SPROUT AQUAPONIC SENSOR CONTROL AND MONITORING SYSTEM

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About this Manual/Getting Started

The purpose of this manual is to aid users in setting up and performing maintenance of the Aquaponic Sensor Control and Monitoring System, also known as Sprout. This manual will help a beginner effectively use and maintain Sprout to keep their aquaponics greenhouse running.

Sprout is used to monitor the delicate closed-loop ecosystem required for an aquaponic greenhouse. The manual includes a general description of the Sprout sensor system, including a parts description and an overview of the Graphical User Interface (GUI). Then, the manual will include instructions on setting up Sprout and replacing and calibrating the sensors. At the end, the manual will include links to the sources of the sensors, additional resources required for some procedures, a glossary, and an index.

This section of the manual includes an overview of the contents of the manual followed by a list of conventions found in the manual.

Overview of the Manual

The manual contains three chapters and an additional section for reference material:

Chapter 1: About Sprout
In this chapter, you will find information on the components of Sprout. This chapter will first cover the hardware, and then it will cover the software.

Chapter 2: Setting Up Sprout
In this chapter, you will find information on how to set up Sprout. You will learn how to set up the hardware and the software, and how to perform simple sensor maintenance.

Chapter 3: Calibrating the Sensors
In this chapter, you will find information on how to calibrate the Electrical Conductivity sensor and the pH sensor.

Reference Material
In this chapter, you will find information on the sensors, additional resources required for some of the procedures, the glossary, and the index.

Document Conventions

Several icons will appear throughout the procedures in this manual. Be aware of their presence and refer to the following for their meanings:

You will see a Tip icon when an alternative method of performing a step or procedure is available

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You will see a Note icon when additional information that clarifies or explains a step in a procedure is available

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You will see a Caution icon when a certain action may cause unintended negative consequences for you or the device. Be aware of the caution icons at all times.

You will see a Warning icon when a certain action may cause physical harm to you. Be aware of the warning icons at all times.

Chapter 1 - About Sprout

This chapter will detail the physical components of Sprout and explain the GUI elements you will use to calibrate the system for your preferences. By the end of this chapter, you will

understand how each component of the system contributes to the monitoring of your aquaponic greenhouse and how you can use it to better automate the process.

In this chapter, you can find the:

- Sprout Components
- Overview of the GUI

Sprout Components

This section will describe the hardware components of the Sprout sensor system. Sprout includes several pieces of hardware held within the sensor bar housing, such as the six sensors, the Raspberry Pi 4, and the printed circuit board.

Sensor Bar Housing

The sensor bar housing is a two-chambered wooden structure that attaches to the side of the tank with a clamp. The structure is waterproof, with one chamber holding the electronics and keeping them safe from potential damage. The other chamber has holes in the bottom for the sensors to poke through so the sensor tips can take readings without being damaged.

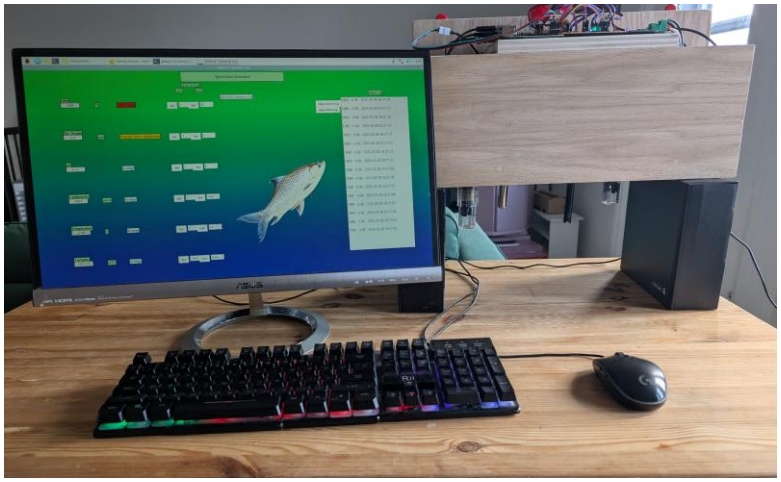

Figure 1 - Sensor bar housing set up next to monitor.

The sensor bar housing provides a stable home for the six sensors for when they are regulating the aquarium. It is adaptable and can be attached to different sizes of tanks.

Sensors

There are six sensors in the Sprout system, with each sensor sending one reading to the computer. However, the Oxygen-Reduction-Potential sensor sends one additional reading to the computer for a total of two.

The chart below names each sensor, explains what each sensor measures, and explains the purpose of each sensor.

Table 1 - Names of sensors, a description of the sensors, and what they are used for.

Part	Description	Purpose
Dissolved Oxygen Sensor	Measures the dissolved oxygen content in water.	Low oxygen content in water can create harsh living conditions for aquatic organisms.
Turbidity Sensor	Measures the turbidity, or opacity, of water.	The turbidity of water is directly correlated with bacteria content and the overall water quality.
pH Sensor	Measures the acidity or alkalinity of water.	If the water is too acidic or alkaline, the plants may be unable to absorb certain nutrients.

Part	Description	Purpose
Oxygen Reduction Potential Sensor	Measures the ability of oxidation and reduction of water. Measures the temperature of the water.	Oxidation and Reduction indicate oxygen levels and quality of the nutrients within. Ecosystem of the greenhouse requires a stable temperature to maintain plant health.
Conductivity Sensor	Measures the ability to pass a current through water.	The conductivity of water indicates the concentration of ions in the water and the salinity of the water.
Ultrasonic Distance Sensor	Measures the time lapses between the sending and retrieving of an ultrasonic pulse to determine the distance to a target.	Maintains a consistent depth to the water to prevent overflow of the tank or damage to Sprout.

Raspberry Pi 4

The Raspberry Pi4 is a miniature computer. In the Sprout system, the Raspberry Pi 4 makes the calculations that process the sensor outputs and runs the graphical user interface (GUI).

