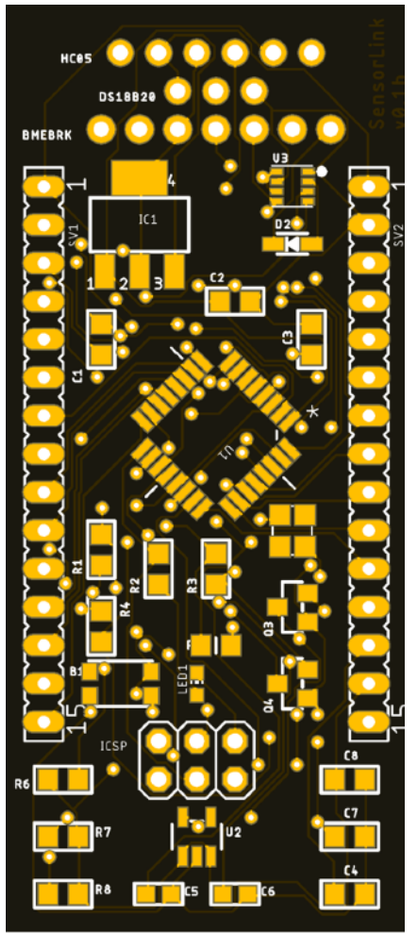
DESIGN

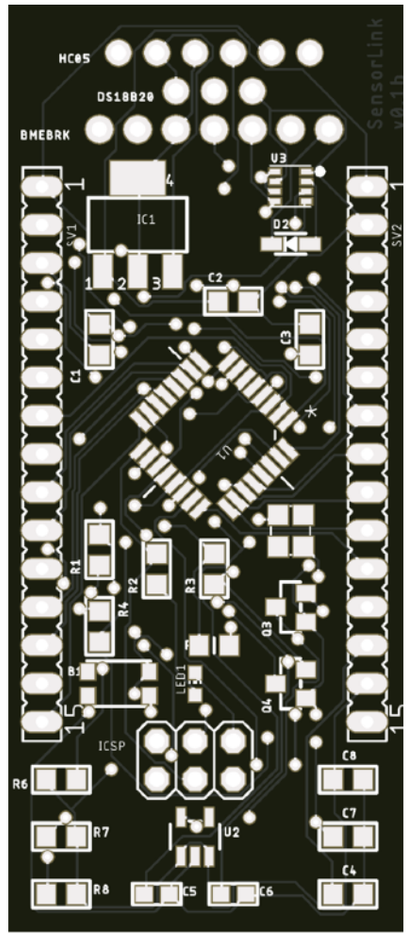


Simply put, all wireless sensors comprise of a MCU, a battery, a sensor, and a radio of some sort. After disassembling and evaluating the components of wireless temperature sensors as well as an iPhone 6S, I discovered the degrees to which sensors are miniaturized and set out to design and build my own board. I chose the Bosch Sensortech BME 280 and worked my way up to build a board to augment thermostats with additional humidity data.

