ANICCA ANTENNAE: SOIL AS BRAIN

Documentation / User Guide

www.kenrinaldo.com/anicca-guide

Introduction

This is a guide for the art installation ***Anicca Antennae: Soil As Brain*** by Ken Rinaldo. It consists of robots in an arena with a soil and insect terrarium in the middle. The robots have movements and behaviors sometimes synchronized, that are triggered by the soil health and insect activity. Meanwhile, the insects go about their business, occasionally influenced by the activity of the robots moving around them.

The soil and bacterial cultures in the soil also have an influence on the robots as they influence the health of the insects living within. This is a kind of brain given the symbiotic relationships between the soil and insect. Common bacterial genera isolated from soil include: *Bacillus, Arthrobacter, Pseudomonas, Agrobacterium, Alcaligenes, Clostridium, Flavobacterium, Corynebacterium, Micrococcus, Xanthomonas*, and *Mycobacterium*. Besides, bacteria are important for the enzymatic degradation of the complex organic and Soil substances to nutrients and the release of nutrients and trace Enzymes elements from the mineral soil fraction. In this ecosystem, fungi are also present and part of the soil organism and brain of the system.

About the robots

Each robot is an autonomous device with many sensors and behaviors. Like many robots, their need for humans is

minimal: most days, a freshly charged battery is all that's needed. Turn them on with the rest of the system, and they're ready to go.

About the insects

A milkback/isopod glass globe enclosure, a substrate of 4 inches with a moisture gradient, a "wet" side with damp sphagnum moss, and a "dry" side with exposed substrate is provided in the glass terrarium. There should be plenty of hardwood leaf litter, decaying wood, and bark for hiding.

Watch the analog sensor on top and maintain temperatures between 70–85°F 70 – 85 degrees cap F and humidity of 60 – 80 % and supplement their diet with a calcium source like dried mealworms once a week. (provided)

You will notice dead isopods ("skeletons") -- LEAVE THESE; do not clean them up. Other small ones eat them to grow after they molt.

This is perfectly natural and Milkback Isopods do die.

A Milkback isopod (*Porcellio laevis*) has a lifespan of up to 3 years with proper care.

About this manual

This manual is written for all levels of expertise, from non-technical gallery staff to very-technical robot repair nerds:

- The next section is for gallery staff who handle the daily operations and may need to do some basic troubleshooting.
- The last, and longest, section has full technical documentation of the hardware and software with troubleshooting and maintenance instructions.

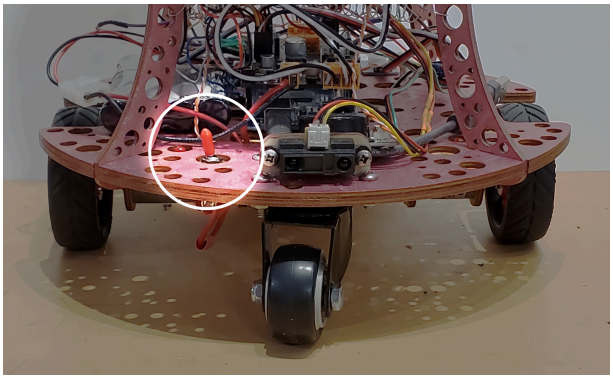
Section 1: The Not-Very-Technical Section (for gallery staff)

Operational

Basic Startup

To start the installation at the beginning of a day:

- The Mac Mini should already be on. If not, turn it on: The power button is underneath, rear left. You should hear the Mac startup sound and see a white power light (front right).
- Turn on video projectors / screens / monitors.
- For each robot:
    - Make sure the batteries have been charged overnight.
    - Turn the power switch on. (see right)
    - The robot's lights will come on one at a time as each sensor initializes
    - The Mac Mini will take a minute or two to start. Once it does, the robots should start moving.



- The installation starts in Dream Mode. (see below)
- Switch it to Active Mode as a test. (see below)

Normal Operation / Activity Modes

Before we describe what you should expect to see, you should know there are two modes of operation: **Active** and **Dream.** Gallery staff can change modes any time (via Mac Mini keyboard, press Space). I recommend that the gallery have a period of 10 minutes each hour that they are in active mode and 50 minutes in Dream mode to assure they will last the duration of this long exhibition.

