FiberControl

Fiber Optics Design High Voltage Equipment Control System Interface

ELECOMP Capstone Design Project 2017-2018

Sponsoring Company:

Phoenix Electric Corporation
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Canton, MA 02021
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WWW.PEC-USA.BIZ

PEC is continuing their support of the Program they initiated last year:

http://web.uri.edu/elecomp-capstone/past-projects-2016-2017/pec/

Company Overview:

PEC specializes in developing custom products, systems and solutions for the power transmission and distribution industry.

PEC custom engineers control, protection, and interlocking systems for leading medium and high voltage gas insulated switchgear manufacturers worldwide. These systems provide a reliable, user friendly control interface for SF6 gas-insulated switchgear and generator/transmission power circuit breakers in accordance with ANSI/NEMA requirements. Control systems range in size and complexity from relatively small motor control equipment to large complex substation control and protection installations.

All control philosophies and interlocking protocols conform to US utility standards and procedures for safe, reliable operation. Controls are manufactured using only readily available heavy-duty UL listed components. Provided with the control equipment, complete ANSI drawings facilitate installation, commissioning, testing, maintenance, and troubleshooting.

PEC headquarters and manufacturing facility are located in Canton, MA.

Technical Directors:

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Project Motivation:

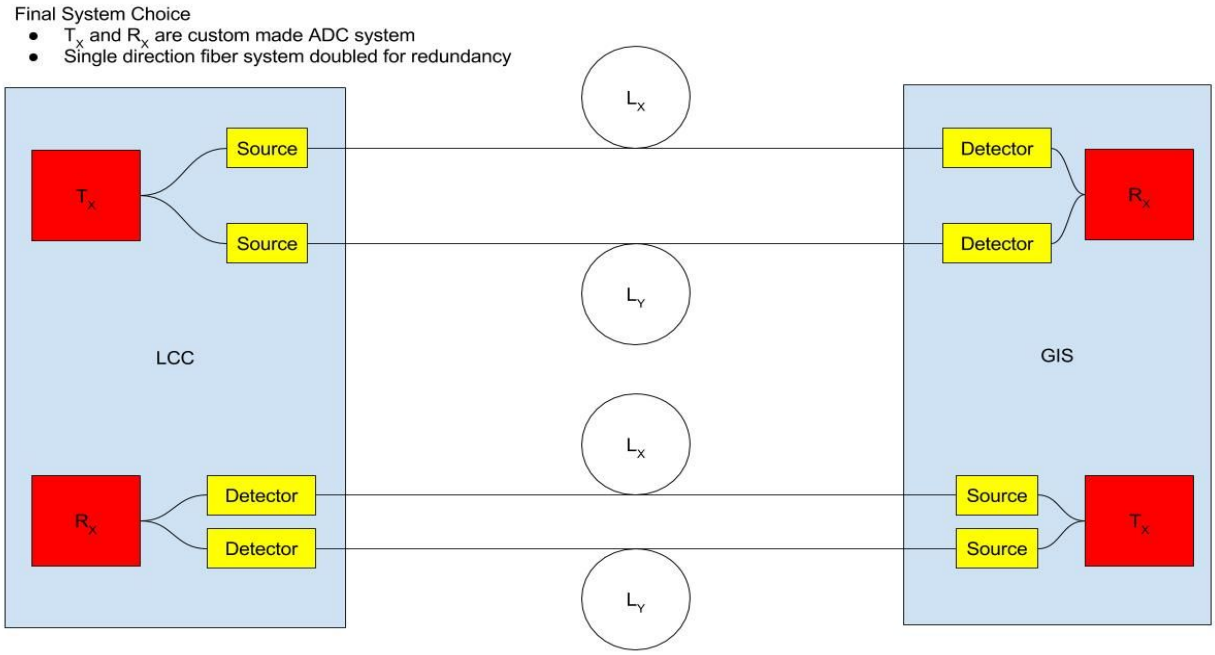
The present issue is that copper wires are vulnerable to Electro Magnetic Interference (EMI), which is interference in signal transmission or reception caused by the radiation of electrical and magnetic fields. Fiber optic cable can be immune to EMI or RFI caused by equipment/material failure or terrorism attack and is extremely durable and provides very reliable signal. Fiber does not conduct electricity because its core is made of glass. In glass, optical attenuation is much less than the attenuation of electrical signals in copper. Fiber can be immersed in water without effect and it can be used in much harsher conditions such as power plants, as it is less susceptible to fluctuation in temperature than copper cables. It does not radiate signals and is almost impossible to be tampered with without the system getting corrupted. Unlike copper cables, Fiber optics offer an unrivaled level of security. Fiber optic cable is also much safer to install and maintain because it is non-conductive. Copper cable attracts lightning and is heavier and harder to maneuver inside conduits and cable trays.