DESIGN

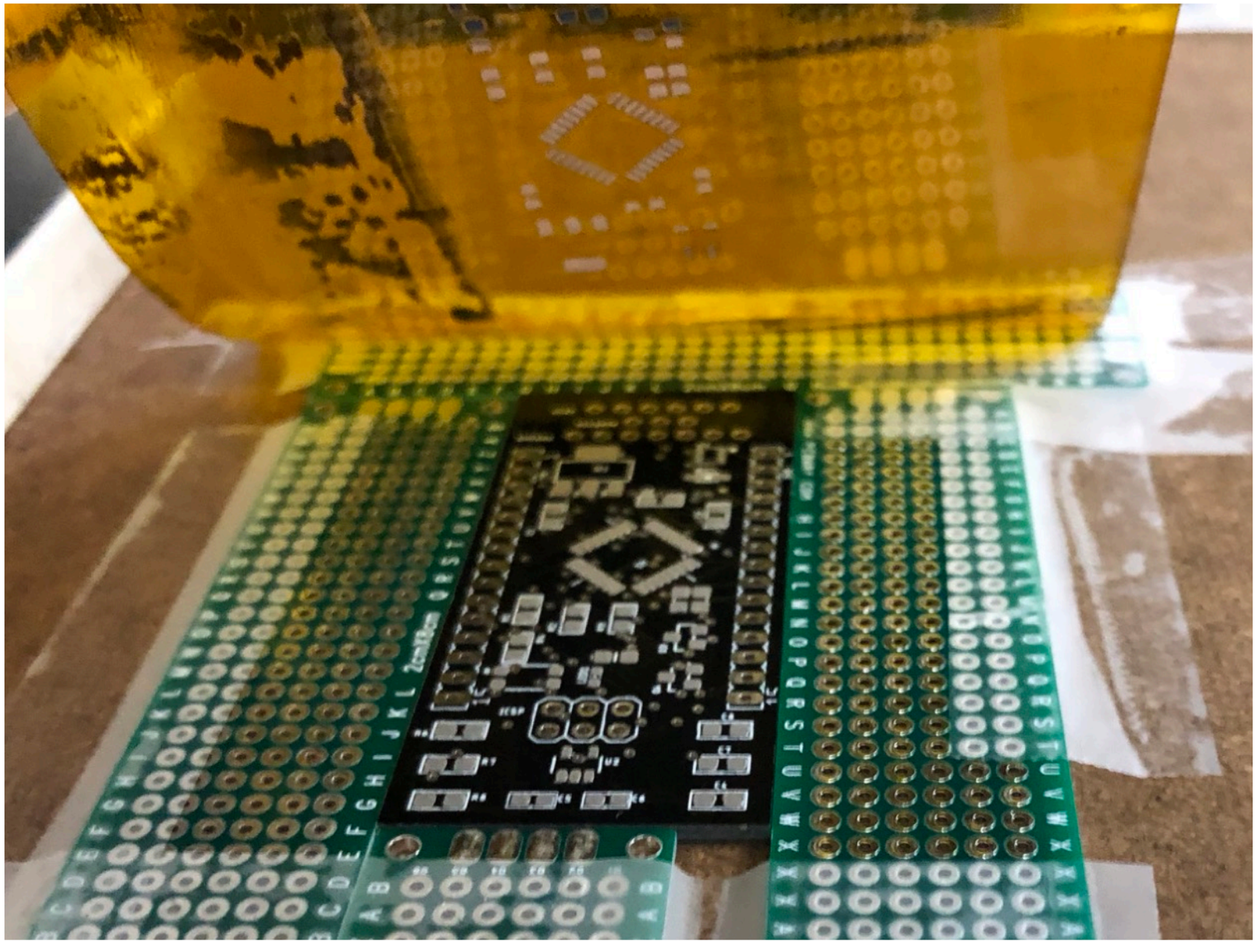






After placing over 32 components on the PCB, components were routed in a manner that would reduce crosstalk while also reducing thermal interference to the BME 280. Considering this chip is prone to self-heating, to dissipate heat, I had two options: ask the manufacturer to laser drill thermal vias under the chip's footprint, or increase the size of the solder pads. In an effort to reduce cost, I chose the latter. To reduce the production cost even further, I chose HASL (pb free) over ENIG surface treatment. By negotiating with overseas vendors, the cost of each PCB was under $35.

