

Ender 3 FDM printer / Hackster IO card

1/29/2024 - Update the paragraph below with a description of what this project is. You can use information from any links to Instructables or other tutorials

Mr. Burnham Notes ▾

This Project shows how to add a Hackster IO card to a standard Ender 3 printer and have it send SMS messages if a print job fails.

We hope this note finds you well. We are writing to provide feedback on our experience with the recent contest. While we appreciated the opportunity to participate and showcase our skills, we would like to express some concerns regarding the support materials provided for the competition.

Specifically, we found that the resources provided for configuring your microcontroller card to connect to LTE and send SMS messages were inadequate. Although we were able to successfully implement the microcontroller aspect of our project, we encountered significant challenges when attempting to integrate the LTE functionality.

Regrettably, the documentation and examples provided did not offer sufficient guidance or working examples for this crucial aspect of the project. Despite my best efforts and extensive research, we were unable to overcome these obstacles and fully realize the intended functionality of our project.

Despite the difficulties we encountered, we remain optimistic about the potential of your product and the opportunities it presents. We appreciate your attention to this matter and welcome any further assistance or clarification you may provide regarding the integration of LTE functionality with your microcontroller card.

Today we are trying to convert the Ender 3, a widely known open source and available 3D printer, to be able to attach one more control card/component and make it more reliable and safer. Our Hackster IO addition will also add to the printer's productivity.

1. **Filament Deposition Manufacturing** is becoming more popular and affordable that it has reached a large audience ranging from professionals all the way down to hobbyists. Whether the operator is a money-making print farm operator or a weekend filament warrior, the same common problems exist where productivity and safety can suffer. Our target audience covers all spectrum from pros to newbies where they would find the world of 3d printing safer and more enjoyable. Our process and technology improvements will add a safety layer to 3d printers but mainly to increase productivity by utilizing a Hackster IO card and notify operators whenever a job fails in one or several ways.

2. **Now that we described our project, let's get started!**

At first, you want to get yourself a used Ender 3 3D printer from Ebay. A used unit in a good condition can be had for around \$60. Most of these used units will be coming for a print farm so don't be surprised if it's a bit weathered! We specifically picked this model since it is very basic in design, easy to modify, open source software and has lots of aftermarket support when it comes to upgradable parts. Click below and check out the parts list:

-Used Ender 3

<https://www.ebay.com/itm/334520680979?hash=item4de2fc8213:g: XK4AAOSwi vdhtj0r&amdata=enc%3AAQAIAAAA8HqIOPL%2B3tx2N0qGdosIPnX9OpBTsxsh NWHpO%2BjGBrzSwEcqzpaP%2FHcxpw989%2FB41RjtVyVXegfH2TZDRpCAe9r6 d94b5n0NFMXMQBTBDbsLPtYLks0RHUXnLtkAUzlc9M3DrkjK01eEJIARJNBnm %2BB6k41KOC0PpuJtcwi9QE%2B97RJUcblyJu53XAp8tt5W4%2BAHxEwwlRiV% 2Fv40QPbie473Zq1nHciDQUDyZJ8YSfK1Tn%2FY%2BVseg1GYIq45oed2BG3o7a gCPKzfVUa9xw2XSsTx1QH08uwTAnqhWAt7hRI8ik%2FNJDqr330FeCxTrsi%2Bw %3D%3D%7Ctkp%3ABk9SR5Txiq-tYw>

-Filament Sensor 2.0

https://www.amazon.com/BIGTREETECH-SFS-V2-0-Filament-Compatible/dp/B0 C77J36T3/ref=sr_1_1_sspa?crd=1M01FEQ7XTPPV&keywords=bigtreetech%2Bf ilament%2Bsensor%2B2.0&qid=1706896146&sprefix=big%2Btree%2Btech%2Bf ilament%2Bsensor%2B2.0%2Caps%2C119&sr=8-1-spons&sp_csd=d2lkZ2V0TmFtZ T1zcF9hdGY&th=1

-Big Tree Tech MotherBoard

https://www.amazon.com/BIGTREETECH-SKR-E3-V3-0-Motherboard/dp/B07YW86YS7/ref=sr_1_1_sspa?crid=1QM1ZQEL19I0U&keywords=bigtreetech%2Bskr%2Bmini%2Be3%2Bv3.0&qid=1706896348&sprefix=bigtreetech%2Bskr%2Caps%2C126&sr=8-1-spons&sp_csd=d2lkZ2V0TmFtZT1zcF9hdGY&th=1

Hackster IO AVR Card

<https://www.hackster.io/microchip/products/avr-iot-mini-cellular-board?ref=project-23e056>

Filament sensor bracket (print this before starting the project)

<https://github.com/bigtreetech/smart-filament-detection-module/blob/master/V2.0/Community%20Mods/Ender3%20V2/SFS%20V2.0%20Bracket%20for%20Ender3%20V2.STL>

You will also need to download CURA software on your computer(or any slicer but we will be using cura exclusively):

<https://ultimaker.com/learn/ultimaker-cura-4-9/>

3. Let's get started!

-First you will need to attach the filament sensor on the bracket that you just printed off of the BigTreeTech website. The sensor has 3 mounting holes but you will only be using two.

-Install the bracket along with the sensor on the printer's Z-axis screw bracket. You will need to remove the 2 existing Z-screw guide mounting bolts.

- Install the new BigTreeTech motherboard.
- https://www.youtube.com/watch?v=NLphYZEm6Ok&ab_channel=YoramSwiers

4. Involve learners actively - It is now recognised that students learn when they are actively involved in solving problems. Treat this tutorial as if it was a discussion

between you and the learner. Students do not learn simply by accessing information. Rather students construct their ideas and understandings of concepts through interactions with your tutorial, so make it hands on. Therefore, effective tutorials will include tasks for students to carry out that lets them try out your learning process.

5. **Work with what learners already know** - When we learn, we compare new information with what we already know. The theory of knowledge construction sees the learner not as an empty vessel into which pre-formulated knowledge can be poured undigested, but as someone with an existing knowledge structure onto which they must fit their new learning. A constructivist approach will therefore begin with what the learner already knows (the known), and involve them in active engagement with the new (Mayes 1998).
6. **Manage the flow of the learning conversation** - This relates to the way that the tutorial guides the learner to think their way through the material. It is not sufficient simply to provide informative material - tutorials need to copy the Step by Step on how to construct and solve construction and creation processes. You are providing an outline, giving the aims of the tutorial, marking the beginning and ending of sections, drawing attention to salient points, making relevant links, summarizing etc. This also relates to how the content is structured - Sometimes you really have to "[Show Them](#)" how to do something. Theory and explaining works sometimes, but sometimes you really have to show them, do a deep dive into an explanation.
7. **Go from the particular to the general (at least sometimes)** - *"... the root of the true practice of education must start from the particular fact, concrete and definite for individual apprehension, and must gradually evolve towards the general idea."* -- Alfred North Whitehead. Depending on their learning style, many learners are happiest starting with concrete examples from which they can extract abstract principles, rather than the other way round. This approach fits well with the principle of active learning and allows new learning to be located in the real world and therefore in the known. Tell them how to do the specific task, step, or concept, but also provide some links to more background information about the specific task, step, or concept.
8. **"Are We Going To Have A Test?"** - Probably you are not going to give them a test, but you should think about what that looks like, because it will help you answer the questions and explain the steps in a way that they could take a test if needed. Imagine, after the tutorial, you will give them a test. Even if you don't, it's a good idea to think about a test. This will force you to think "what do I want the person who watches the tutorial to learn"

9. **ELI5 - Explain Like I'm 5** - Ask yourself what if someone non-technical had to read/watch the tutorial. You can't teach them all the prerequisites they may need, but you should keep all the concepts simple. No one wants 99 hours of prerequisites to 1 hour of the content you are teaching them... That's true, but imagine you're trying to simplify some explanation (esp. "why" they should bother), it can help to think ELI5 (explain it like I'm 5)
10. **Is There A Gap?** - How to write a tutorial that truly educates and entertains is a challenge many writers face. The importance of clear communication and engaging content is more critical than ever. Imagine pouring hours into tutorial writing, only to be met with blank stares and bewildered criticism. The gap between your knowledge and your readers' understanding can be disheartening.
11. **Are Your Sources Valid, and Well Researched?** - By presenting a well-researched tutorial, you establish yourself as an authority in your field. As your tutorial gains traction and is shared, your reputation grows, earning you admiration and acknowledgment from your peers and readers alike.
- 12.

