

# Executive Summary

ECE 443 Senior Design

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# Project Summary

## Project Purpose

Tektronix is interested in exploring options towards reducing oscilloscope costs while still providing a feature rich environment. By offloading the work needed to analyze waveforms and displaying them into existing software, a low cost device that is only capable of sampling waveforms and sending these to a computer would still be capable of advanced features without needing the infrastructure and costs associated with these features.

## Scope

The project begins at the point of a signal being measured, and ends at the point when that signal is serialized and sent over USB to an external computer. In between these two points the signal must be attenuated, sampled, analyzed for triggerable events, and serialized into a common communication standard. Using this data is out of the scope of this project, however such data could be easily utilized within existing Tektronix software with minimal effort.

## Key Technologies

The project uses a large number of components. The front end, handling the analog signal, uses relays, multiple types of opamps, ADCs, DACs, input buffers, and more. The data side uses an FPGA as well as an FTDI controller for USB communication to a computer.

# Design Process

The team sought to approach the design by creating well separated and compartmentalized sections to ease integration of the entire system as the team worked remotely. This reduced the amount of complicated interfaces significantly, often leaving just one or two avenues where each member's section interacted with another. The compartmentalized sections were analog design, digital design, and power. The analog section was chosen by Graham as he wanted to explore analog signals and gain experience with them, Benjamin selected the digital side as he felt he had more experience with these systems, and Ali selected power as this was a relatively simple block.

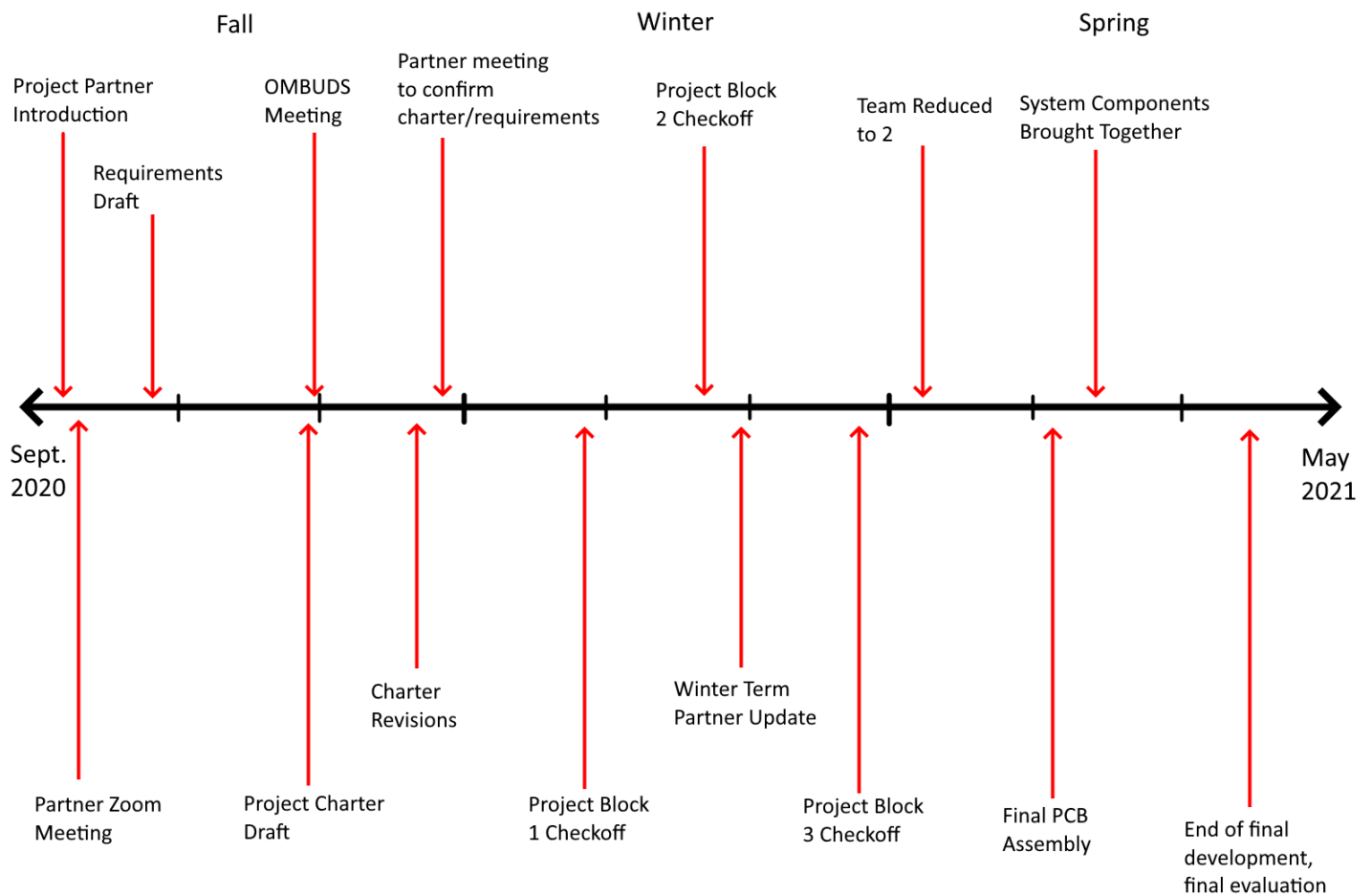
The initial design process focused around gaining a scope of the project and abilities each member of the team could bring to the table. Tektronix left the team with a relatively open design proposal leaving the team to choose the scope of the project themselves. The group committed to a relatively simple and conventional oscilloscope from the high design risk of many modules and expected design friction from working remotely.

