Creating a Biosignal Acquisition Platform for Medical Research

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Introduction: Measuring biomedical signals of a patient can allow researchers to analyze brain, heart, and muscle signals. Previous work has allowed our lab to utilize the Cyton Board, an open-sourced circuit board, to sample these signals. The goal of this project is to improve the form factor of the printed circuit board (PCB) for our purposes, aiming to make it smaller and lighter while maintaining the essential functions of the original board, the most important ones being the conversion of analog signals to digital ones and sending the digital signals over Bluetooth to another device for processing.

Methods: New parts for the board had to be used as the ones in the original design were obsolete and no longer manufactured. Analyzing data sheets was crucial to select parts that were able to communicate with each other through interfaces such as UART and SPI. The components also needed to be able to withstand the voltage that would be provided by the main regulator, 3.3V. Utilizing KICAD, a circuit schematic and PCB creation software, work for a new design was underway. While designing the circuit schematic, the specific pins on each device had to be analyzed to determine which ones to use to create the communication buses to other components as well as receiving and transmitting data. While designing the PCB, every component, trace, and via needed to be carefully arranged according to the constraints set out by the board manufacturer, recommendations from the datasheets, and general ease of connection between components. The use of multiple layers and vias allowed for components to be grouped together as the traces could be routed in a different layer. Once the designs were complete, and the boards were manufactured, we could start to assemble the boards with the components. Soldering of the components requires different techniques for the different pin types, SMD and LGA. But both require careful soldering between the pins of a component and the pads of the PCB to ensure connectivity and avoid any bridges/short circuits.

Results: A 40x40mm square PCB was made with all the necessary connections between components to ensure functionality. The area of the board has been decreased by 46% of the original design. The board has been made with parts that are still available to order, making this board useful for other future projects that seek to recreate this design and utilize it for their purposes.

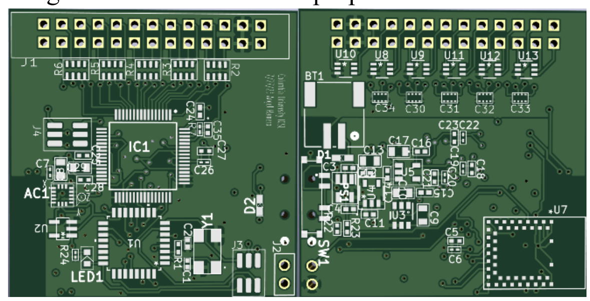

Figure 1. Front and back of 40x40mm Design.

Future Work: The board needs to be tested to ensure that voltage regulators are providing that voltage. The components also need to be programmed to be able to function the way we want them to. ADC measurements have to be compared to the ones obtained from the Cyton Board. Software needs to be developed in order to make this board plug and play; ultimately, we would like users to utilize this board the same way they use the Cyton Board. Further optimization of space can be made with more adjustments to the design as well as searching for smaller parts that function in a similar way. Being able to make this design into a flexible PCB would also be of great interest as it would further enhance the comfort factor of any device that the board is used in.

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