Have 1-3 project pictures, videos or other images that will capture the imagination of the reader.

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| | | |
|------|---|---------------------|
| Date | No Instructable available for our project. Hackster IO addition to Ender 3 printer is a pioneering project. | Mr. Burnham Notes - |
|------|---|---------------------|

Prerequisite & Baseline Knowledge:

< Replace This Text/Paragraph/Section With Your Explanation Of What The User Should Already Know - Provide an Example text here

- know how to do this ← the "this" should be a link to where to learn more
- and this...
- and also this would help

Explain any overarching concept that people need to know about this project.

Have you ever read a tutorial and realized midway through that it's beyond your level of experience? The author forgot to mention the skills you need to complete this tutorial, and now you're frustrated because you've wasted time on something you can't use yet.

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Parts & Software used in this project:

< Replace This Text/Paragraph/Section With Your Overview Or Introduction to the Parts and Software - This section and paragraph is to list out the parts and software, where to get them or how to access them. This paragraph is to say something about any hard to get or hard to access parts or software. You don't want the reader to jump into this project without understanding what parts may be hard to get or software to access.

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Hardware components

| | Item | # | Description / Link |
|---|-------------------------------------|---|--------------------|
| 1 | Microchip AVR IOT Cellular Mini | | |
| 2 | BigTreeTech filament run out sensor | | |
| 3 | 3d printed AVR Mini mount | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |

Software components

- Software to edit in C++
- Github of big tree tech
- Visual studio code (looking at BTT Code)
- Autodesk Fusion 360 (design of Mount for AVR)
- Cura (mount for AVR)

Additional Electronic Files and Links

- <https://www.hackster.io/contests/avr-iot>
- <https://www.youtube.com/watch?v=BO8wzNx5hM>

- https://drive.google.com/file/d/1_EXSxvmr2EIPQDpjSY9eI_kcKIPb7Sli/view?usp=sharing
- <https://arduino-craft-corner.de/index.php/2024/01/03/connecting-the-avr-iot-cellular-mini-board-to-the-internet/>
- <https://www.hackster.io/wizardofmake/sensor-cube-1-727bbc>
- <https://www.hackster.io/keen-an-johnson/avr-iot-cellular-mini-107a63>
- <https://www.youtube.com/watch?v=BOh8wzNx5hM>
- <https://www.youtube.com/watch?v=qMLzUdqDvj8>

< Replace This Text/Paragraph/Section With Your Explanation of the parts & software, how they work and what to think about when using them - Provide a brief explanation of the actual parts and what they do and how to use them so an explanation of how the particular sensor works or particular motor controller works or particular electromagnetic theories and how they work. -- >

Project Overview:

< Replace This Text/Paragraph/Section - Do a deep dive in explaining the purpose and goals of the project, and what the reader will know and be able to do... - This paragraph is an intro to getting started on the specific project. The reader has gotten this far, they are ready to start... get them going with some explanations and then jump into the steps.

Do the following in this introduction and/or in the steps:

- Think of any questions the reader will have, and try to answer them here in the introduction or in each of the steps. Remember, this is your 2-3 time thinking about and trying this lab/tutorial, but your audience may never have seen or learned about this topic. Try to proactively answer any questions they will have.
- On all of your images, make sure to provide a detailed caption that really tells the user what they're seeing and WHY.
- If you are posting code, make sure it is selectable if it is a small snippet, but if not make sure there is a link to a github site so your readers can cut and paste it.
- If a step seems too complicated or has multiple topics, then it probably should be split into multiple steps. It's OK to have lots of steps.
- Make sure you provide a time frame for each step. How long should it take your reader to do?

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Step 1: <Step Title >

< Replace This Text/Paragraph/Section - Give an Overview for the Step - This paragraph is an intro to getting started on the specific project. The reader has gotten this far, they are ready to start... get them going with some explanations and then jump into the steps.

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Overview:

Give an overview for this step. Include a "Why are we doing this step in this order". This can be a short or long or multiple paragraphs.

- This Step will include... < list what they are going to accomplish >
- This Step should take about N minutes to complete.

Tools, Components & Software Used:

List any tools, components or software used in this step. Describe how to prepare these items.

- Arduino IDE
- Autodesk Fusion 360
- Cura
- Ender 3
- Relay module
- Buck converter
- Usb c-c wire
- Usb c splitter
- BTT SFS V2.0
- Visual Studio Code

Let's Get Started:

Now tell them what they are doing, and how to do it... This is the details of the step.

This is probably a few paragraphs or sub-steps. It can be a mix of paragraphs and bullet points. Pictures or videos are also good to have.

- Paragraphs describing the step
- Pictures describing the step

- Blocks and links to code. Your code should be nice to look at. It should look like code, so you could put it in a table cell and color the background and change to a monospaced font like `Courier New`, which is the typical default for a computer terminal font, but you might like other fonts. I currently like Roboto Mono or something like Helvetica Neue. See this [Google Docs code font tip](#)

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What Should be Working/Done:

This is just a last paragraph to tell the reader what they should have accomplished, what should be complete, what should be working... AND how they will know. Is there some test to run, is there some mechanical capability the item should have? Just make sure they are done with this step before they move on.

Step 2: <Step Title >

< Replace This Text/Paragraph/Section - Give an Overview for the Step - This paragraph is an intro to getting started on the specific project. The reader has gotten this far, they are ready to start... get them going with some explanations and then jump into the steps.

Overview:

Give an overview for this step. Include a "Why are we doing this step in this order"

Tools, Components & Software Used:

List any tools, components or software used in this step. Describe how to prepare these items

Let's Get Started:

Now tell them what they are doing, and how to do it... This is the details of the step.

This is probably a few paragraphs or sub-steps. It can be a mix of paragraphs and bullet points

What Should be Working/Done:

This is just a last paragraph to tell the reader what they should have accomplished, what should be complete, what should be working... AND how they will know. Is there some test to run, is there some mechanical capability the item should have? Just make sure they are done with this step before they move on.

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Software:

Related and "What's Next?"

< Replace This Text/Paragraph/Section With Your "Dig Deeper" Plan - This where you provide a paragraph on what you think your or reader should do next. Describe what your plan to do or what they should do to learn more, dig deeper, or how to expand their learning on this topic.

- List links
- list another...

