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UNIFIED EMBEDDED SYSTEM DEVELOPMENT: COMBINING 3D-PRINTED PCB PROTOTYPING WITH RASPBERRY PI-DRIVEN CLOUD DATA EXTRACTION AND RETRIEVAL

Abstract

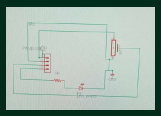
A DAQ is a circuit board that helps us to analyze cosmic rays, but it is complex and requires many hours of work to create. Small mistakes during the creation process mean others have to review the board and fix it instead of making another one. So I streamlined the process by implementing 3D-printed components. In the past, schematics were made to guide other researchers to minimize mistakes, but they are still confusing and require high-level skills most people don't have. However, if you make a 3D model of the board and use a 3D printer to print it out. It will make this process much easier by removing certain skills that take days to learn. This will allow future researchers to complete this process in a more timely manner. Therefore, using 3D-printed PCBs will streamline the process and save time and resources.

Introduction

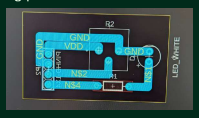
PCBs are printed circuit boards that are 3D-printed and used in the DAQ Box, a box made for data acquisition from cosmic rays. These boards act as an already organized space for connecting components required for the DAQ box. This also required several other skills such as 3D printing, soldering, and coding. Soldering was used to secure the components onto the PCBs and act as a pathway to connect the components onto the soldering. Accurate soldering was needed so that the components were securely connected and so that the iron did not burn through the plastic. Also, programming was used to familiarize ourselves with the code used for collecting and organizing the cosmic rays. Understanding the program helped us understand the purpose of our work and how the DAQ box works.

Methods and materials

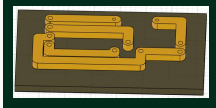
The Bambu Lab H2D printer was used to print the PCBs. While Fusion360's CAD software was used to help design the PCBs. They allow you to easily place components onto a circuit board and lay traces for the copper wiring. Also, we did a lot of hands on work that included making our models on a perf board and struggling through the soldering process



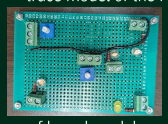
the electronic model of the PCB



trace model of the PCB

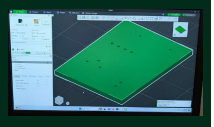


3D model of the PCB



perf board model

H2D printer



Bambu Lab software

Results

The PCBs were mostly successful and had several advantages over normal perf boards. One of them is that they made the circuit easier to assemble. Instead of connecting each component with wires or creating solder lines, researchers could place the components into the holes on the board. This helps prevent mistakes like accidentally connecting the wrong components or messing up the solder lines. Using PCBs also made the assembly much faster. Once the PCBs have been designed and printed, the components could be easily placed into the slots. This would be very useful for future interns and researchers who have little experience in electronics. So, the ability to solder and wire electronics will be less important. The PCBs will also have fewer loose connections because wires will not be used. Loose wires were a very common error that would repeatedly appear over time. Since the PCBs have copper wiring, the circuit would be more durable and not have to deal with loose wires. However, the PCBs do have some problems. One of the issues is that they are fragile and could be damaged if excessive force is used while soldering. The PCBs are sensitive to heat, so if the soldering iron is left in one area for too long, the heat could cause the board to be melted through.

Conclusion

The PCB design is effective and shows that the design works. However, it still has some problems. Some of these could be fixed by having the board manufactured professionally using proper materials. However, creating the board ourselves allows us to test different designs without having to send each version to a factory and wait several weeks for it to be returned. The PCB we made also shows that the design works. Making it ourselves allows us to find problems before sending it in. Also, this would reduce the amount of time needed to teach new researchers how to solder. Having this will help us make more DAQ boxes, allowing us to focus on other things, like the software. If I could continue the research, I would like to finalize the DAQ board design. This would require me to add other components that are not currently in the model. Once the design is finished, we would have the board professionally made. This would make it stronger and allow us to do other things.

Credits

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