Active Mode has the robots on full display: lots of motion and sound, almost continuous, some interactions with each other and the barriers. They're busy, and it shows. **During active mode a monitor must be present and be sure the robot necks do not get tangled and if they do enter the ring immediately and pull the robots apart.**

Dream Mode has the robots resting. LIke humans, "dreaming" has some activity and movement, just much less than when awake. For this mode the gallery lights can be dimmed as it is quite dramatic.

In Dream Mode, the robots are making light movements, typically only with their antennae, and some blinking a kind of REM rapid eye movement for the robots.

In either mode, not all robots run all the time. Often, a new behavior triggers multiple robots simultaneously. It may trigger all of them, but not always. This is normal. But if a robot isn't doing anything for quite a while, see the troubleshooting section below.

Why two modes? Active Mode actions use more battery power. All day in Active Mode likely would require many battery changes. By switching periodically to Dream Mode, the robots can stretch their battery life out longer. Beyond batteries, multiple modes provide more variety and a richer experience for the viewer.

Switch Modes -- Computer / Mac Mini operation

The Mac Mini under the glass globe of insects has a wireless keyboard. Control keys:

RETURN (Enter)	Stop / Start everything (robot commands, video, and sound)
SPACE BAR	Change modes (Active or Dream).
	The current mode is displayed on the camera video.
Q	Press the letter Q to shut down the whole computer. (takes 5 seconds)

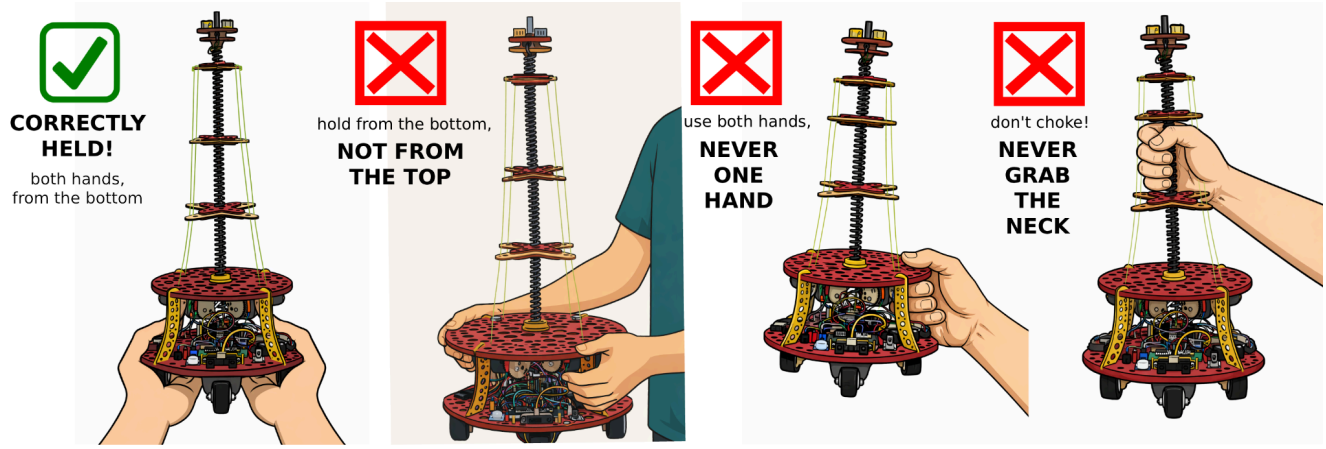
The Mac Mini should run and start everything automatically when powered on.

Shutdown -- don't!

Leave the Mac Mini on continuously. Don't shut down!

If you MUST shut down for some reason, press Q -- the Q key will shut down instantly.
DO NOT UNPLUG power to shut it off! Press Q and shut it down the right way.

Lifting / Moving the Robots



Use BOTH HANDS and grab the sides of the BOTTOM platform.
Lift straight up. Do not turn them upside down please!
Be careful not to move or pinch any wires in the process.
DO **NOT** LIFT BY THE NECK!

Battery recharging

Batteries should be left on the robots for recharging, and connect to the chargers via the white plastic connector -- pull it apart so the battery disconnects from the robot, then connect it to the charger.

Charger Light:

RED	Battery is charging
OFF	Battery is charged, or disconnected

Recharge can take up to 8 hours.
Measuring with a multimeter will show about 11.5 volts fully charged.