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Daily Blog Of Work and Project Progress:

1. 02/01/2024 We blew the motherboard. The motherboard shorted and blew a resistor when we installed the retaining clips on the build plate not knowing that it was too far in the top left corner and touched both positive and negative terminals for the heating element.
2. 02/06/2024 Installed a new motherboard and it is functioning as designed but we noticed that we are having extrusion (under extrusion/ no extrusion at all) issues. We think that it is due to a lack of "part cooling" hence we are printing a new fan shroud to direct the air right on the printed part.
3. 02/07/2024 thought about the z-hop retraction being the issue leading to no extrusion at all since the aftermarket hot end
4. 02/13/2024 Today we decided to have the Hackster IO card to control a relay board that will de-power the 3d printer instead of having the printer software stop the print job when a failure is detected. We feel like this showcases the Hackster IO card's capabilities more. We also decided on encasing the Hackster card and bolt it on the printer frame to showcase it and give it more visibility.
5. 02/14/2024 currently tried refining the z-hop retraction (from 3mm to 1.5mm) currently testing with a small print and fixed the bed mesh to fix any residual bed leveling issues.

6. 02/14/2024 We started designing the display case for the Hackster IO on Fusion 360.

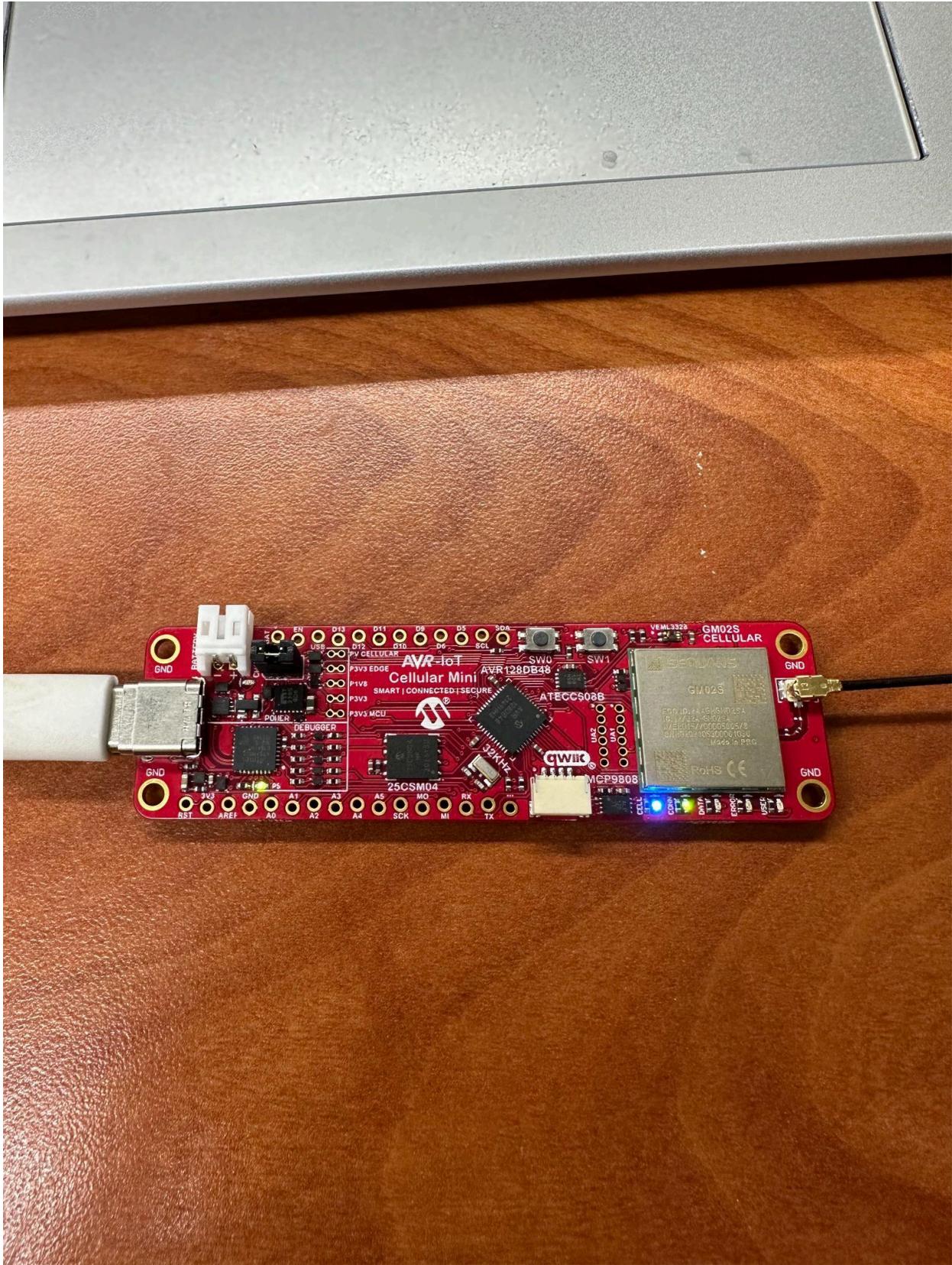


2/16/24 fixed issue with printer jamming once again will need further refinement on the z-hop retraction distance on e3d volcano hot end clone.

