ELECOMP CAPSTONE SUMMIT
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THE UNIVERSITY OF RHODE ISLAND

THINK BIG WE DO™

Fiber Control

Fiber Optics Design High Voltage Equipment Control System Interface

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Project Motivation

Electromagnetic interference threatens signal transmission and reception in copper wires. The current power grid is rarely shielded from electromagnetic interference (EMI), which makes it particularly vulnerable to terrorist attacks and other serious equipment failures that could leave entire cities or counties without power for weeks. In modern times, people are extremely dependent on electricity; no power for a week could prove fatal. Fiber optic cables are immune to EMI and provide a reliable and effective solution. Fiber provides pronounced signal quality while also not conducting electricity. Fiber is also resistant to fluctuations in temperature and can be directly placed in water without affecting the signal that it’s carrying. The glass core makes tampering with fiber optic cables impossible therefore offering a higher level of security. Fiber optics are a safer, more rugged alternative to copper cabling especially in electrical facilities. Utilizing fiber optics is the next step to revolutionizing and modernizing the power transmission and distribution industry.

Key Accomplishments

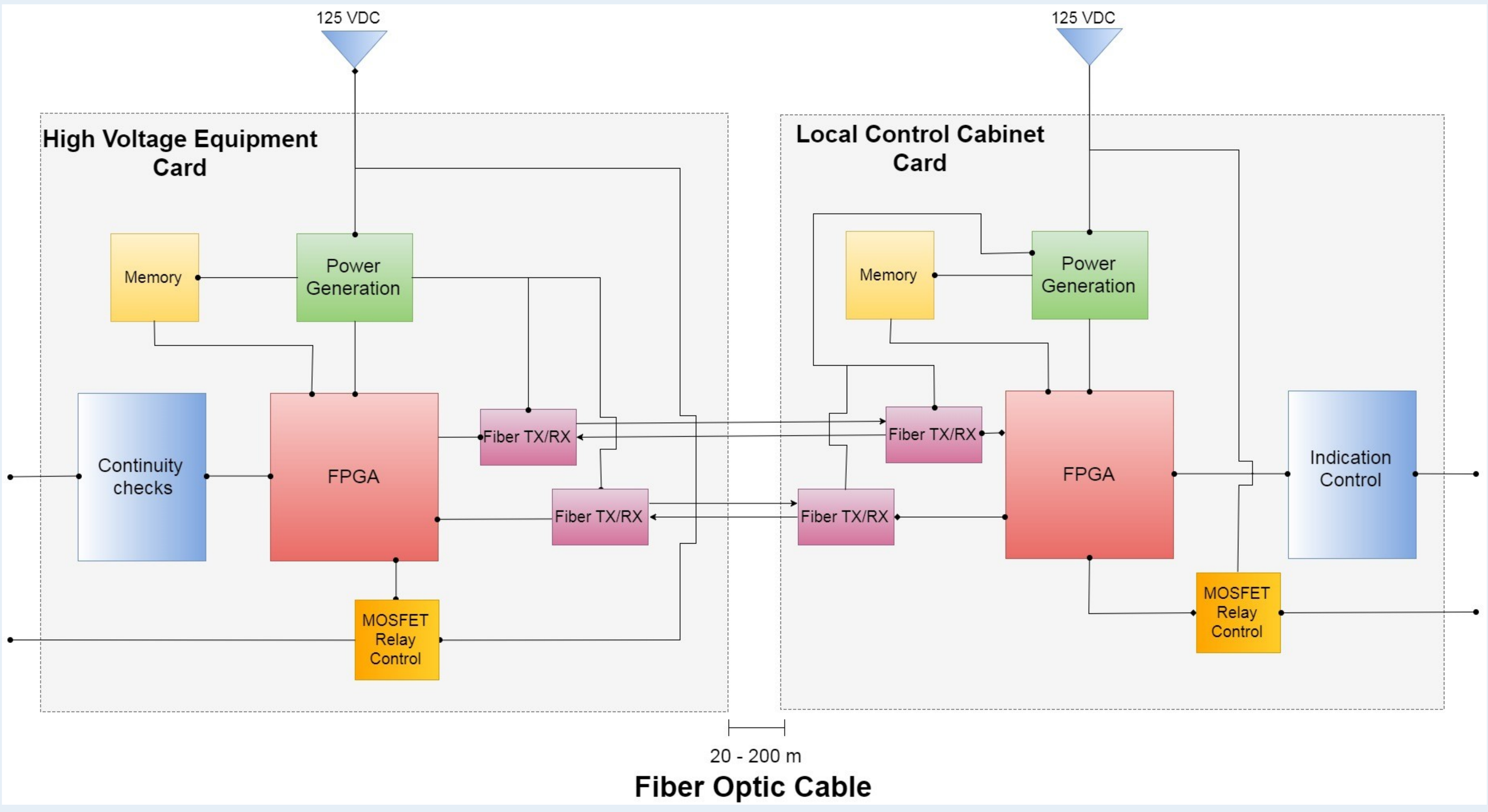

***Figure 1:** System Design Block Diagram*

Simulate Major Circuits: Vital circuits in our design have been simulated to ensure proper functionality using manufacturer supplied models in P spice.

Generate Schematic for High Voltage Equipment Board: The team has created a schematic for the board that will be used on the High Voltage side of the system. We used Diptrace as our computer software tool to design the schematic. This is the schematic that was used to generate the PCB design that will be placed where the High Voltage switching equipment is located. The design features a high voltage following circuit to enable digital logic to control high voltage signals highlighted in figure 3. This circuit was simulated in Pspice and the functionality confirmed in figure 5.

