EE/CprE/SE 491
wDAQ System (sddec24-19)
Design Document: User Needs

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TEAM MEMBERS

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1.1. PROBLEM STATEMENT

Most modern data acquisition systems, also known as oscilloscopes, require the use of BNC cables to connect to and analyze electrical and physical signals. BNC cables are a type of coaxial cable, which are essentially cords that carry an electrical conductor, surrounded by a protective outer layer, to transmit electrical signals from an electrical circuit or physical body to an external device (i.e., the oscilloscope or data acquisition system) for analysis. In addition to these hefty cables, which are often over two feet long, the data acquisition systems require a corded power supply, and they typically use a built-in graphical display to view signals, as well as physical buttons and knobs to adjust display settings, which take up space and increase the size of the device. The combination of cables, power cords, buttons, and display screens make traditional oscilloscopes and data acquisition systems bulky, heavy devices that are not friendly for mobile data gathering (e.g., attempting to monitor an electrical or physical signal outside of a lab setting) or applications of data acquisition devices within larger systems.

In an effort to tackle the size and mobility constraints associated with commercial oscilloscopes, our team wants to create a wireless data acquisition system, powered by a rechargeable battery, that enables mobile real-time data communication using Wi-Fi and is compact enough to fit in about a 1"x5" space. The reason we are striving for mobile capabilities and a small size for our device is because it will be used within a Photoacoustic Tomography (PAT) system in the Biomedical Imaging Laboratory at Iowa State. A PAT system is a noninvasive device used for biomedical imaging that enables the physical anatomy, oxygen and blood levels, and other biological properties of animals and humans to be identified, similar to an ultrasound. (ISU's lab will be using the device on small animals.) To accompany the data acquisition device, our team will create a graphical user interface in a software called LabVIEW that enables users to view and analyze data from an external source (e.g., a computer or tablet).

By developing a Wi-Fi connected, battery-powered device that is compatible with external software for data analysis, our team will eliminate the need for BNC cables, power cords, and physical buttons in an oscilloscope and, consequently, be able to easily integrate data acquisition technologies within a larger application.

1.2. INTENDED USERS

Currently, our project's end user is Iowa State University's Biomedical Imaging Laboratory (BILab), which will use the device for medical imaging on small animals. The laboratory users are likely to be fairly skilled with traditional oscilloscopes and quick to pick up on the new technologies. Looking ahead, the goal is for our device to be applied to a larger user base, from research facilities to educational environments. Some of the potential user groups associated with these include: Researchers, Lab Assistants, and Educational Institutions.

Researchers

Researchers and scientists will be regular users of our device. These users are highly educated, experienced in a lab setting and with lab equipment, and familiar with data collection and analysis techniques. Their needs include accurate data collection and analysis, mobility and portability of data analysis within and outside of the lab, and a quick, efficient device. Our device would offer many benefits to the user, such as saving lab space, increasing mobility within and beyond the lab space, and new technology to effectively collect and analyze data.

Lab Assistants

Our second user group, lab assistants, is another common user; however, their background experience and education may be significantly less than that of a lead researcher. They would need a tool that is easy and relatively fast to learn and become familiar with. Their experience with technology and data analysis may be highly limited, so the device would need to be user-friendly and provide clear, comprehensible data analysis. They would benefit greatly from having an easily accessible tool to help them complete tasks and gather measurements.

Educational Institutions

This is a device that can be used within educational institutions' research or even lab coursework. These institutions could be colleges, universities, or educational training programs for professionals. Users would need educational tools that facilitate teaching and learning for research practices. They would need live data for students to analyze and comprehend. Our device could provide an affordable solution for educational institutions to provide valuable tools to instructors and students.

APPENDIX

Appendix A: Empathy Maps, User Personas, and Journey Maps (from Figma)

Figma: Empathy Maps, Personas, and Journey Maps