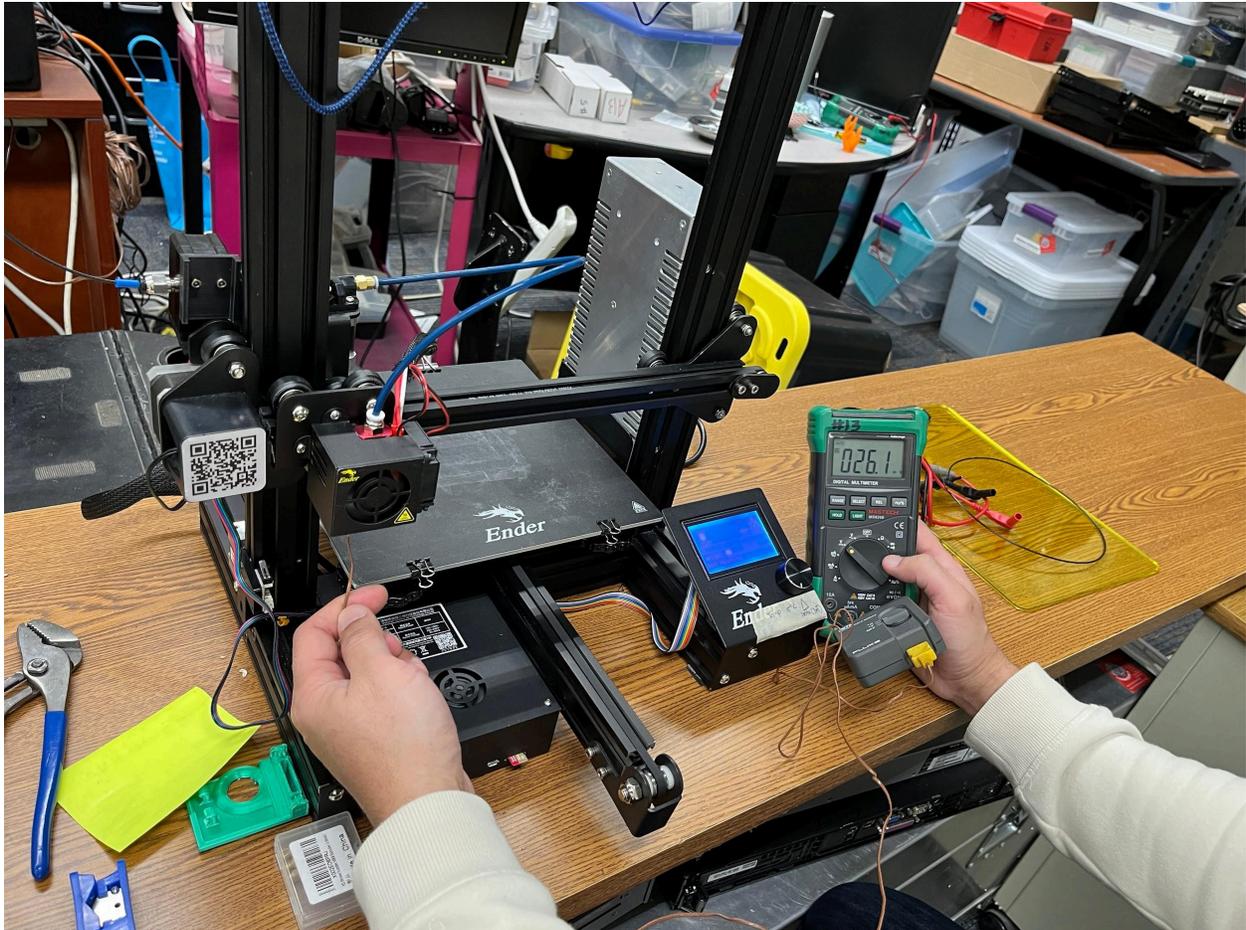
7. **2/26/2024**

Today we navigated the Hackster IO sim card website and activated it. Our Hackster IO card is not connected on line as indicated by the blue and green LED's.

*Getting an error connecting the card with cell phone providers.



3/5/24 issues with temp



Found a issue of the printer having issues with the hot end having a 15C delta between stated and actual temperature on screen (used thermocouple measuring device)

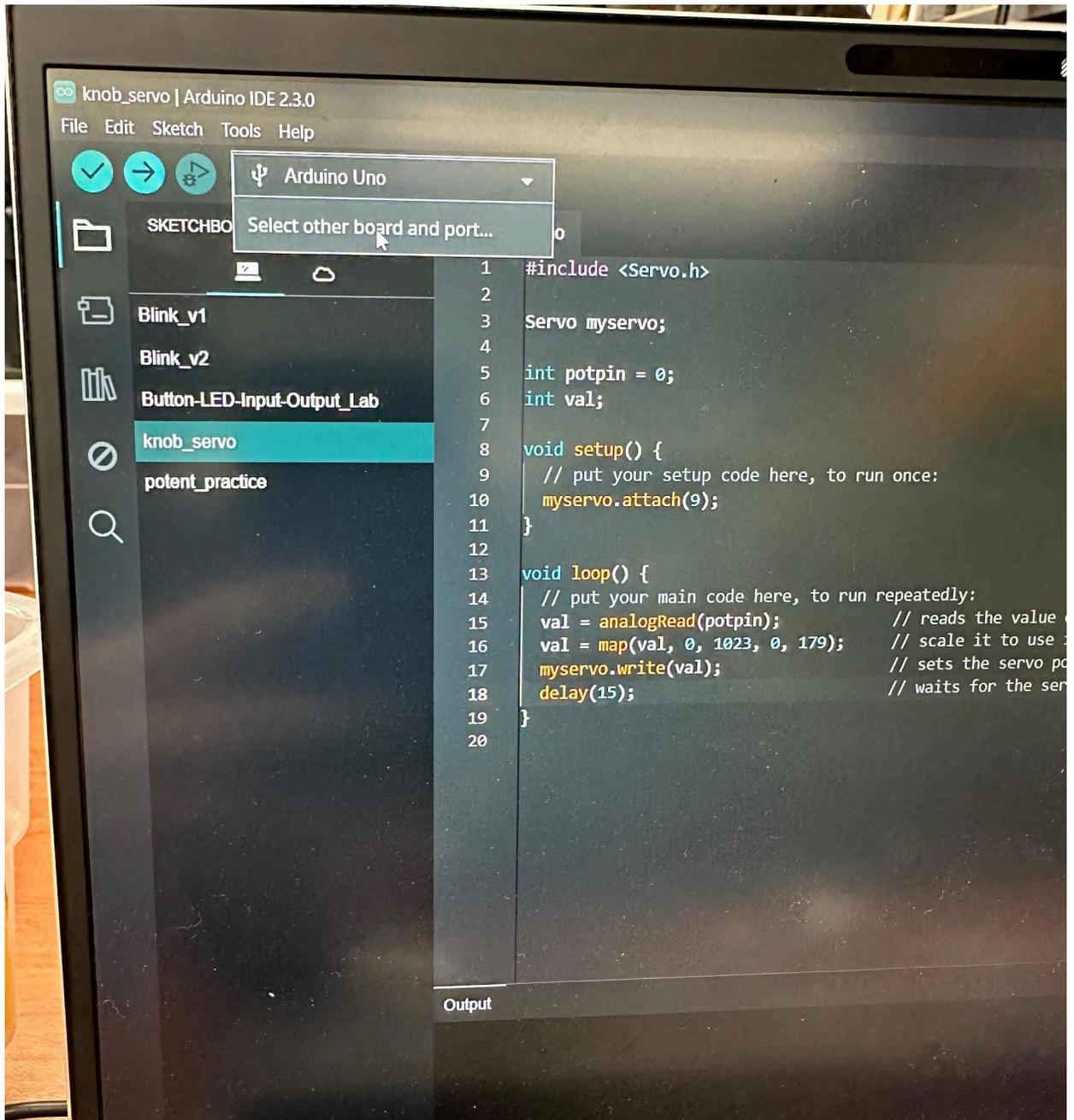
03/06/24

Adding AVR Board to Arduino IDE

1. Install DX Core:
 - connect ACR card to computer
 - Open Arduino IDE
 - Go to File → click Preferences
 - On the bottom most line labeled "Additional boards Manager URLs" type in:
http://drazzy.com/package_drazzy.com_index.json
 - Click ok
2. Click on "Board Manager" icon on the left most side of the IDE
 - type "DXcore"

-click install

-Click on "Select Board" drop down menu



-Scroll down and select "AVR DB - series (No Bootloader)"