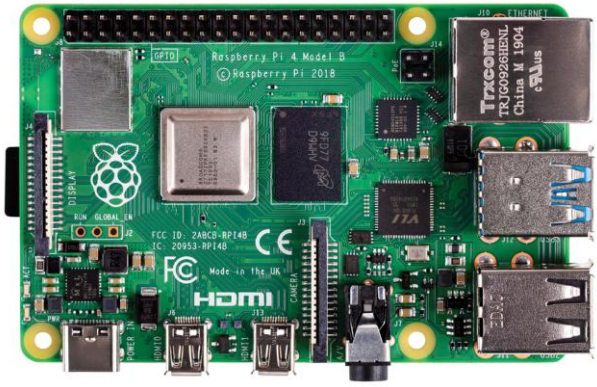

Figure 2 - Raspberry Pi 4.

Printed Circuit Board

The printed circuit board was made specifically for the Sprout system. It functions as the medium between the sensors and the Raspberry Pi 4. It processes the analog signal from the sensors and converts this information to a digital signal, one that can be read by the Raspberry Pi 4.

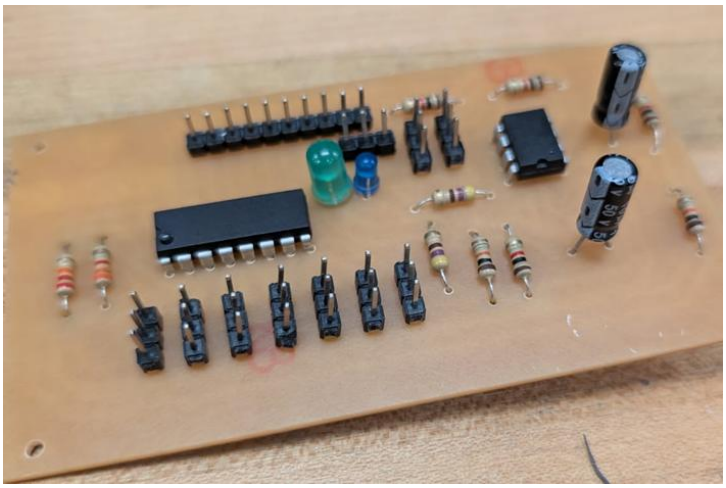

Figure 3 - Printed Circuit Board (close up).

Overview of the GUI

This is the user interface for Sprout. It is the point of control and monitoring for users operating the sensor system. The GUI for the present iteration of Sprout is run through the compiler within the application Geany.

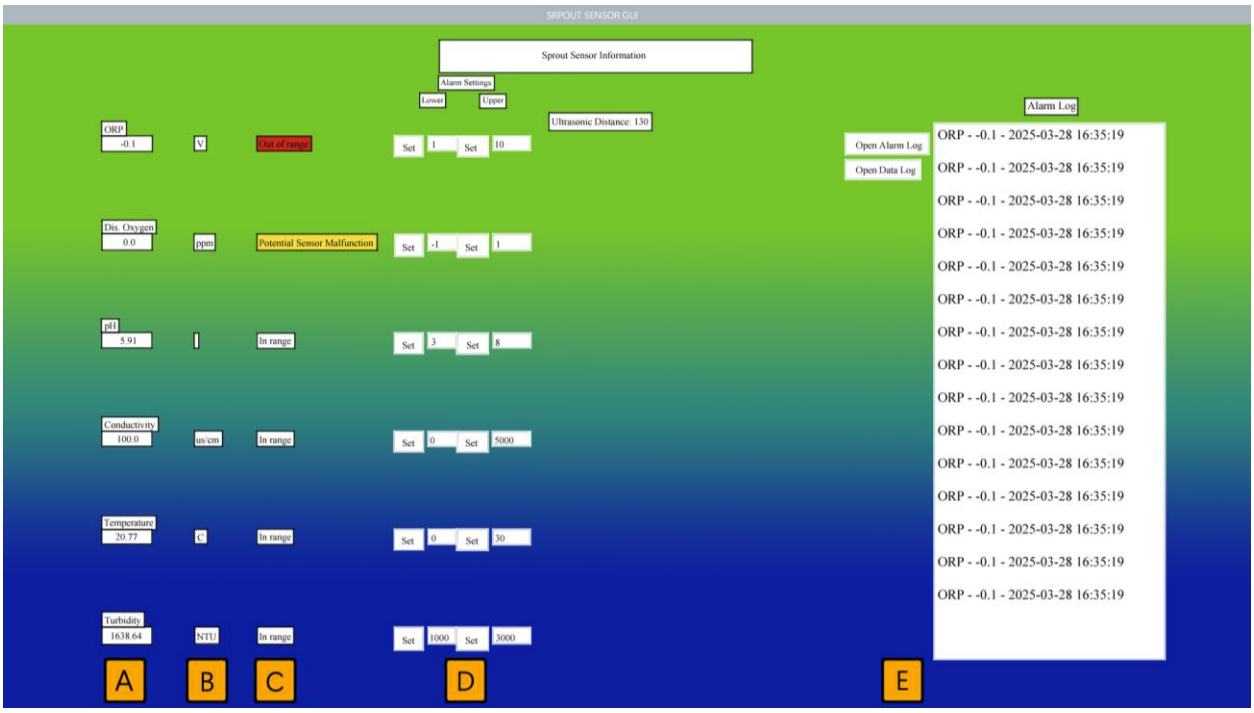

Figure 4 - Mockup of Sprout Sensor GUI.

A. The **current levels** column displays the current levels as detected by each sensor.

B. The **units** column displays the units used by each sensor, such as Degrees Celcius.

C. The **status** column displays whether the levels are in range, whether the levels are out of range, or if the sensor is experiencing a malfunction.

D. The **alarm settings** column allows the user to select a lower bound and an upper bound for monitoring the levels of each sensor.

E. The **alarm log** displays each recent alert. Each row includes which sensor sent the alert, what detected value caused the alert, and the time the alert was posted.