Generate Schematic for Local Control Cabinet Board: The team also created a schematic for the board that will be used inside of the Local Control Cabinet. Just as with the High Voltage Equipment board, Diptrace was used in its creation. This is the schematic that will be used in the creation of the other PCB for the Local Control Cabinet. This board featured several types of sensing interface circuits to relay information to the High Voltage Equipment Board.

Design High Voltage Equipment PCB: With the schematics for the High Voltage Equipment complete, the team has fully designed the printed circuit board. The design featured voltage regulating circuits and was able to drive and handle currents as high as 20 amps.

Design VHDL Communication Protocol: In order for the boards to perform their desired functions, much coding had to be done. The communications system was written in VHDL with SerDes (Serializer/Deserializer) as the protocol. This is going to tell the boards how to “talk” to each other and receive/transmit data. The protocol included signal comparison and verification features that enhanced reliability.

***Figure 4:** Local Control Cabinet and High Voltage Equipment*

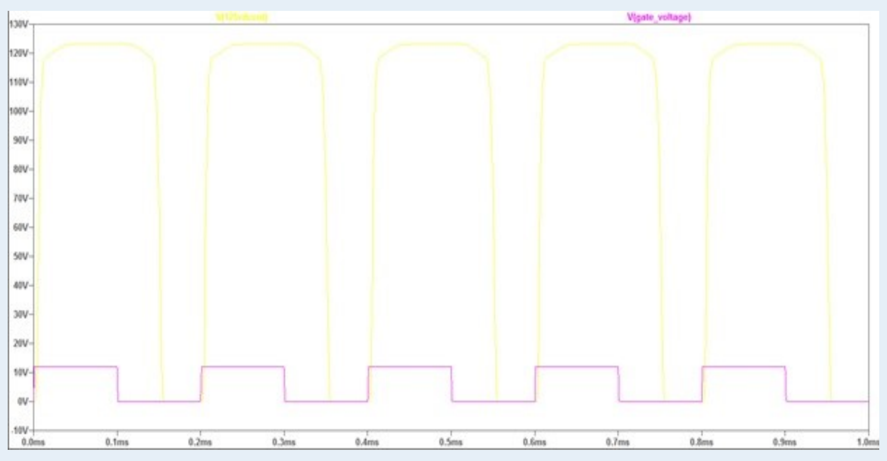

***Figure 5:**N-Channel MOSFET Gate Voltage and P-Channel MOSFET Gate Voltage vs. Time*

Anticipated Best Outcome

The best outcome of this project by the end of the spring semester will be to have a functional prototype interface control system. The control system will operate with two distinct control cards. First, the master control card will interface with the previous control power hub to drive indications and relay state changes to its counterpart. The other distinct card will detect changes in connectivity, adjust relays states, and report back to the master card via the fiber. This design will have additional connections for future signals and enough extra memory for any future programming.

