Hello! Welcome to my exit document. This is going to contain any information about goals or what needs work and where things are heading.

What I have accomplished:

* Built Sideways Microscope
* Got Stage and Motors working with ESP301
* Connected ESP301 to labview
* Connected Joystick to esp301
* Tracked Vorticella with joystick
* Devised procedure for setting up the setup
* Built Labview programs and blocks to aid in the use of the ESP301
* Set up the Favella and Algae growth center in the cold room
* Did troubleshooting for how to keep favella alive

What needs to be done

* Figure out how to line up the setup more precisely.
  + Maybe in a way that allows you to just change settings instead of having to estimate and eyeball the alignment of the optics.
* Create a Labview Program with IMAQdx that captures images from camera through the blackmagic card
* Build a program that will find the pixel to real length conversion so that tracking is possible
* Once those programs are finished, create a program that can track organisms using the images taken from the camera
* Track an organism
  + Most likely this will still require user input to focus on the organism
* Combine multiple programs into one Monolith program
* Figure out how to automate the focus
* Get a better container made of glass and airtight

**IMPORTANT**

* If you have done the initial setup procedure, DO NOT turn off the ESP301 without running the DailyEnd program or you will have to do the last page all over again.
* The best camera to use is the Sony alpha 6000, especially if youre doing video tracking.
* To have any NI software read the camera you have to acquire 1920x1080 resolution at 29.97fps

**The ESP301**.

* The power switch is on the back.
* Errors show up in the top left corner of the screen as a blinking “E”
* For some reason on startup there is an error. I don’t know what is causing it. It has not caused a problem yet though.
  + It is best to dismiss this error before running any labview programs otherwise the first time you run one it will tell you the error and not work.
  + You can dismiss errors using the front panel of the esp301.  
    press: Menu/Enter  
    press: down until you see “Get Errors”  
    make sure the black diamond on the left is next to “Get Errors”  
    press: Menu/Enter  
    it will tell you “1 Program Not Found” I have no idea why this is happening  
    press: “Esc/Delete” and it will be gone.
* The axes are set up such that Axis1=x; Axis2=y; and Axis3=z. I think this is the default setting.
* When you start the ESP301 up you will generally need to turn the axes all on
  + If you run the startup LabView program (which you probably should) it will do this for you as well as put the axis in the center of their motion range.
* Be careful going to the full extent of the z axis as it may hit the lens which could scratch it.
* For the most part you want to use labview to run any commands on the esp301
  + If you want to pass commands directly to the ESP301 you can use the control software that came with the box
    - go to the FavellaResearch folder
    - inside the ESP301 folder you will see a shortcut titled “ESP301 Standalone Program”.
    - Click that, press discover and select COM3.
    - Go to the Diagnostics tab. You can use the command line to send commands to the ESP301
    - DO NOT turn off the ESP301 while this program is running. It freezes some stuff up and is annoying.
    - A list and description of commands are in the ESP301 user manual
* DO NOT run two labview programs that connect to the ESP301 at the same time.
* Any other questions can most of the time be answered by the user manual.

**Next: Initial Setup**

* If the ESP301 hasn’t been used lately or the camera and the lens have been bumped around you HAVE to do this. It’s a bit tedious but once you do it you don’t need to do much else.
  + Take the 40x lens and turn it so it is pointing away from the closest edge of the table
  + Make sure that a ziplock bag is over the lens to prevent scratching it
  + Run the “InitialSetup” LabView program
  + Use a 1/16 allen wrench to loosen the slide holder
  + Place the calibration slide in the holder
  + Slide the holder up until the calibration slide fits snug
  + Push the slide back so it is standing straight up and flat
  + Tighten the holder to hold it in position
  + Turn the lens back in line with the setup
    - To do this it is best to have the lens point slightly left before tightening the screw that holds it in place because that screw turns it to the right a bit.
    - Try to get it as straight as you can at the beginning. Eyeball it.
  + Make sure the sensor cover is on the camera to prevent dust getting in there
  + Check that the camera looks like it is not angled relative to the stage it is on
  + Check that the stage that the camera is on isn’t angled off in some direction
  + Turn on the light source
  + Move the light source so that the circle of light is on the lens and small enough that it isn’t going past the lens
    - I find it helpful to place a piece of paper in front of the lens and move the light source until the circle is a little smaller than a quarter.
  + Move the 0.01 calibration scale to the center of the circle of light on the slide.
    - You can see what part of the slide is illuminated. Use the two knobs on the slide holder to position it in the middle of that circle.
  + Take the ziplock bag off of the lens
  + Move axis 3 to roughly 8.5mm
  + Place a piece of paper between the lens and the camera
  + Move the Slide holder knobs and the rotation knob until the scale is in the center of the projection and not distorted
  + Take the sensor cover off of the camera and see how the image turned out
  + Move the camera using knobs or by raising and lowering the platform until the 0.01mm scale is in the center of the image.
  + Look at the image and if one side of the image seems in focus while the other is out of focus or if there seems to be any distortion of the scale move the angle knob and move the camera left or right until the focus or distortion is fixed (or at least a little bit better)
  + Take the calibration slide out and resize the holder to fit the chamber

**LabView Programs**

If you are not programming then make sure you are on the “master” GitHub branch, Rachel can help with this.

The programs in the master branch are all functional and should work as advertised. They are necessary for the use of the setup for various reasons. This section will not cover how they are built but instead will cover what each one does. There are three main LabView program folders, Programs, Resources, and Square Library. Most of this information is in LabView’s context help. I tried to put as much of this in labview as possible.

* **Square Library**: contains programs that are not necessarily individually operable, they are mainly used to build other programs
  + They are all pretty self-explanatory or have context help
* **Resources:** contains programs other people wrote I stole code from or found useful in learning how to do things in labview
* **Programs:** contains fully built programs that are useful for research sometimes
  + **Examples:** This folder has a couple easy to understand programs that are a good intro to programming the ESP301
  + **Initial Setup**
    - Run this program if you have not used the setup in a while and things have been bunped or could have been bumped.
    - This program takes a little while
    - It will move all of the axes as far back as they can go and define that position as zero
    - They will then move all the axes as far forward as possible, divide that distance by two and move to that position
    - The middle position will be redefined as zero.
    - Use this in the process of the Initial Setup Procedure defined on the previous page.
  + **DailyEn**d
    - IMPORTANT:Run this and let it finish before turning the ESP301 off
  + **DailyStart**
    - This program is meant to prevent you from having to redo the initial setup procedure
    - IMPORTANT: Run this whenever you turn the ESP301 on
  + **CalibrateFromSavedImage**
    - This program is a hopeful guide and precursor to a better calibration program
    - This program will take a photo that is already saved on the computer and allow you to draw a line. You tell it how long that line actually is and it will output a .csv file containing the magnification and the pixel to real distance conversion factor
    - The pixel conversion factor will be necessary for future tracking programs
  + **PositionGraphData**
    - This program will show you the position of each axis with 1ms resolution
    - It will also save each position along with a ms timestamp from when the program was started.
    - When you are done the program allows you to save where you moved the stage as a .csv file
  + **Turn on Joystick**
    - Run this program and the joystick will be turned on
  + **Turn off Joystick**
    - Run this program and the joystick will be turned off

**If You Are Programming**

* Make a github account and have Rachel add you as a collaborator
* Create a branch for each new block you are going to build so that there is a specific pull request when that is added to the master branch.
* If you are making significant edits to a program in the master branch, make another branch to do this and then create a pull request when the new version is complete. This way there will always be functional programs in the master branch.