Chapter 2: Setting Up Sprout

Sprout is built to be a convenient, quick way to set up a monitoring system for your aquaponic greenhouse. The system has a quick setup. You can attach the sensor housing to your aquarium, plug in the monitor, set the alarms, and the system will run for you on its own. In addition, cleaning and basic maintenance of Sprout is built to be simple and intuitive.

In this chapter, you will learn important steps to set up, take down, and perform simple maintenance on Sprout. You will learn how to set up Sprout's hardware, set up Sprout's GUI, and replace and clean the sensors.

In this section, you will find information on:

- Setting Up the Hardware
- Setting Up the GUI
- Replacing and Cleaning the Sensors

Setting Up the Hardware

This section of the manual will concern the basics of setting up Sprout's hardware. You will learn how to attach the sensor bar housing to the Aquarium tank so that the system can function properly. The following instructions will also instruct you how to detach the sensor bar housing from the Aquarium Tank so that you can either store Sprout for later use, or manage cleaning, replacing, and calibrating the sensors.

In this section, you will find instructions on how:

- To Attach Sprout to the Aquarium Tank
- To Remove Sprout from the Aquarium Tank

To Attach Sprout to the Aquarium Tank

1. Carefully lift the sensor bar housing over the tank so that the wooden casing is over the inside of the tank.
2. Use your thumbs to press down the red handles to open the clamp.
3. Lower the sensor bar housing so it is inside the tank and horizontal in respect to the floor.
4. Release the clamps slowly.
5. Remove hands slowly to ensure the sensor bar housing is securely attached to the tank.

To Remove Sprout from the Aquarium Tank

1. Securely place both hands on either side of sensor bar housing with thumbs on the red handles.
2. Ensure that your grip is stable, then use your thumbs to slowly press down on the handles.
3. Lift the sensor bar housing off of the tank.
4. Put the sensor bar housing down, making sure to mind the probes sticking out of the bottom of the case. Place the sensor bar housing down so the probes and electronics do not get damaged or jostled.
5. Wipe down the casing of the sensor bar housing with a damp cloth.
6. Follow the steps to clean and store the probes, then leave the sensor bar housing to dry.

Setting Up the GUI

This section of the manual will cover the process for setting up the GUI, from connecting the monitor to setting the alarms. The computer setup for the Raspberry Pi is meant to be simple and easily customizable. If you need to move your aquaponic greenhouse, and likewise Sprout, you can quickly take apart the computer system to relocate. Running the GUI is simple as well. A user can easily execute the GUI file and set the alarm ranges using the interface.

In this topic, you will find instructions on how:

- To Connect the Raspberry Pi to a Monitor
- To Run the Sprout GUI Through Geany
- To Set the Alarms Using the Sprout GUI

To Connect the Raspberry Pi to a Monitor

1. Plug the monitor into a wall socket or extension cable port.

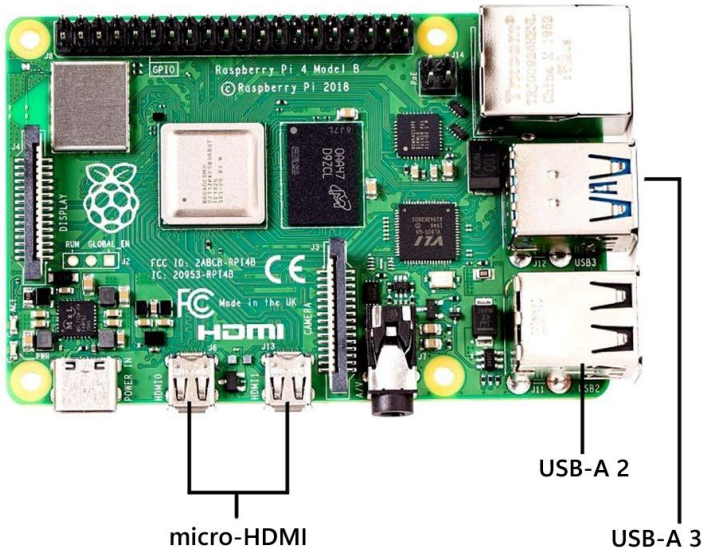

Figure 5 - Micro-HDMI and USB-A ports on the Raspberry Pi.

2. Plug the micro-HDMI end of the micro-HDMI to HDMI cord into the Raspberry Pi.

3. Plug the HDMI end of the micro-HDMI to HDMI cord into the monitor.
4. Plug your mouse into a USB port on the Raspberry Pi using a USB-A cable or bluetooth dongle.
5. Plug your keyboard into a USB port on the Raspberry Pi using a USB-A cable or bluetooth dongle.
6. Turn on the monitor. The Raspberry Pi Operating System (OS) should be up and running on your monitor.

To Run the Sprout GUI Through Geany

1. Make sure you have the Raspberry Pi 4 OS open and working on your monitor.
2. In the top left of the screen, open the **File Manager**. The icon will be in the shape of a file folder. Upon opening, a new window will appear on your screen.