Project Outcome

The Anticipated Best Outcome was not achieved. The PCBs still need fabricated and VHDL tested.

Figures

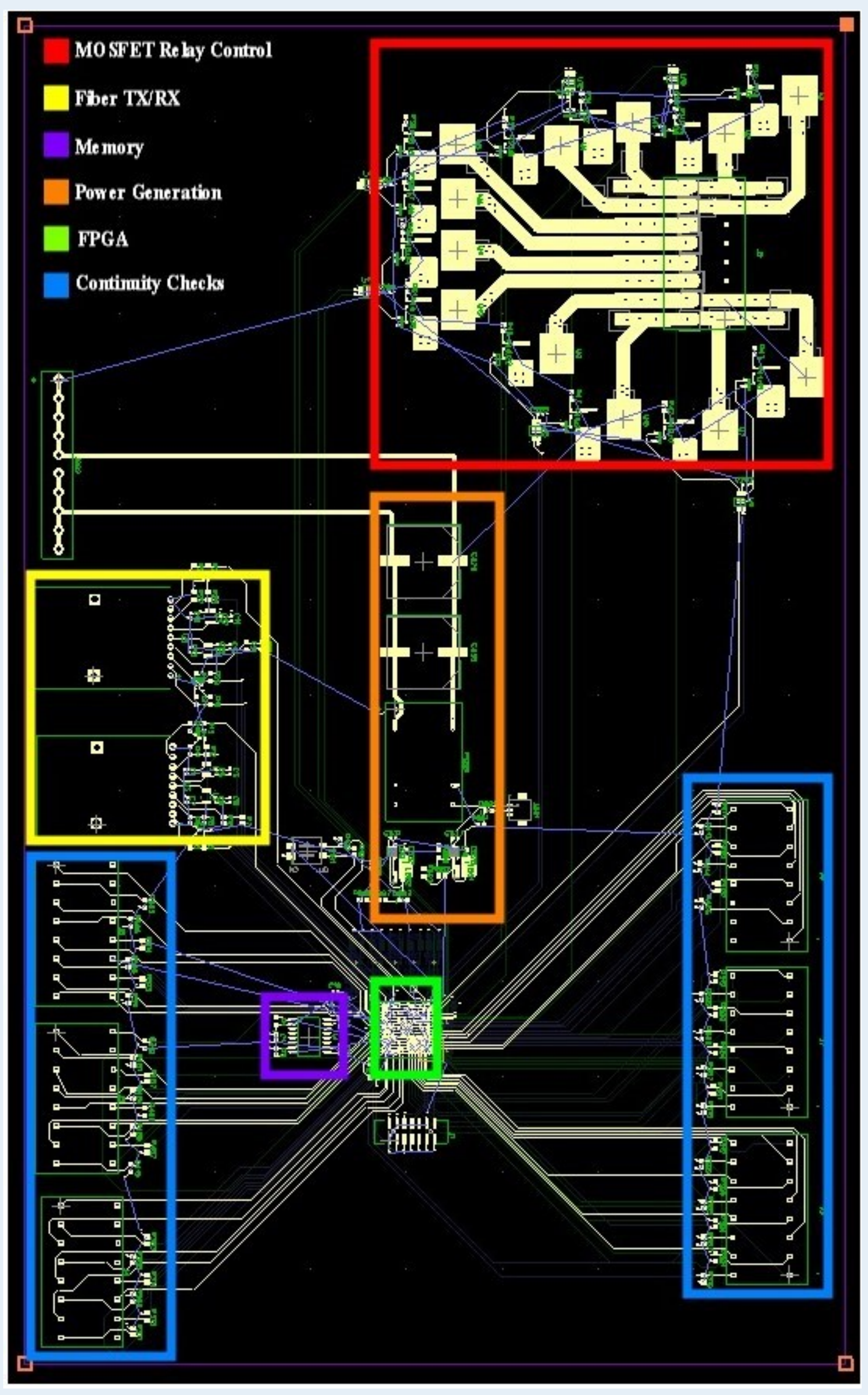