FABRICATION

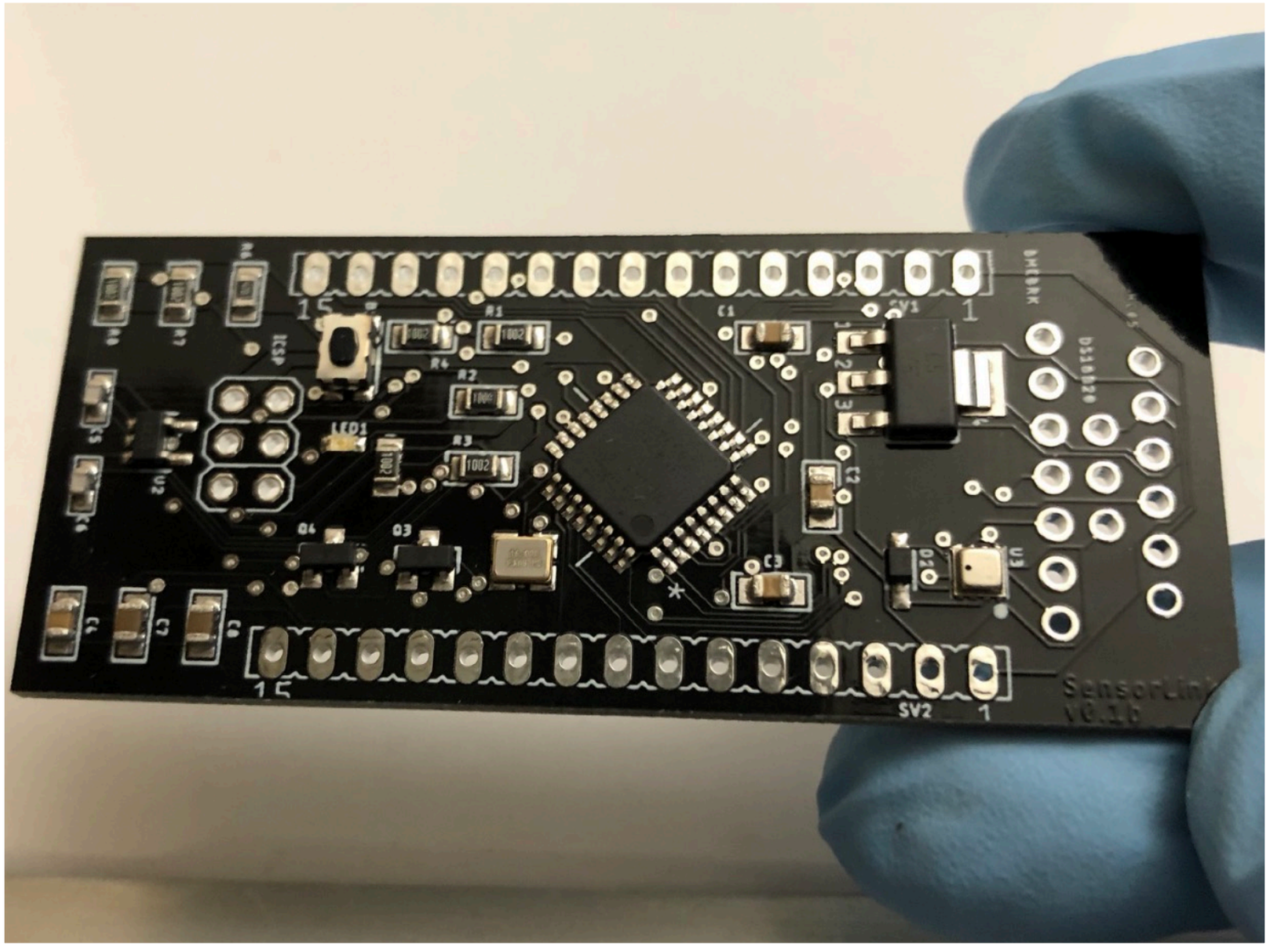


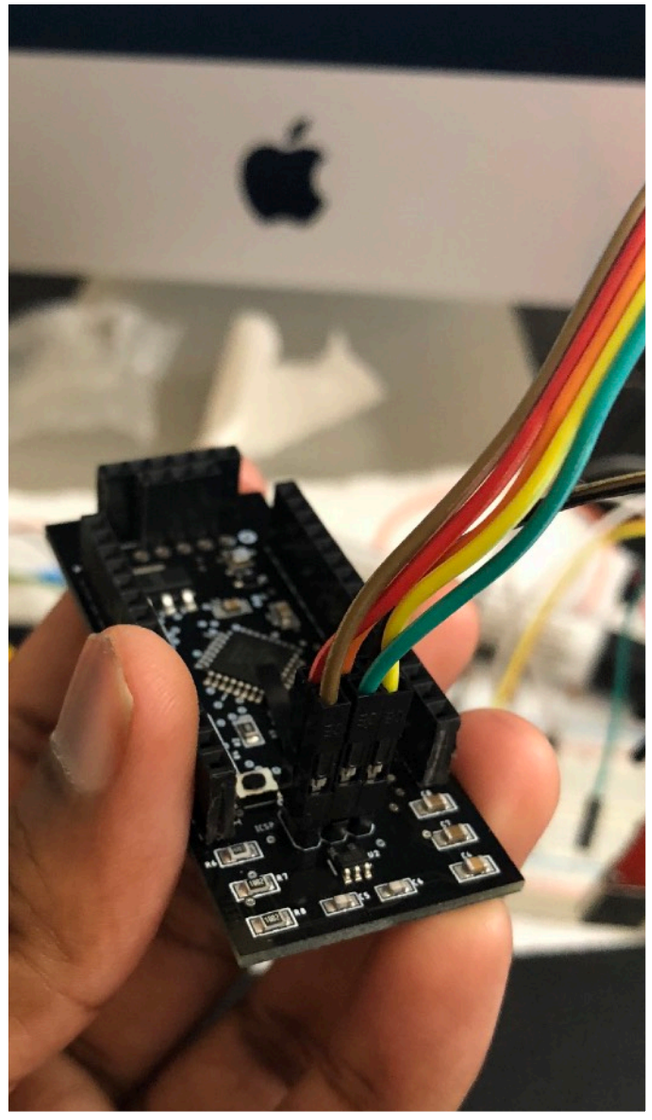
Due to the number of small surface mount components on the board. It was not possible to hand solder contacts without having bridged pins. A custom laser-cut polyimide solder paste stencil was used to uniformly apply paste for reflow soldering.