3. Go to "Library Icon"

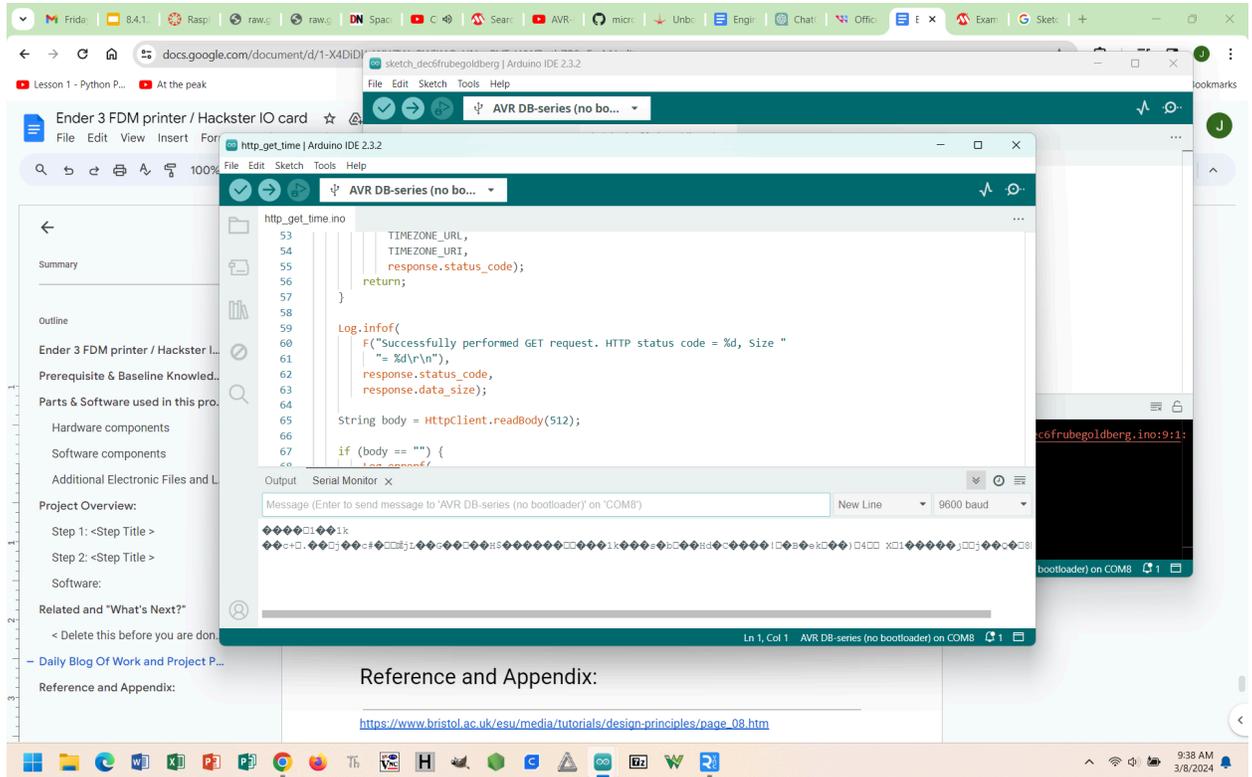
-type "AVR IOT" and click "AVR-IOT-CELLULAR.1.3.4"

(reference video in resources)

03/08/2024

Microchip Cell Mini

1. Was able to successfully load Microchip's library successfully in Arduino Library
2. Successfully loaded code in AVR card. Code ran properly but card is not connected to cellular system yet.



3/11/24

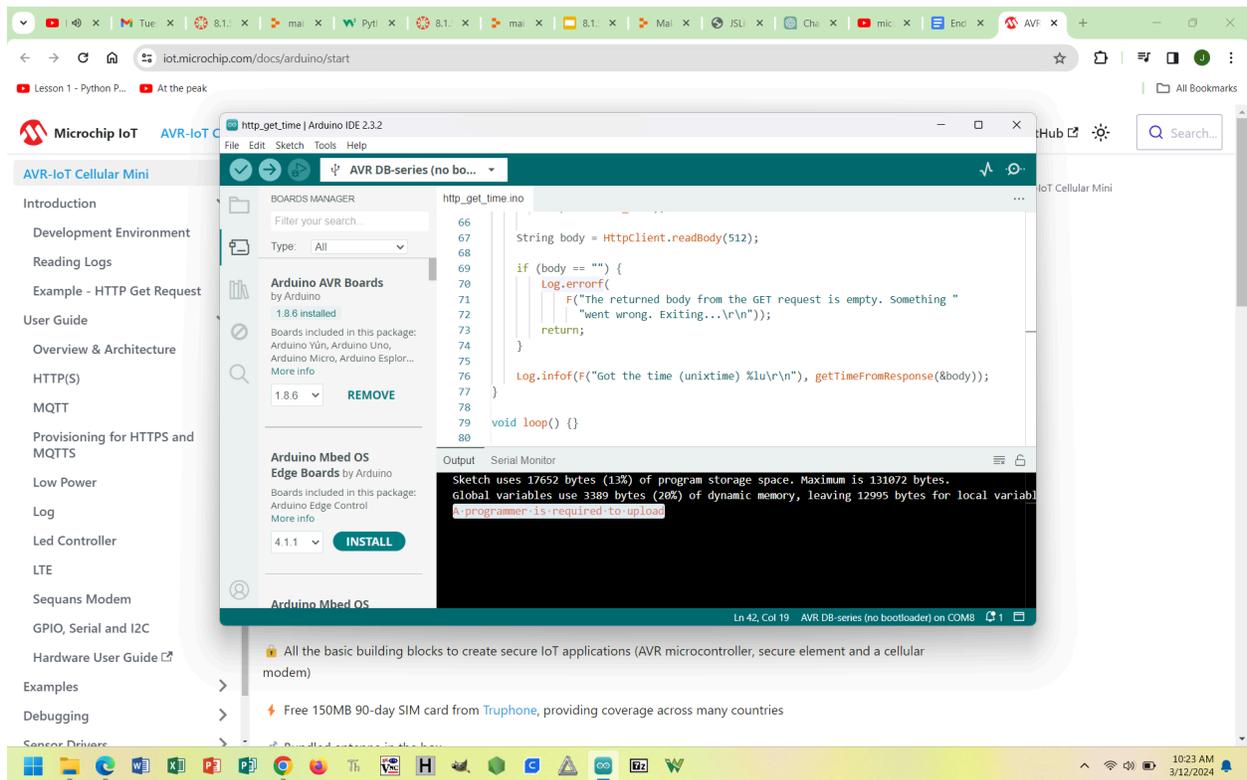
Corrected the heat break assembly

Moved the heat break further to the rear and inserted the nozzle all the way in before installing heat break. Our hypothesis is that with the larger contact area on the nozzle to the heater block we would get less of a delta between nozzle and heater block.

Currently still need to do some testing and a heat cycle before any definitive results.