***Figure 2:** High Voltage PCB Design with Section Breakdown*

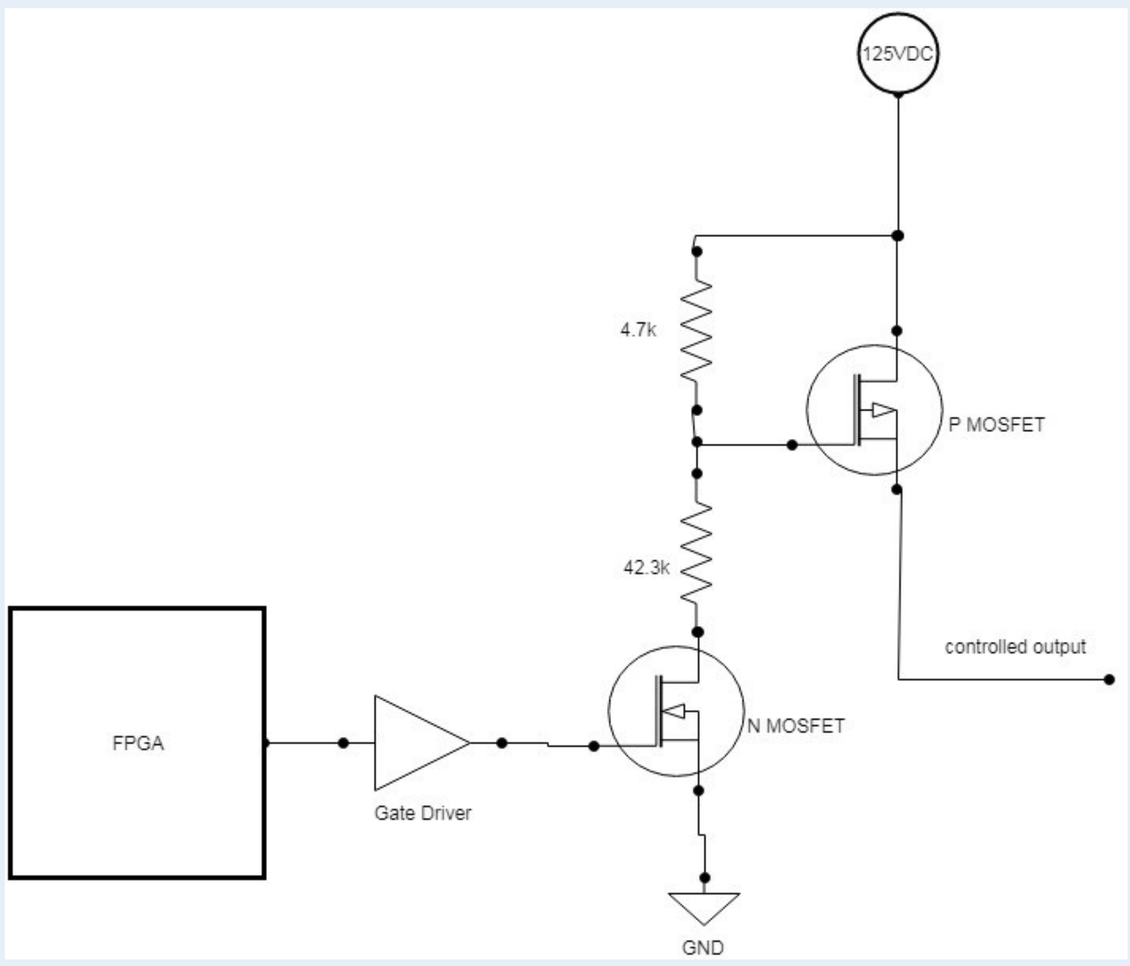

***Figure 3:** High Voltage following Circuit*

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