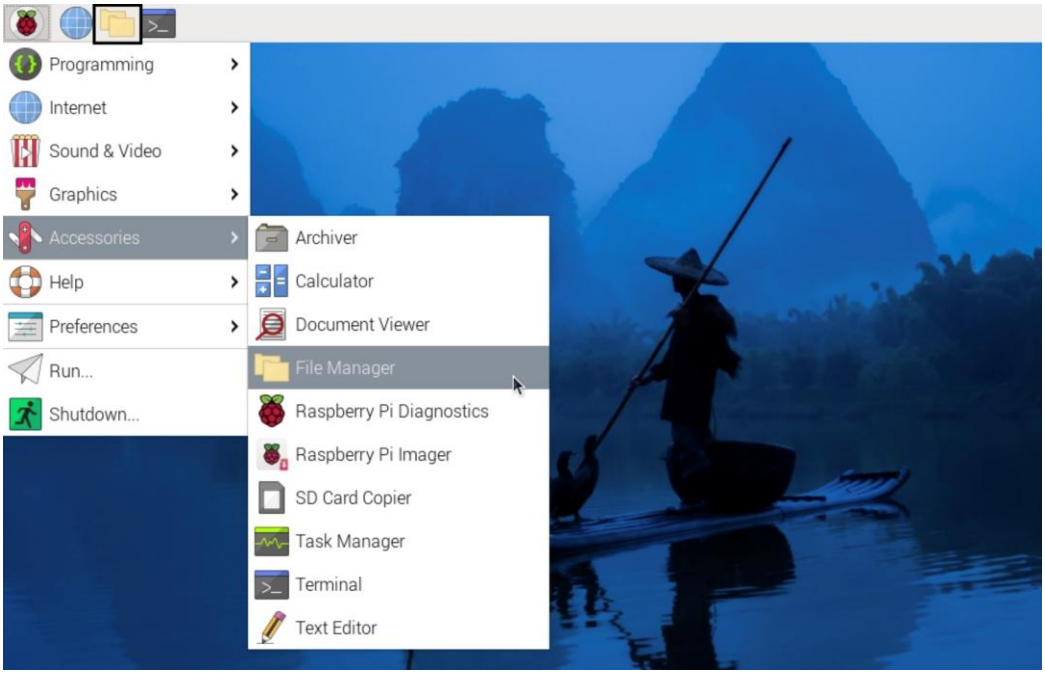

Figure 6 - Location of the File Manager icon on the Raspberry Pi OS.

3. From the ribbon on the left side of the File Manager, open the **Documents** folder.

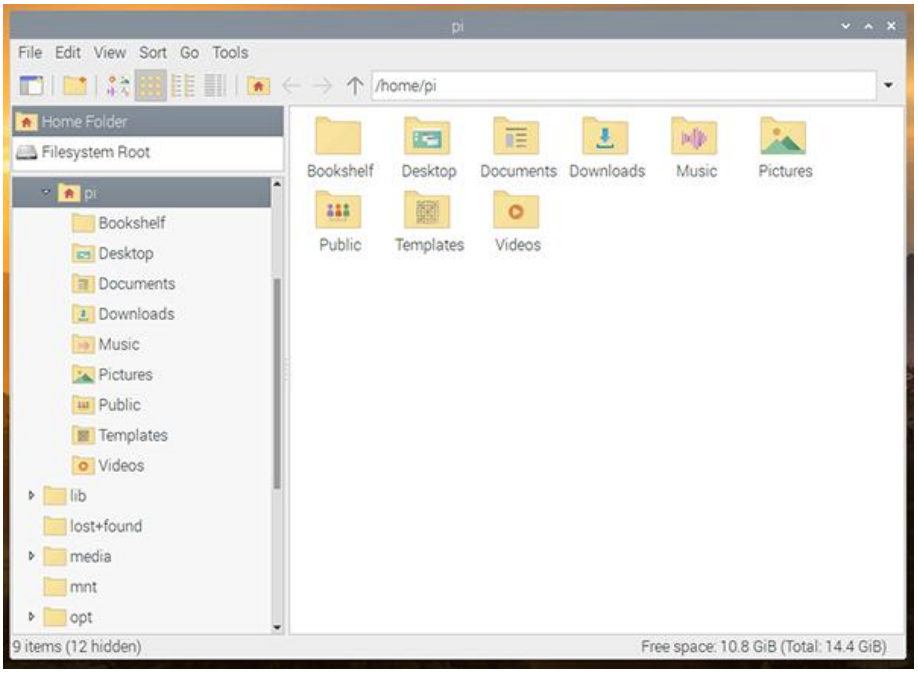

Figure 7 - File Manager application.

4. Find the file named **SproutGUI.py** and open it using the **Geany** application.

5. In the toolbar at the top of the Geany application, select **Build** then **Execute**. You will see the Sprout GUI open on your screen.

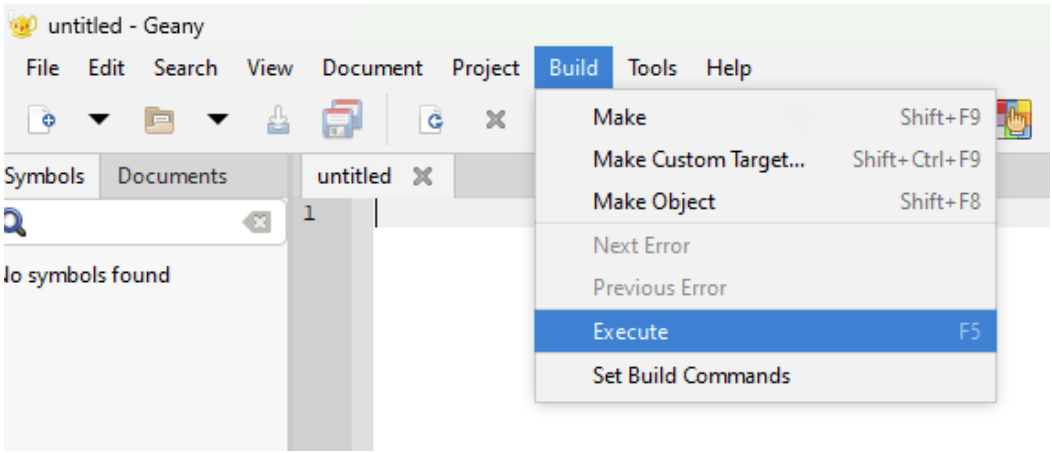

Figure 8 - Location of the Execute function in Geany.

You can also execute the file by pressing F5 on your keyboard, or by selecting the paper airplane icon in the toolbar.

To Set the Alarms Using the Sprout GUI

1. Make sure that you have successfully opened the Sprout GUI on your monitor.
2. On the screen, find the row that corresponds to the sensor you wish to reset the alarms for.

Figure 9 - Alarm setting tool in the Sprout GUI.

3. In the left text box, input the number for the lower bound.
4. To the left of the text box, select **Set**.
5. In the right text box, input the number for the upper bound.
6. To the left of the text box, select **Set**.