FABRICATION

As an experiment, instead of using a normal reflow oven, I modified a toaster oven to heat the boards to the correct solder profile for the components. A peak temperature of 395 °F was achieved, following a cooling period to reduce thermal stress on the components.

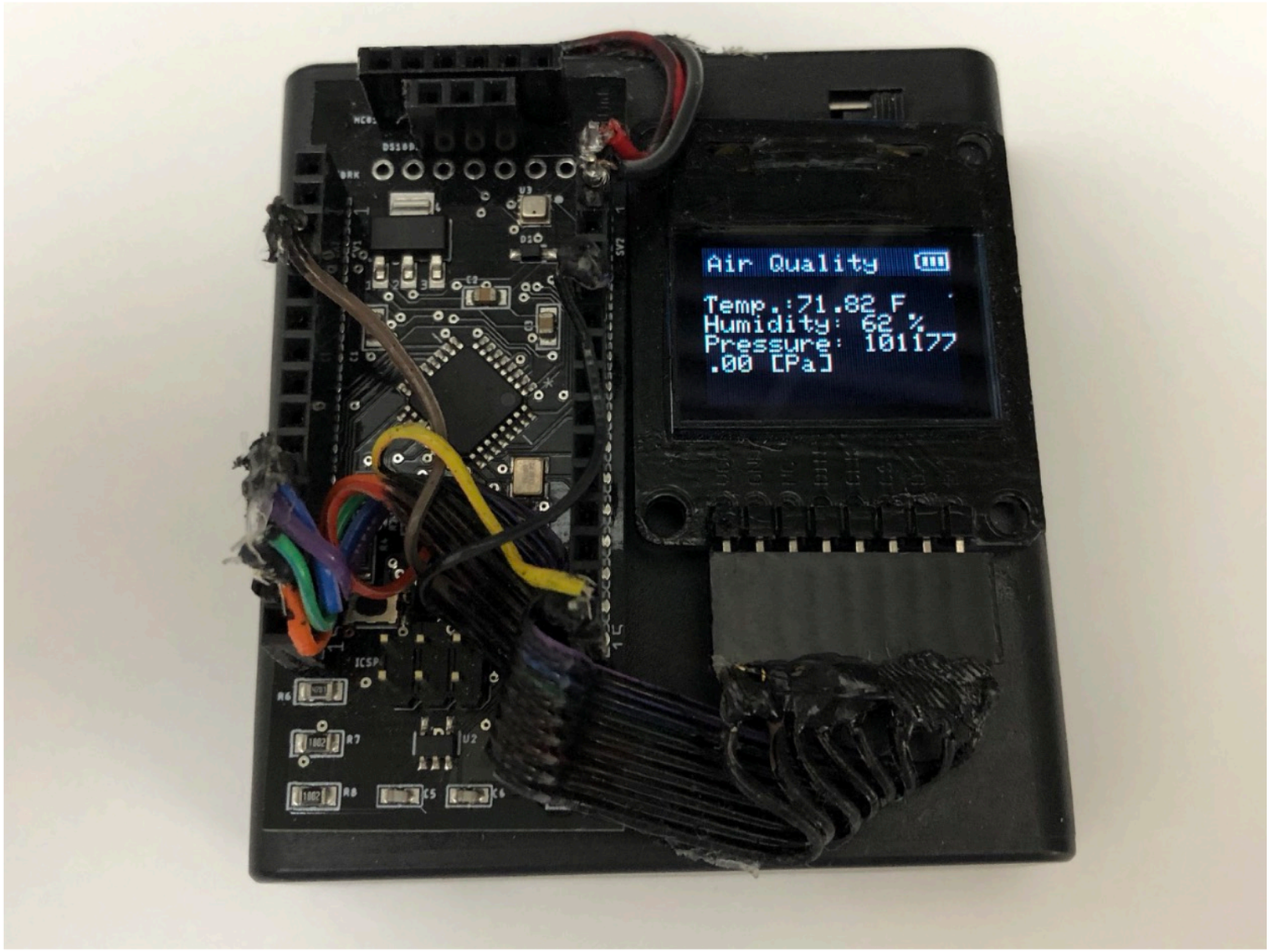
VALIDATION





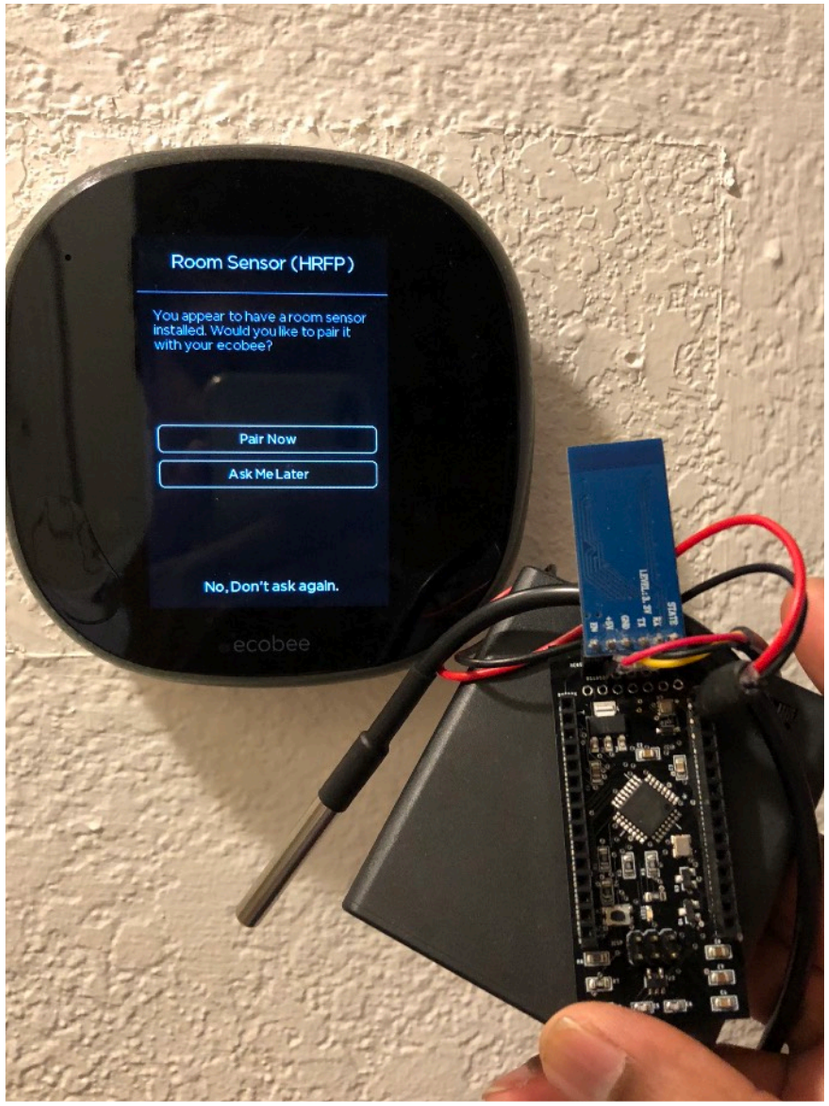
Fresh out of the oven, SensorLink was ready for its first test: flashing a bootloader via its ICSP pins. Header pins were routed to allow individual testing of microcontroller pins. Breakout pins were routed for independent evaluation of the sensors, in case the board didn’t boot.

VALIDATION



To test out the components on the board, custom firmware was developed to read battery levels, temperature, air-pressure, and humidity. Results of the tests were printed on an RGB OLED display.