Insects / Isopods — Care

The isopods require some greens once per week. Once per week the spray bottle should be used to spray springtails off the surface of the glass. (Sprayer provided) The water needs to be filtered (pitcher provided) as tap water will injure them. They like old carrots or small bits of apple rinds.

Troubleshooting

Note that this Troubleshooting section is for low-technology issues and understanding. For expert problem solvers and tougher problems, see the other Troubleshooting section further below.

Error Messages

Error messages may appear on the camera video:

Webcam Disconnected

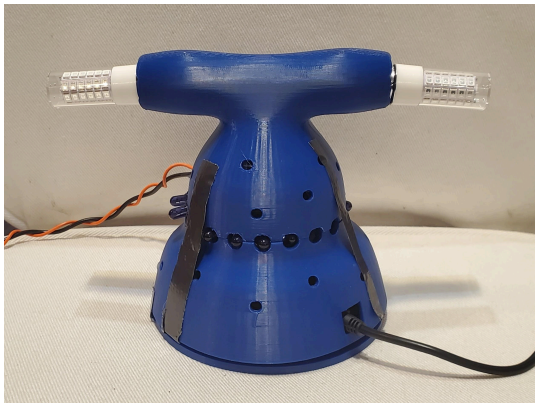
The webcam that looks down on the insects / isopods is disconnected from the Mac Mini below the insect tank.

- Turn off the computer (press Q on the keyboard).
- Check the USB cable connection from the webcam / camera to the computer, both at the camera AND at the computer.
- Then, turn the Mac Mini back on.

IR Arduino Disconnected

The USB cable going to the blue lighting beacon may be disconnected.

- Turn off the computer (press Q on the keyboard).
- Check the USB cable connections from the blue beacon to the Mac Mini below it, both at the blue beacon AND at the computer.
- Then, turn the Mac Mini back on.



We actually call this the “stalk-eyed beacon” in homage to the stalk-eyed fly:

Robot Problems

TRY THIS FIRST!	**Turn the robot power switch off, wait one second, then turn it back on.** The robot startup procedure takes up to five seconds, and may take more time to receive a command before moving.
Robot not moving	The robot isn’t getting power. Make sure a freshly charged battery is recharged. Turn the power switch on. The robot’s lights will come on as each sensor initializes, ending with almost all on and staying on.
Robot on, but not moving (although other robots are moving)	The robot can’t see the “control egg” beneath the insect tank. Eventually it’ll turn itself toward the controller. Or, the bot’s battery may be too low for movement.
Wheels slip on carpet / floor	This is likely a HEX nut that has come loose on the robot wheel. Remove the battery and lay the robot on its side gently. See if the wheel is turning but the shaft of the motor is not turning. This can be fixed by turning the wheel so you can see the HEX nut and retighten and use blue loctite once tight.
Robot runs, but doesn’t play sounds	The robot may not be reading its MP3 files. Turn the robot off. Locate the Micro SD card of MP3s near the front of the robot on the lower level. Push the card in and release. It should push the card further out. Pull it out, put it back in, pushing until it clicks. Turn the robot back on.
Robots power on, but no movement for any robot	Behavior commands may not be broadcasting. Is the Mac Mini on? If you don’t see a white power light (front right), turn the Mac

	Mini on (power button is underneath, rear left). Make sure the blue “control egg” is plugged into the Mac Mini AND plugged into power. Important not to remove the cable from the EGG however check the connection at the computer.
Isopod and springtails care	You will notice Isopod skeletons and leave these as other small ones eat them to grow after they molt. This is perfectly natural and Milkback Isopods do die. A Milkback isopod (*Porcellio laevis*) has a lifespan of up to 3 years with proper care.
Wheel nuts come loose	Hex tools

Maintenance

Each morning before turning the robots on, check that the wheels are OK and making good contact with the shaft so if the wheel turns the shaft turns with it. Check the neck and also make sure the drive wheel for the necks are also tightly working with the shaft. If they are not they need to be tightened with the tools provided. A small HEX nut and some loctite to hold the HEX nut.

All robots break at some point and the more wear and tear they get the more they are likely to need maintenance.

Section 2: The Very Technical Section (for robot repair nerds)

Hardware

Robot Anatomy (photos with labelled sensors, motors, etc.)