Replacing and Cleaning the Sensors

This section of the manual will cover how to perform simple maintenance on the Sprout System. Replacing the sensors is necessary to learn because they may require cleaning and need to be replaced after a certain amount of time. The Dissolved Oxygen and pH sensors require specific maintenance that will also be covered in this section. Both require different liquids to be stored within their caps to keep them operating at optimal capacity.

In this section, you will find instructions on how:

- To Replace a Sensor
- To Replace the Dissolved Oxygen Sensor's Filling Solution
- To Clean the Sensors
- To Clean the pH Sensor

To Replace a Sensor

1. Remove the sensor bar housing from the aquarium tank, ensuring the housing is in a dry, stable location.
2. Carefully reach into the sensor bar housing and gently pull the probe out of its designated slot.

Make sure to remember which sensor fits in which slot so you can return them later without accidental damages.

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3. Unplug the old sensor from the board.
4. Take the new sensor and plug the end of the attached cord into the cable connector port on the board.

If installing the Dissolved Oxygen Sensor, make sure you have filled the membrane cap with the Sodium Hydroxide solution before placing it in the sensor bar housing to be used.

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5. With the new sensor attached, slide the probe back into the sensor bar housing and fit it into its designated slot.

To Replace the Dissolved Oxygen (DO) Sensor's Filling Solution

Sodium Hydroxide (NaOH) is irritating and corrosive. Wear gloves to keep NaOH Solution off of your bare skin. Do not touch eyes, mouth or nose.

1. Turn the membrane cap clockwise to unscrew the cap.

Make sure you fill the cap with the correct amount of solution. If there is too little solution, bubbles may form. Some solution overflow is acceptable.

2. Make sure the cap is in a vertical position, then fill the cap ⅔ of the way full with 0.5 mol/L NaOH solution.

Information on acquiring NaOH solution can be found in the References chapter.

Keep the cap and the probe in a vertical position to prevent bubbles from forming in the filling solution.

3. Make sure the cap and probe are in a vertical position, then carefully screw the cap back on the probe by turning it in a counter-clockwise motion.
4. If some overflow occurs, carefully clean the excess solution with a tissue.
5. Follow the instructions in the previous topic *To Replace a Sensor* to return the DO Sensor to the sensor bar housing.

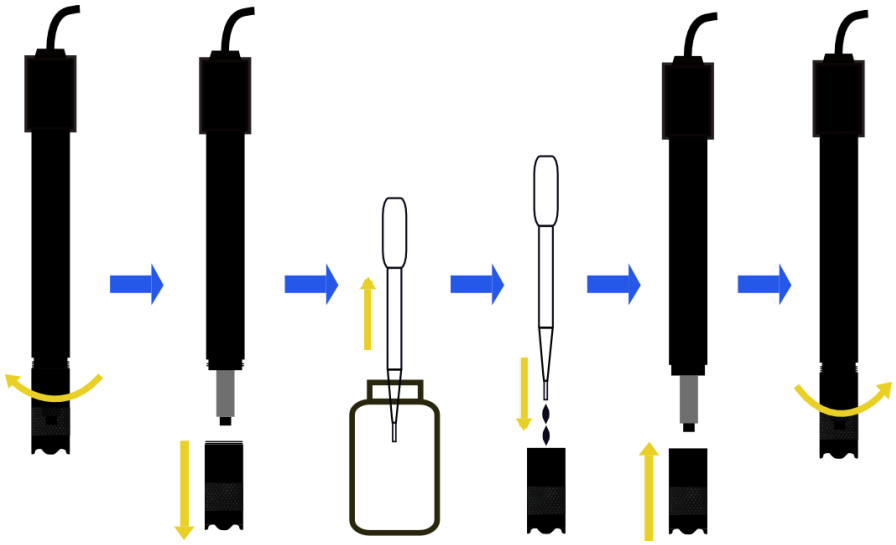

Figure 10 - Diagram of the process for filling the DO sensor's cap.

To Clean the Sensors

1. Remove the sensor from the sensor bar housing.

Ensure that you avoid getting the wire end of the sensor wet, for this may damage the sensor.

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2. Gently pour distilled water over the probe end of the sensor to wash off any residue.
3. Gently dry the sensor with a soft towel, such as a tissue or a microfiber cloth.
4. Return the sensor to the sensor bar housing.

To Clean the pH Sensor

1. Remove the sensor from the sensor bar housing.

Ensure that you avoid getting the wire end of the sensor wet, for this may damage the sensor.

---

2. Gently pour distilled water over the probe end of the sensor to wash off any residue.

Figure 11 - pH sensor with cap.

3. Unscrew the cap at the end of the sensor probe.
4. Fill the cap with 1 cm of distilled water.
5. Screw the cap back on the sensor probe.
6. Gently dry the sensor with a soft towel, such as a tissue or a microfiber cloth.
7. Return the sensor to the sensor bar housing.

Chapter 3: Calibrating the Sensors

In this chapter, you will learn how to calibrate the Electrical Conductivity sensor and the pH sensor. Regular calibration is necessary for these two sensors to ensure they maintain accurate readings. Reading this chapter will help you understand the importance of calibration to maintain the integrity of the monitoring system.

In this chapter, you will need additional resources not found within the Sprout system. Please refer to *Additional Resources Required for Procedures* in the References chapter for more information.

In this section, you will find information on:

- Calibrating the Electrical Conductivity Sensor
- Calibrating the pH Sensor

Calibrating the Electrical Conductivity Sensor

This section of the manual will cover the process for calibrating the Electrical Conductivity sensor. Calibrating the sensors does not require extensive knowledge of Aruduino or Python. These instructions are designed to guide an unfamiliar user through this technical task. Calibrating the Electrical Conductivity sensor regularly will ensure that the sensor is operating at optimal capacity.

In this section, you will find instructions on how:

- To Download the Zip Library for the Electrical Conductivity Sensor
- To Add the Calibration Code to the Arduino Program
- To Calibrate the Electrical Conductivity Sensor
- To Add the Voltage Measurement Code to the Arduino Program
- To Find the Voltage of the Electrical Conductivity Sensor

Figure 12 - Electrical Conductivity Sensor.