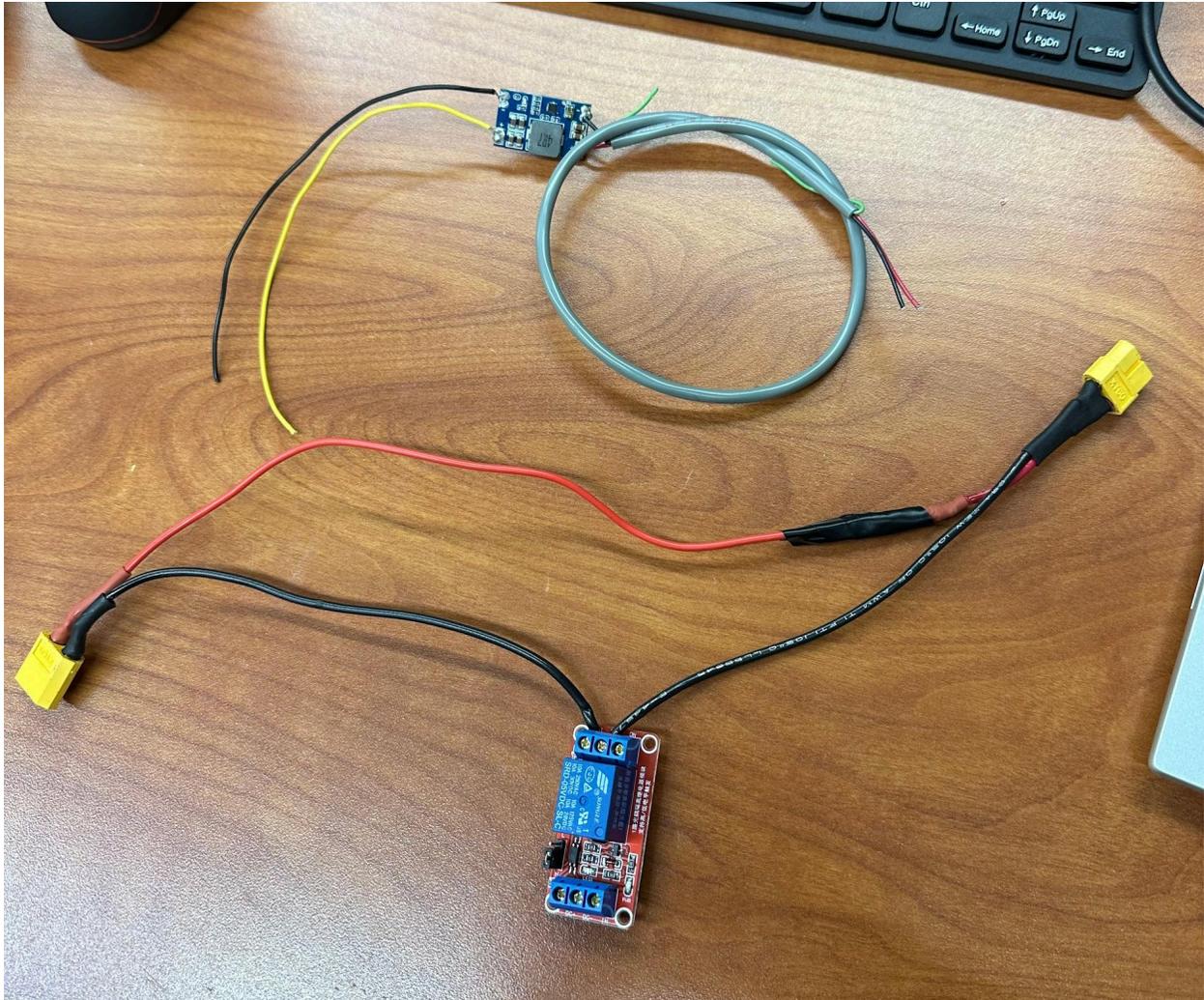
3/12/2024

Loaded code to Arduino IDE but couldn't make it run successfully.



03/14/2024

Today we soldered and assembled our relay cutoff and buck converter for our 3d printer

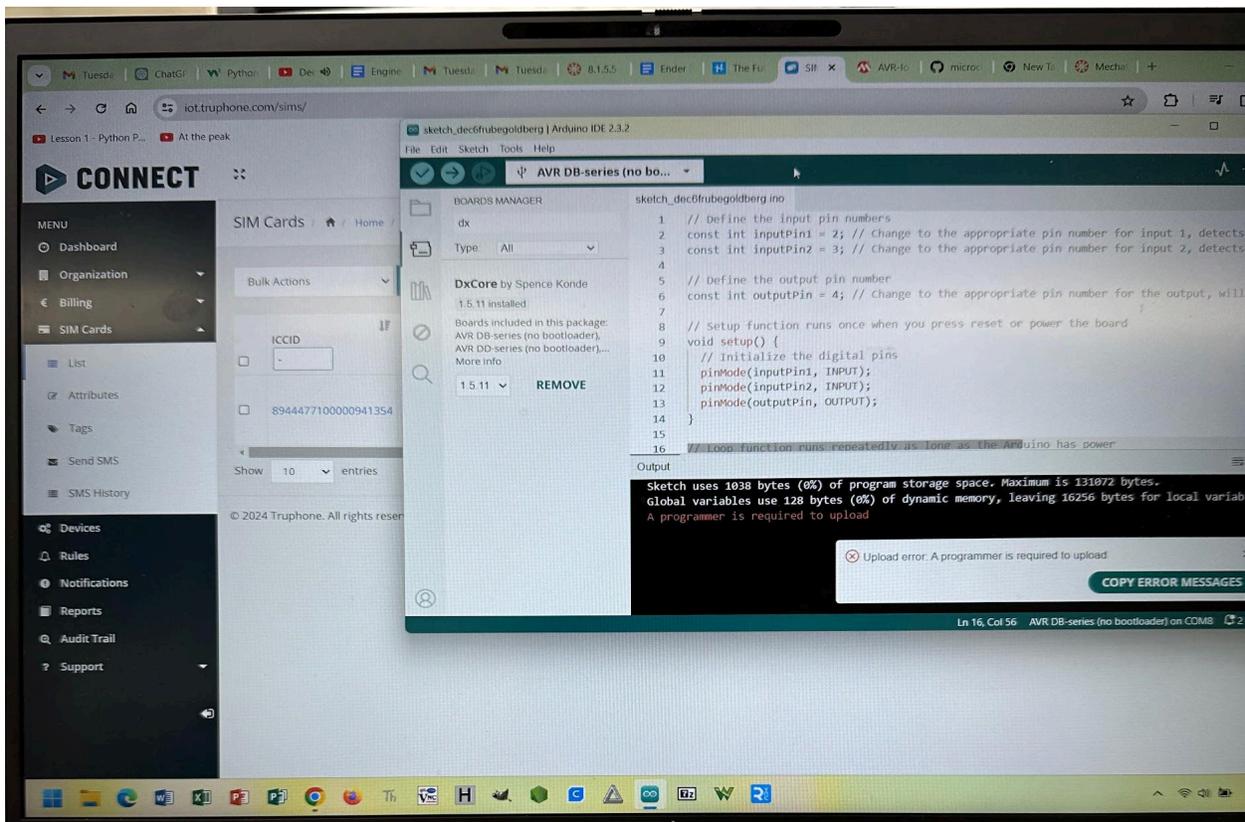


3/19

Today we started building our code. Still trying to find direct info on how to enable Cell mini card to send SMS message. Posted question on discussion board and waiting further instructions.

3/20 coding issues

Currently exploring new codes and reading through the manual and have issues with it it and its currently trying to communicate through the serial ports currently instead of trying to communicate on the board to the sms texting part will need to work on that in the future