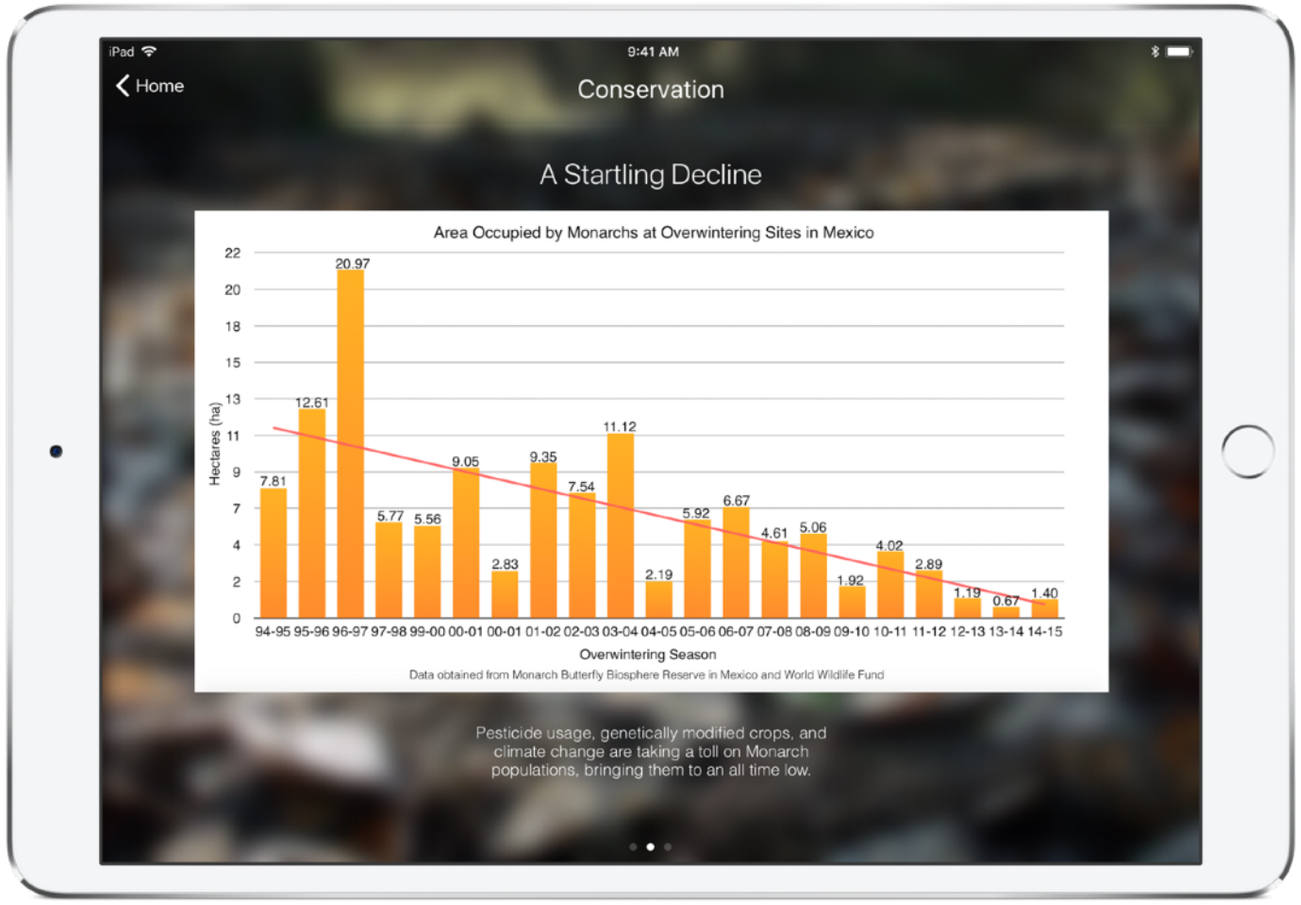
PAIRING



I successfully reverse engineered the ecobee wireless communication protocol and managed to get the ecobee thermostat to recognize and pair with SensorLink via a Bluetooth module. Instead of just displaying the humidity at the base station, the thermostat now displays an average of all the humidities across the rooms.