To Download the Zip Library for the Electrical Conductivity Sensor

1. Open the GitHub Repository for the DFRobot_EC Library in your browser.
2. Select the green dropdown menu labelled **Code**.
3. Select **Download as ZIP**.
4. Open the Arduino program.
5. In the top bar, select **Sketch** > **Include Library** > **Add .ZIP Library...**

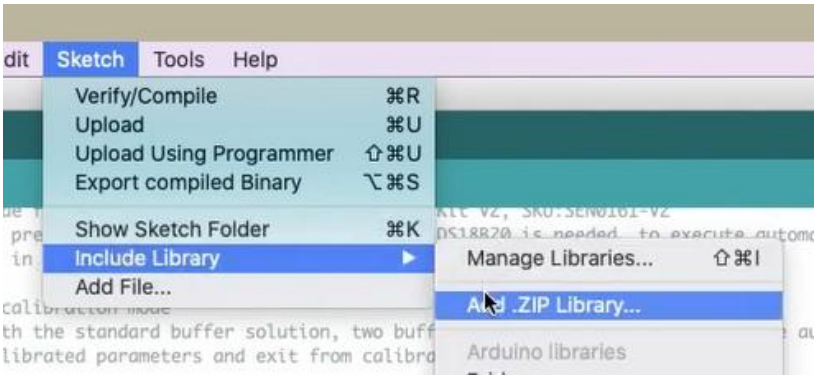

Figure 13 - Add .ZIP Library in dropdown menu.

6. Locate the **DFRobot_EC** Library you installed onto your computer and open it.

To Add the Electrical Conductivity Calibration Code to the Arduino Program

1. Open the Arduino program.
2. Copy the **Calibration for Higher Accuracy** code found at the documentation site for the Electrical Conductivity Sensor.
3. Delete all text in the Arduino program.
4. Paste the code into the Arduino program.
5. In the top bar, select **Sketch** > **Include Library** and select the **DFRobot_EC** Library.
6. Save the file.

To Calibrate the Electrical Conductivity Sensor

1. Rinse the probe in distilled water.
2. Dry the probe gently with a tissue.
3. Submerge the end of the probe in the 1413 us/cm electrical conductivity standard solution.
4. Shake the probe slightly to remove air bubbles.

If the monitor prints a randomized sequence of symbols, you will have to change the baud rate at the bottom of the Serial Monitor screen. The baud rate of this program should be set to 115200.

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5. In the Arduino program at the top right of the screen, select the icon shaped like an hourglass to open the **Serial Monitor**.

6. Input **C calibration solution electrical conductivity** in the Serial Monitor and press enter to calibrate the probe.
7. The Serial Monitor will print the calibration value K. Record this number to be used in the following procedure.

The calibration value K should be close to 1.0.

To Add the Voltage Measurement Code to the Arduino Program

1. Select **File** > **New** in the top bar to open a new file.
2. Copy **The First Measurement** code found at the documentation site for the Electrical Conductivity Sensor.
3. Delete all text in the Arduino program.
4. Paste the code into the Arduino program.
5. On line 14, at **ec.setCalibration(1);** replace the 1 with the calibrated K value.
6. Save the file.

To Find the Voltage of the Electrical Conductivity Sensor

1. In the Arduino program at the top right of the screen, select the icon shaped like an hourglass to open the **Serial Monitor**.
2. Record the detected voltage and conductivity, for the information will not be stored if you seek to access it later.

Calibrating the pH Sensor

This section of the manual will cover the process for calibrating the pH sensor. This process will have to be done twice for two different buffer solutions: one with a pH of 4 and one with a pH of 7. Calibrating the sensors does not require extensive knowledge of Aruduino or Python. These instructions are designed to guide an unfamiliar user through this technical task. Calibrating the pH sensor once every 1-2 months will ensure that the sensor is operating at optimal capacity.

In this section, you will find instructions on how:

- To Download the Zip Library for the pH Sensor
- To Add the pH Calibration Code to the Arduino Program
- To Prepare the pH Sensor for Calibration
- To Calibrate the pH Sensor

Figure 14 - pH Sensor.

To Download the Zip Library for the pH Sensor

1. Open the GitHub Repository for the **DFRobot_PH** Library in your browser.
2. Select the green dropdown menu labelled **Code**.
3. Select **Download as ZIP**.
4. Open the Arduino program.

5. In the top bar, select **Sketch** > **Include Library** > **Add .ZIP Library...**

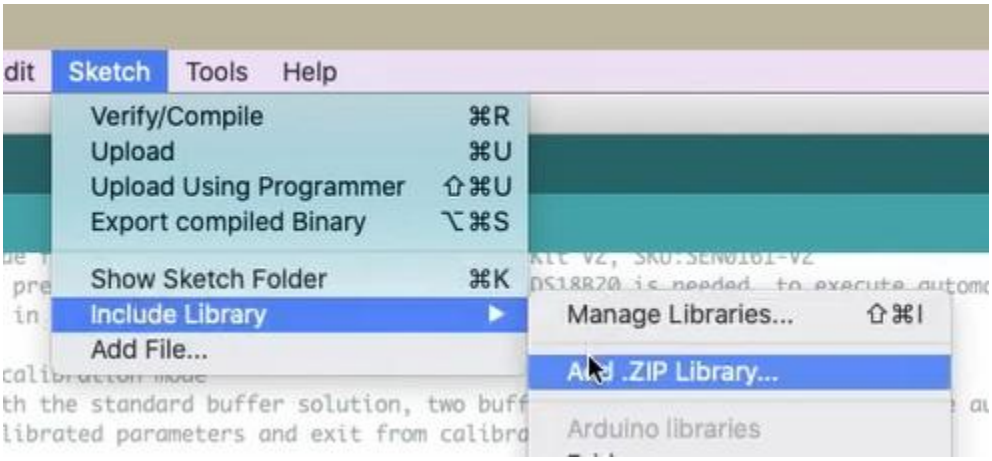

Figure 15 - Add .ZIP Library in dropdown menu.