TRY THIS FIRST!	**Turn the robot power switch off, wait one second, then turn it back on.** The robot startup procedure takes up to five seconds, and may take more time to receive a command before moving.
Neck goes all the way down and keeps going	Motor Encoder
Neck string too loose (motor runs, neck doesn't move)	
Neck string breaks	Panic! Fatal failure…
Wheel nuts come loose	Hex tools

Arduino Mega 2560 R3 is the brain of the robot, however the true brain are the Isopods and Springtails communicating they positions back to the MAX MSP software and allowing these motions to talk to the individual robots in this swarm system
OSEPP Motor Shield (TB6612) use to interface between the main controller and to the motors and sensors
OSEPP LS-00041 High Torque Electric Motors x 4 drives the motion forward, back and motion of the neck in 360 degrees.
Motor encoder (A3144) used for feedback of the position of the motor relative to the neck
Accelerometer (ADXL 345) used or controlling the pitch and and motion of the neck
Infrared receiver module (KY-022) used for communication from the main control egg and software monitoring the movement of the Isopods and Springtails and translating that into movement of the robots.
Magnetometer used for finding North South East and West (LIS3MDL)
Infrared active distance sensor (2Y0A21) x 2
Two Ultrasonic distance sensors at the front of the robot and back of the robot (**HC-SR04**)
MP3 player (DFRobot Mini) used to play insect sounds
Light sensor / photoresistor used to find the light underneath the main controlling soid/insect terrarium
Passive infrared (PIR) sensor used for avoiding wall and each other
LED x 8 used for emotional feedback of the robots to the controlling insects and soil

Blue egg of lights (IR and visible)
Fence / rails / perimeter -- call it a: “Wiggle-Wood Wall”
Mac Mini

Software

Main Arduino code

Serial monitor messages

Max patch

Errors (missing webcam or Arduino) (need screen captures with insects)

Test Arduino Sketches for troubleshooting

[[TradeMark to include screen captures of each with “yes, it works” serial monitor output:]]
There are test programs for each sensor:

ADXL345_Test_Mega_2025
DFRobotMP3Mini_TradeMarkTest
IRDispatcherControl_for_cyclops
LED_9_Output_Test_v2025
Motors_And_Encoder_Test_2025

Motors_And_Encoder_Test_2025_v2
MP3_TEST_Mega_2025
Sharp_IR_Test_2025_Analog
Sharp_IR_Test_2025_Digital
Ultrasonic_Sensor_Test_2025

Download all of them from the Anicca support page: www.kenrinaldo.com/anicca-guide

Repair & Maintenance

Bot start-up procedure - LED status
Neck goes all the way down and keeps going (motor encoder)
Neck string breaks
Neck string too loose (motor moves, neck doesn't)

Repair & Advanced Troubleshooting

Note that this Troubleshooting section is for high-technology issues and understanding. For basic problem solvers and less technical problems, see the other Troubleshooting section further above.

TRY THIS FIRST!	**Turn the robot power switch off, wait one second, then turn it back on.** The robot startup procedure takes up to five seconds, and may take more time to receive a command before moving.
Neck goes all the way down and keeps going	Motor Encoder
Neck string too loose (motor runs, neck doesn't move)	
Neck string breaks	Panic! Fatal failure…
Wheel nuts come loose	Hex tools

THIS IS OUR PRIVATE PAGE AND SHOULDN'T GO IN THE FINAL MANUAL!!!

Q's:

- Power button, Mac Mini --
    - How do we avoid someone lifting / reaching underneath to press the power button?
    - Does the Mac MIni just stay on constantly?
    - Or do they always turn everything off each night?
- One video feed from the Mac Mini goes to the Xumo TV -- what about the 2nd video?
    - The 2nd will go to the monitor we've been using with the Mac Mini
- How do they get / upload test code for troubleshooting?
  Maybe it's hosted on kenrinaldo.com?
- Should gallery staff have a remote control? (for the bots)
    - Probably not…. What for?
- How does a bot with a low battery behave?
    - It stops moving, but otherwise still runs -- lights, sound (I think), etc.
    - Implement a test for this: during turning movements, test whether the compass direction has changed. If not, movement isn't happening, likely because low battery, so blink lights and/or make a special sound

2do's:

- Install Remote Desktop software on the Mac mini
- Need photos of a bot from different angles, each sensor and motor labelled
- Make a hidden webpage with this manual and support files on it,
  linked to by a QR code printed on the bottom of each bot
- Make extra SD cards with robot sounds on them
- Add a startup sound for each robot (to confirm MP3 working)