MONARCH APP

BACKGROUND



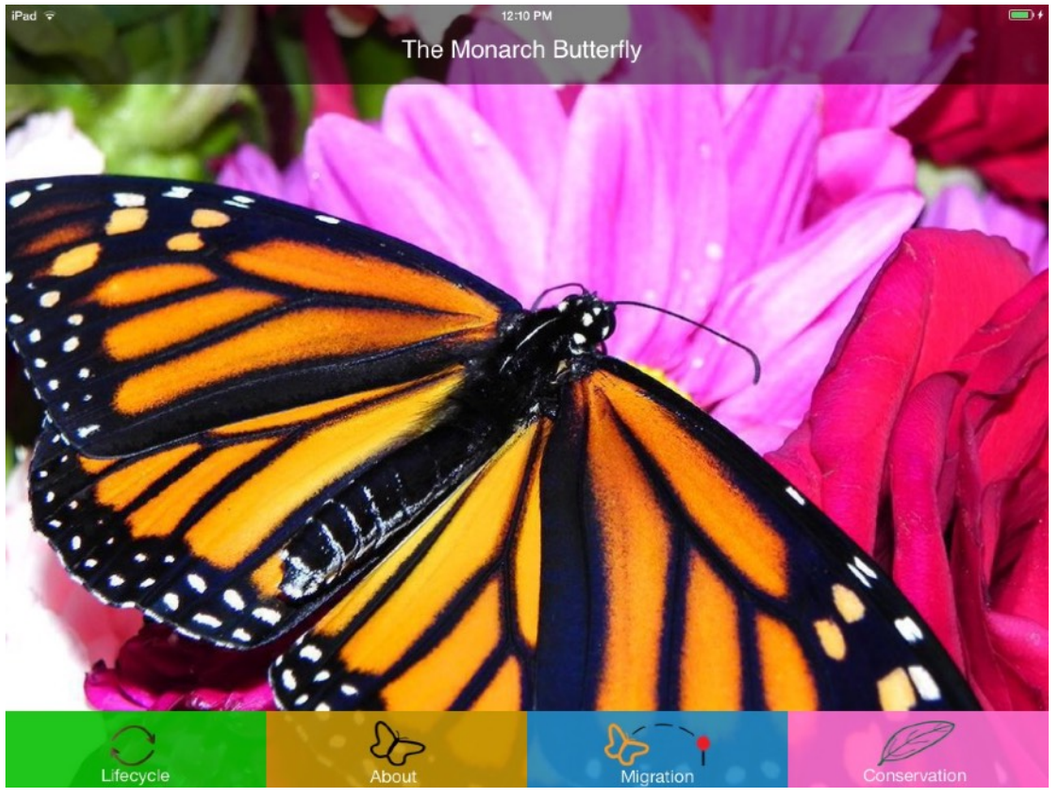
Monarchs are a species under threat.

Human activities coupled with a changing climate have resulted in a steep decline of the butterfly's population.

In an effort to raise awareness about the issue, I developed an educational iPad app.

Featuring original photography, Monarch App illustrates the life history and the remarkable migration of the butterflies with the swipe of a finger.