6. Locate the **DFRobot_PH** Library you installed onto your computer and open it.

To Add the pH Calibration Code to the Arduino Program

1. Open the Arduino program.
2. Copy the **Example Code** found at the documentation site for the pH Sensor.
3. Delete all text in the Arduino program.
4. Paste the code into the Arduino program.
5. In the top bar, select **Sketch** > **Include Library** and select the **DFRobot_PH** Library.
6. Save the file.

To Prepare the pH sensor for Calibration

1. Rinse the pH sensor in distilled water.
2. Dry the sensor gently with a tissue.
3. Submerge probe end of the pH sensor into one of the buffer solutions and stir gently.

To Calibrate the pH Sensor

1. Ensure that the pH sensor is properly prepared and submerged in the appropriate buffer solution.
2. In the Arduino program at the top right of the screen, select the icon shaped like an hourglass to open the **Serial Monitor**.

If the monitor prints a randomized sequence of symbols, you will have to change the baud rate at the bottom of the Serial Monitor screen. The baud rate of this program should be set to 115200.

3. Enter **enterph** into the serial monitor. The program will enter calibration mode.

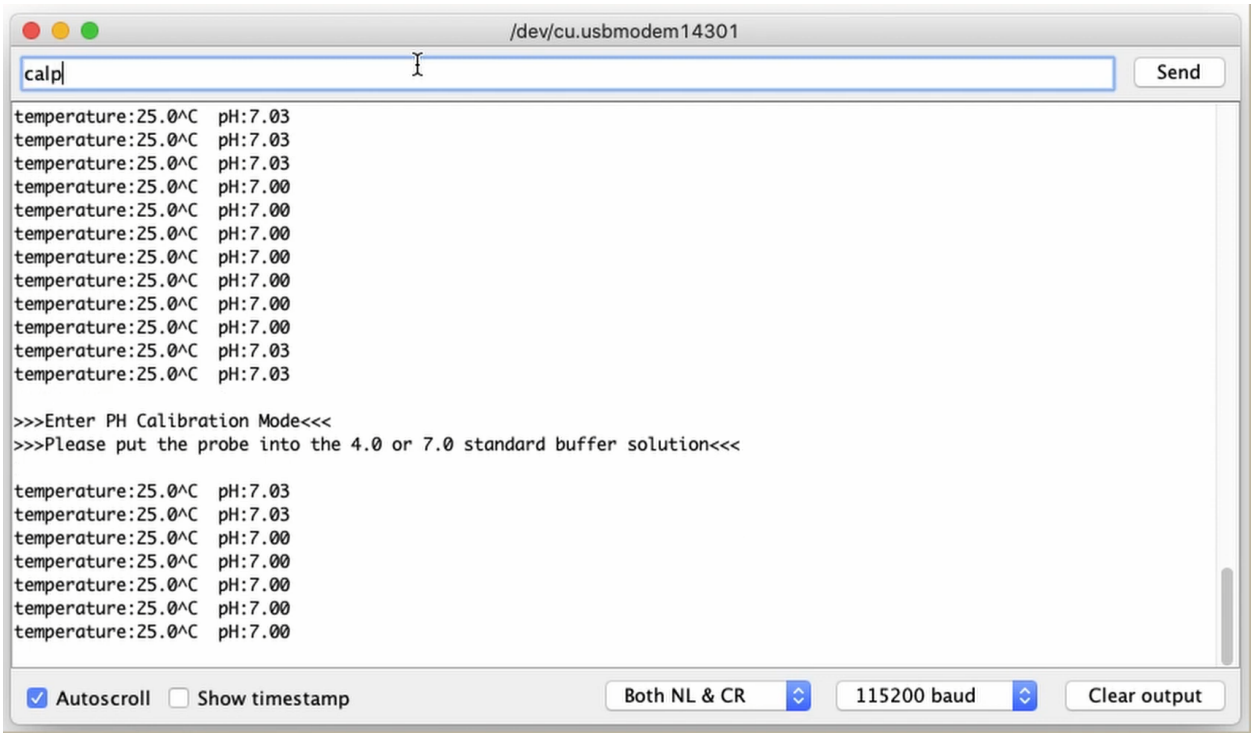

Figure 16 - Serial monitor in calibration mode.

4. Input **calph** into the serial monitor. The program will start calibration. The program will detect which of the standard buffer solutions you are using to calibrate.

5. Input **exitph** into the serial monitor. The program will exit calibration mode. The data will then be saved to the EEPROM of the control board if you seek to access it later.

6. If you have only calibrated using one of your solutions, repeat the steps once more with the other solution.

Reference Information

This section of the user manual provides you with additional information that may be of use to you when reading this user manual. The sensor specifications section will provide you with the name of the sensor and a link to the wiki for that sensor. The Additional Resources Required for Procedures section will provide you with information on resources you may need to purchase to complete some of the procedures. The Glossary will provide you with definitions for some of the terms in this manual. Finally, the index will provide you with terms and their page numbers so you can find information quickly.

Sensor Specifications

The following table includes the name and source for each sensor used in the Sprout System. If you have any further questions about the sensors that are not answered in this manual, follow the link to the DFRobot wiki.

Table 2: Sensors and where to find more information about them online.