With the basic design selected, each member then worked on their section and investigated how to accomplish the final design. During this process the interconnections between each member's sections were redefined as the project grew and became better understood. A PCI-E connection was suggested and used to ease integration while offering a nice visual appearance for showing.

At the beginning of spring term, the team became 2 people instead of 3. This necessitated a pullback in system requirements for a simpler design so that the power system could be designed.

Currently the project is still very much in a prototype format, and while it works there are many investigations and experiments that should be undertaken on it. Certain behaviours could not be modeled in simulation, or performance in certain areas does not reflect expectations or create bottlenecks.

# Timeline



# Teamwork Key Lessons

There is likely to be a different expectation of the level of communication necessary among a team of people. Whereas one team member might expect only a comprehension on the part of each person of their responsibilities and when to accomplish them, another might expect regular generation of artifacts related to the progression of the project cycle, detailed documents outlining the thoughts behind design decisions, and/or a formal structure of version control for both software and hardware. Considering the perspectives of each person on that subject and coming to a codified conclusion on which the team can act will be important going into future project work.

There might be a failure of one team member to understand something which seems innate to others, like an expectation of self-reliance on the part of each person. While having team expectations isn't unreasonable in most circumstances, it will be important to disclose any notable ones early in a project cycle and get a confirmation of understanding from each team member.

Research is as much a part of the work needed for a project as development, with the level needed depending on the previous experience of team members. As there was a differential in the amount of experience in this project cycle, more research could have improved the project outcome. Excluding any deadlines related to development of system artifacts, the first term of work on the project should consist of research to locate the best approach to it, if necessary. The process of locating a good approach may be aided by constant cross-evaluation on the part of the team.

While not assuming the position that executive oversight of a team by one of its members is necessary, it has been made clear what benefits leadership has for a project cycle. In the event of non-contribution of a team member, the project cycle can suffer minimal impact through a quick removal of the team member and restructuring of the responsibilities of the others. The ability to penalize missed deadlines in some way might

prevent any one person from getting critically off-track, or otherwise establish a structure for the delegation of blame in the event of a failure. Despite the potential benefits, having any one person in the team assume leadership still carries the risk of washing out the perspectives of other members on the project approach. That might not be a bad outcome if the team has one highly-experienced member with multiple less-experienced ones, but if that dynamic best suits the project it should be agreed on in initial discussions. Otherwise, one of a few arrangements should be assumed. In one, a single person or sub-team- the one with the most leadership experience -will have the explicit role of approving actions for the project, keeping people on track, and generally guiding the approach based on project constraints. In the other, a team will act as equals so long as they can come to a reasonable agreement on the project approach.