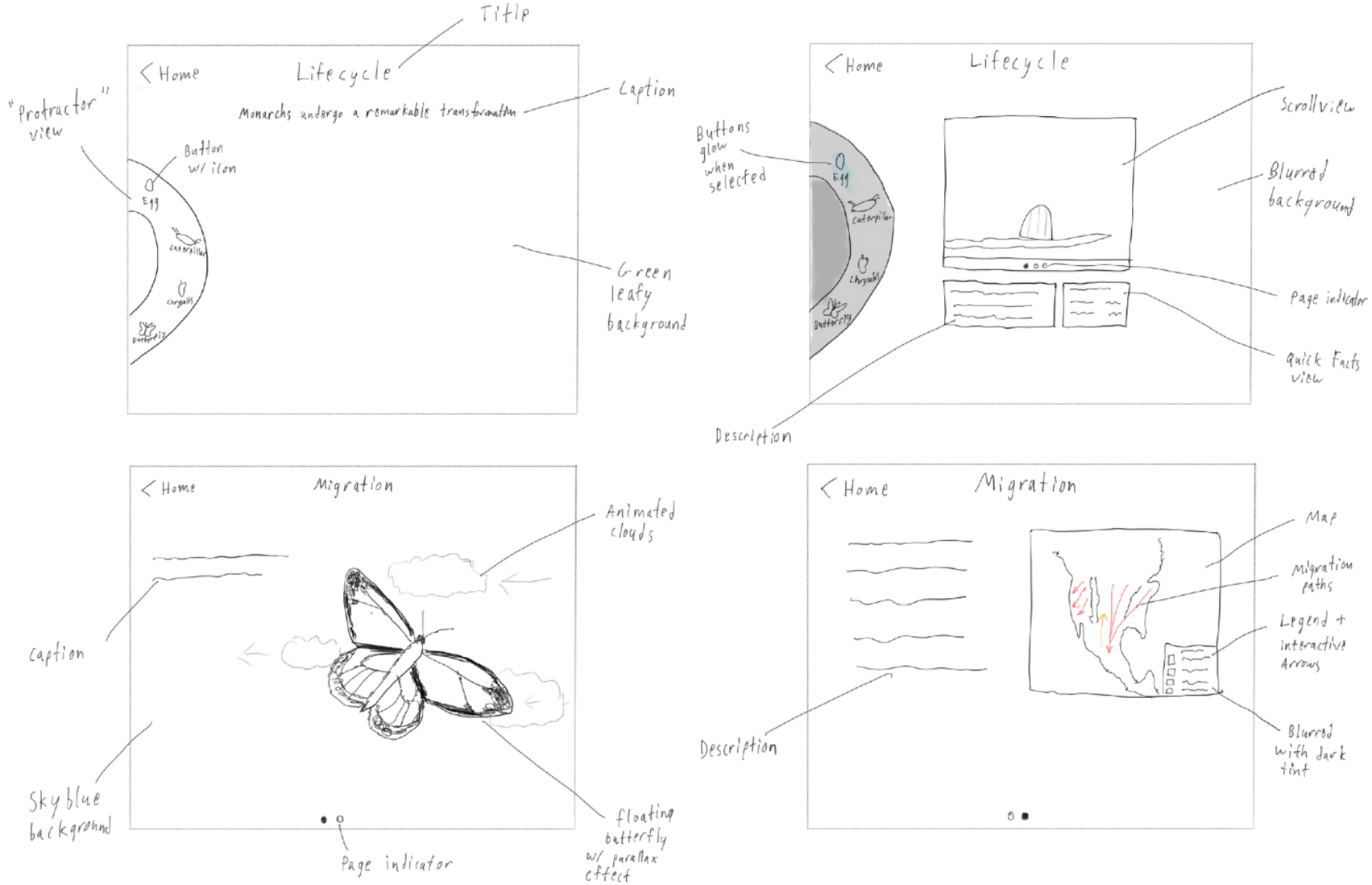
OLD DESIGN



The metaphor of a custom tab bar at the bottom of the home screen, provided the false affordance to users who felt that the bar would persist throughout the app's screens.

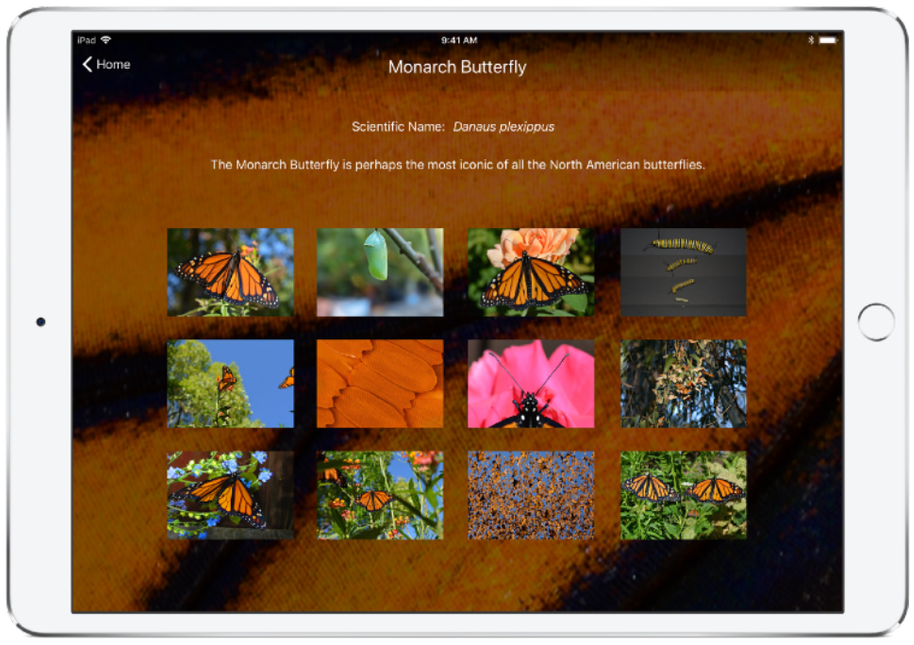
After observing users and getting feedback at WWDC 2014, I chose to redesign the app from ground-up to create a more interactive experience.

REDESIGN



After sketching a few new screens similar to these, users were invited to tap on the icons. Observing them interacting with low-fidelity prototypes allowed me to gain enough insights into their behavior to develop a better user experience. Finally, before investing in writing code, I made interactive app prototypes in Keynote to gain a better understanding of how the users would respond to animations.

NEW DESIGN



Through the use of motion from accelerometers in parallax effects and through the use of extensive blurs, Monarch App's new design creates a sense of hierarchy which immerses its users within the content.