Item	Source
Gravity: Analog Dissolved Oxygen Sensor Meter Kit for Arduino	DFRobot (https://wiki.dfrobot.com/Gravity__Analog_Dissolved_Oxygen_Sensor_SKU_SEN0237)
Gravity: Analog Turbidity Sensor for Arduino	DFRobot (https://wiki.dfrobot.com/Turbidity_sensor_SKU__SEN0189)
Gravity: 7/24 Industrial Analog pH Meter Kit	DFRobot (https://wiki.dfrobot.com/Gravity__Analog_pH_Sensor_Meter_Kit_V2_SKU_SEN0161-V2)

Item	Source
Gravity: Arduino Analog Industrial ORP Sensor Meter Pro for Arduino	DFRobot (https://wiki.dfrobot.com/Gravity__Analog__ORP__Sensor__PRO__SKU__SEN0464)
Gravity: Industrial Analog EC / Electrical Conductivity Meter Kit for Water Quality Monitoring (K-1, IP68)	DFRobot (https://wiki.dfrobot.com/SKU__SEN0451__Gravity__Analog__Electrical__Conductivity__Sensor__PRO__K__1)
A02YYUW Waterproof Ultrasonic Distance Sensor (3~450cm, UART, IP67)	DFRobot (https://wiki.dfrobot.com/__A02YYUW__Waterproof__Ultrasonic__Sensor__SKU__SEN0311)

Additional Resources Required for Procedures

Some procedures require resources not found within the Sprout Sensor system. The following section will provide information on which resources are needed to acquire for these procedures. The procedures and topics referred to in this section are:

- Requirements for: To Connect the Raspberry Pi to a Monitor
- Requirements for: To Replace the Dissolved Oxygen (DO) Sensor's Filling Solution
- Requirements for: Calibrating the Electrical Conductivity Sensor
- Requirements for: Calibrating the pH Sensor

Requirements for: To Connect the Raspberry Pi to a Monitor

The Raspberry Pi 4 runs as a computer does. To operate the Raspberry Pi, and thus the Sprout GUI, you will require:

- A computer monitor
- A micro-HDMI to HDMI cable
- A USB-A compatible keyboard
- A USB-A compatible mouse

Instructions on how to set up the Raspberry Pi 4 computer can be found under the procedure: *To Connect the Raspberry Pi to a Monitor*.

Requirements for: To Replace the Dissolved Oxygen (DO) Sensor's Filling Solution

Sodium Hydroxide (NaOH) solution is used to fill the membrane cap of the Dissolved Oxygen sensor. You can purchase 0.5 mol/L NaOH solution online or create your own by diluting stronger NaOH solution.

To make your own solution for the Dissolved Oxygen sensor, first purchase the following items:

- Sodium Hydroxide (NaOH) solution
- Glycerinum dilution drops

To create a solution for the DO sensor, add one to two drops of Glycerinum to the NaOH solution for every 100 mL of NaOH solution.

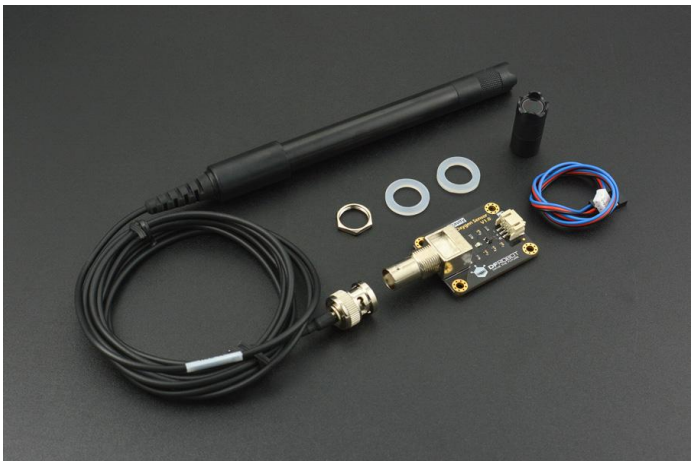

Figure 17 - Dissolved Oxygen sensor.

Instructions on how to fill the membrane cap of the Dissolved Oxygen sensor can be found under the procedure: *To Replace the Dissolved Oxygen (DO) Sensor's Filling Solution*.

Requirements for: Calibrating the Electrical Conductivity Sensor

Calibrating the Electrical Conductivity sensor is important to ensure that the sensor is sending accurate readings to the Sprout GUI. Calibration must be done via an Arduino board through the Arduino IDE. It is suggested that you calibrate the Electrical Conductivity sensor regularly, though the exact frequency is up to your own discretion. However, you must calibrate the sensor at least once a year or if the sensor is taking noticeably inaccurate readings.

To calibrate the Electrical Conductivity Sensor, you will require:

- An Arduino board, found at the following link: https://www.arduino.cc/en/hardware/
- The Arduino IDE, found at the following link: https://www.arduino.cc/en/software/
- The library for calibrating the Electrical Conductivity sensor, found at the following link: https://github.com/cdjq/DFRobot_ECPRO

Instructions on how to calibrate the Electrical Conductivity sensor can be found under the topic: *Calibrating the Electrical Conductivity Sensor*.

Requirements for: Calibrating the pH Sensor

Calibrating the pH sensor is important to ensure that the sensor is sending accurate readings to the Sprout GUI. Calibration must be done via an Arduino board through the Arduino IDE. It is suggested that you calibrate the pH sensor once every 1 to 2 months. You must also calibrate the sensor if the sensor is taking noticeably inaccurate readings.

To calibrate the pH sensor, you will require:

- An Arduino board, found at the following link: https://www.arduino.cc/en/hardware/

- The Arduino IDE, found at the following link: https://www.arduino.cc/en/software/
- The library for calibrating the pH sensor, found at the following link: https://github.com/DFRobot/DFRobot_PH

Instructions on how to calibrate the pH sensor can be found under the topic: *Calibrating the pH Sensor*.

Glossary

Arduino: Arduino is a simple open-source electronics program that can read sensors.

Calibrate: Adjusting the settings to the sensors so that the sensors can measure properly.

GitHub Repository: A location where one can keep their information such as codes, files and file revision history.

Geany: A text editor that contains IDE (Integrated Development Environment) components

GUI (Graphical User Interface): A graphical user interface is an electronic interface that connects with graphical components such as icons, symbols, and menus.

Monitor: A type of hardware that allows graphics that are produced by a computer to be displayed.

Sensor: A Sensor is a tool used to measure changes to the environment and allows a physical occurrence to be converted to an analog voltage that can be read by humans.

pH: Is a quantitative measurement of acidity or basicity within water solution or other solutions that are liquid.

Printed Circuit Board: A mechanical substructure that holds and connects parts of an electric circuit.

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