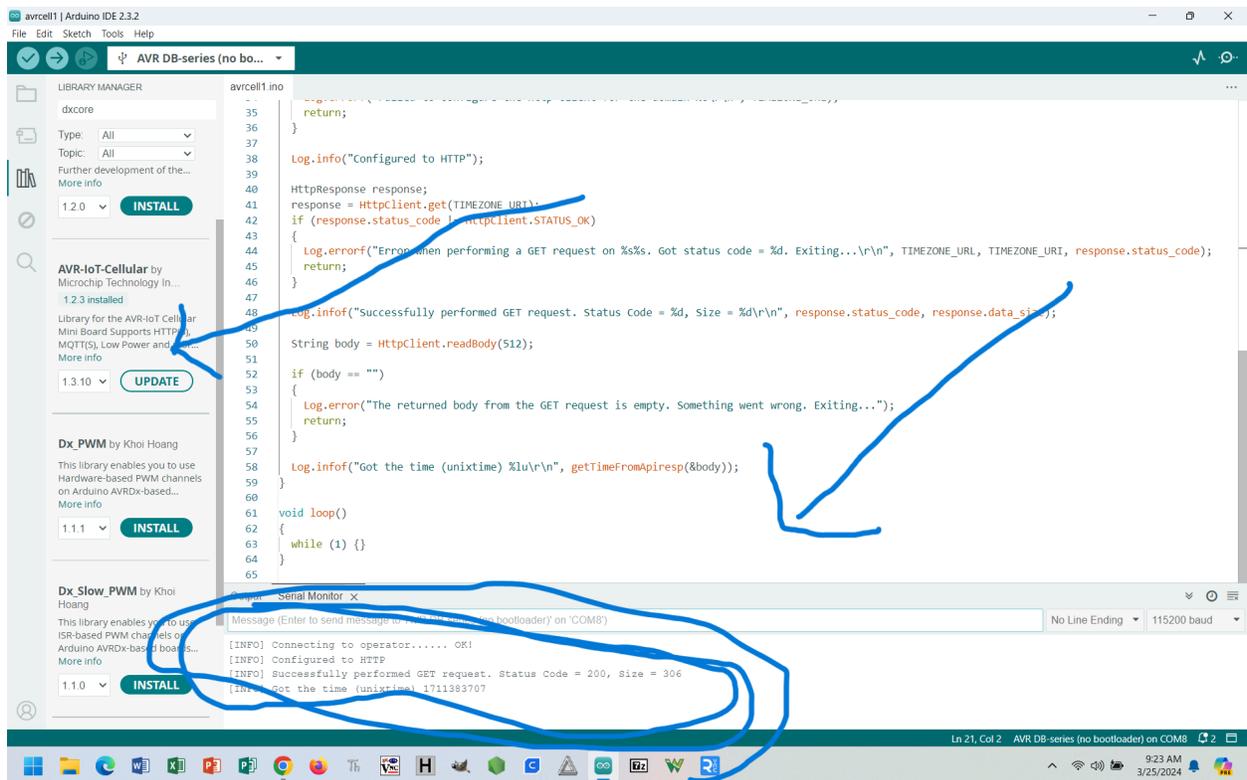
3/25/24 blue light stay on

Got the blue light for connection to cell connection to stay on constantly and learned to use older version of the libraries and managed to get a response through the serial monitor.

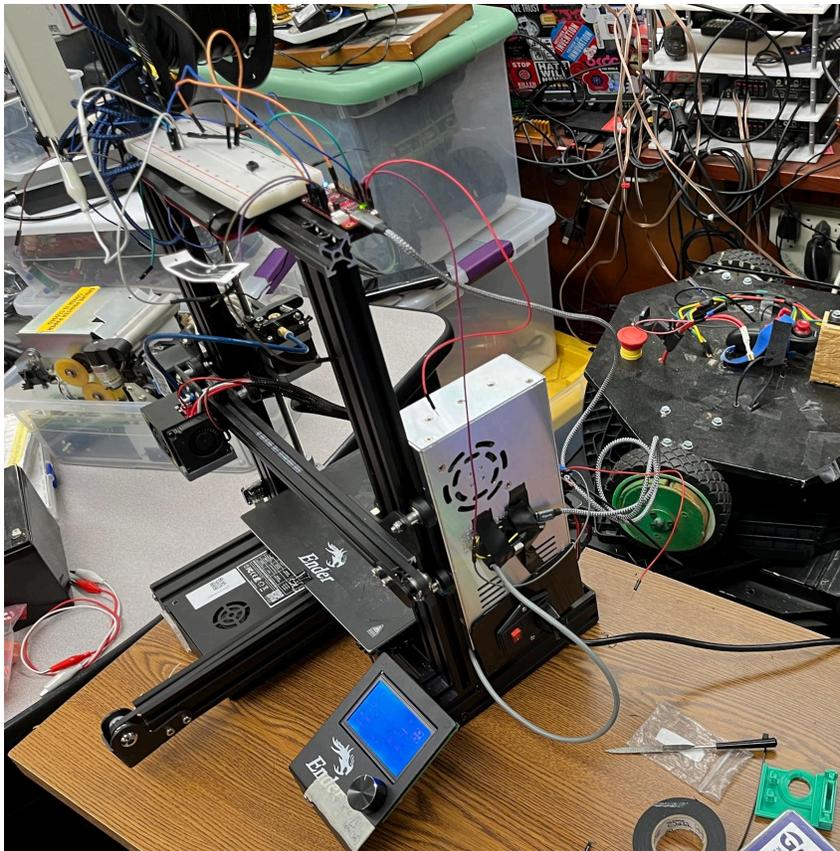
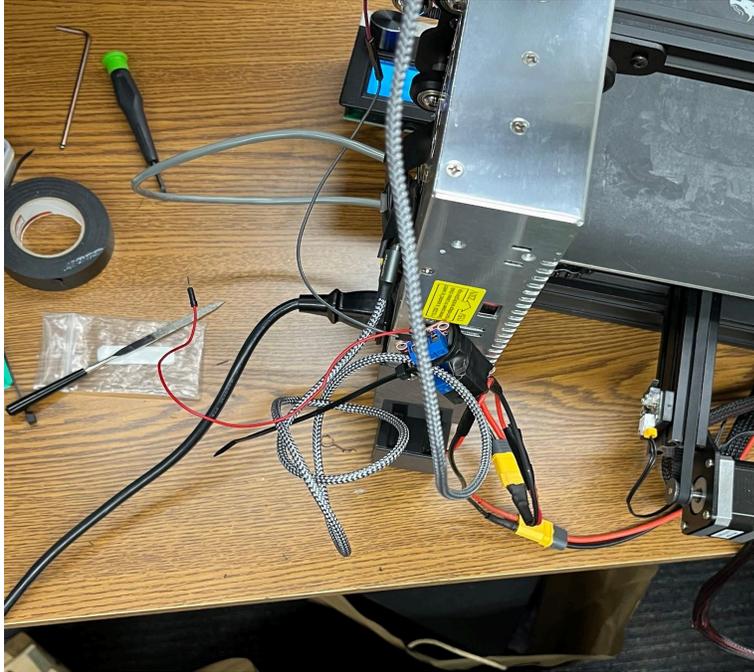
Currently found article on how to connect to the sandbox using mqtt. currently exploring Mqtt

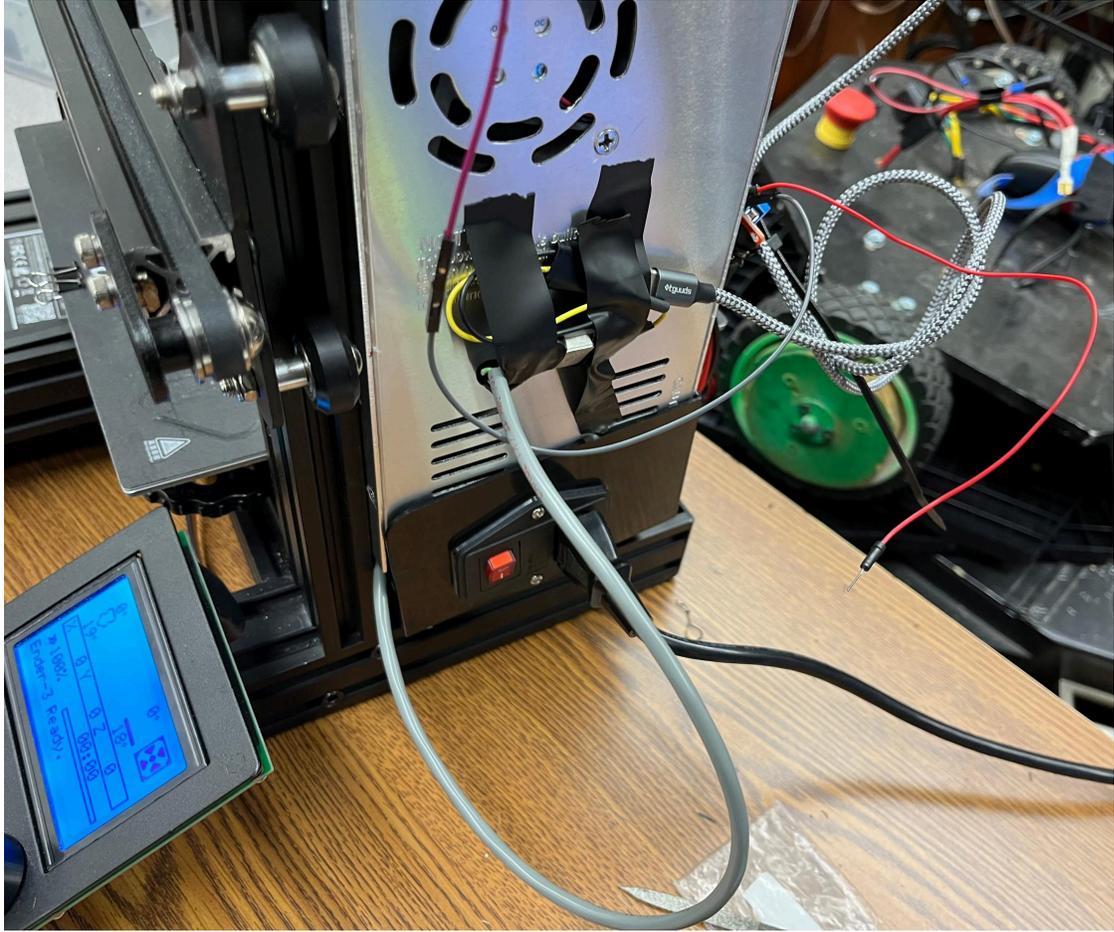
<https://arduino-craft-corner.de/index.php/2024/01/03/connecting-the-avr-iot-cellular-mini-board-to-the-internet/>

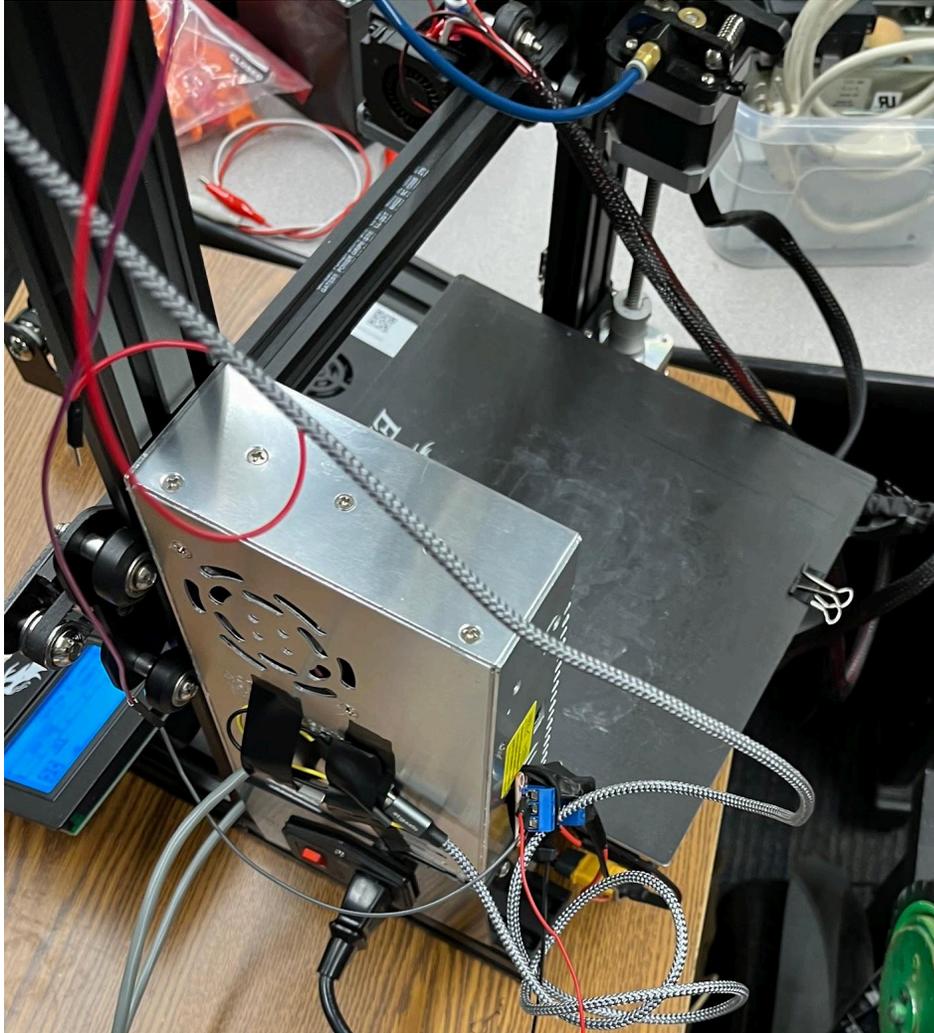
Scroll down to “MQTT or not MQTT” section



3/27/24 Jerry rigged the ender 3 x avr iot card







Reference and Appendix:

https://www.bristol.ac.uk/esu/media/tutorials/design-principles/page_08.htm

https://www.reddit.com/r/learnprogramming/comments/yf9zb2/what_makes_a_good_tutorial/

How to Make an Actually Good Tutorial

<https://uwaterloo.ca/centre-for-teaching-excellence/catalogs/tip-sheets/key-strategies-effective-tutorials>

<https://www.webdew.com/blog/tutorial-video-examples>

<https://dailyblogtips.com/11-essential-tips-to-writing-the-ultimate-tutorial/>

<https://codingwriter.com/how-to-write-better-tutorials-part-1/>

<https://dev.to/savvasstephnds/in-your-own-opinion-what-makes-a-tutorial-beginner-friendly-mg4>

<https://medium.com/@keshidong.dev/how-to-format-code-in-google-doc-833e28b304f1>

03/06/2024

Adding AVR card to Arduino IDE

https://www.youtube.com/watch?v=qMLzUdqDvj8&ab_channel=Hackster.io%2CanAvnetcommunity

03/08/2024

https://www.youtube.com/watch?v=NsZW1i61Ocg&ab_channel=RSDesignSpark

3/25/24

<https://arduino-craft-corner.de/index.php/2024/01/03/connecting-the-avr-iot-cellular-mini-board-to-the-internet/>

<https://www.hackster.io/wizardofmake/sensor-cube-1-727bbc>

Another video showing how to add an AVR card to arduino IDE (starts at 3:43). More streamlined.

Make sure your Arduino IDE is updated!

Microchip IOT Cellular Mini Arduino Page

<https://iot.microchip.com/docs/arduino/start>

<https://iot.microchip.com/docs/assets/files/Monarch2-LR8.0-ATCommandsReferenceManual-Rev.9-da07a5665e87441e408fd9a9fb47cfc8.pdf>

Microchip GitHub Library (if needed, but YouTube vid should be enough to get library installed)

<https://github.com/microchip-pic-avr-solutions/avr-iot-cellular-arduino-library>

Microchip IO Webpage for LTE setup?

<https://iot.microchip.com/docs/arduino/start>

Notes

Mr. Burnham Notes ▾