Conducted electromagnetic interference is caused by the physical contact of the conductors as opposed to radiated EMI, which is caused by induction (without physical contact

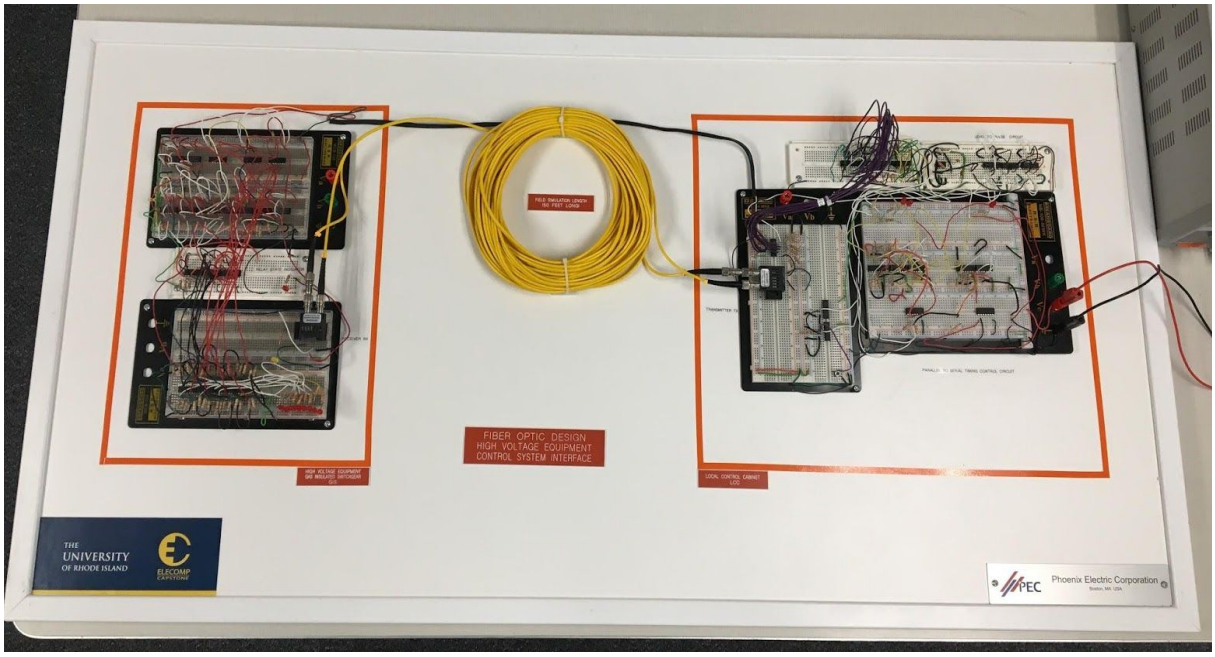
of the conductors). This persists in all conductors and mutual inductance between two radiated electromagnetic fields will result in EMI. For lower frequencies, EMI is caused by conduction and, for higher frequencies, by radiation. EMI through the ground wire is also very common in an electrical facility.

Anticipated Best Outcome:

PEC expectations for April 2018 is to have the team present a Working Prototype of a fiber optic interface control system unit that would be cost effective, functionally equivalent and reliable in comparison to current electrical control, and finally electromagnetically immune to outside electromagnetic influences



Proper application of fiber optic technology will lead to a highly secure system. Engineers will choose proper products, design, programming and install an appropriate fiber optic cable system, test components selected and ensure that system is immune to any interferences.



Above is last year's PEC Capstone Project final presentation.

http://web.uri.edu/elecomp-capstone/past-projects-2016-2017/pec/

This year we expect a fiber optic interface control that would be cost reasonable, functionally equivalent and reliable in comparison current to electrical control, and finally electromagnetically immune to outside electromagnetic influences.

Project Details:

PEC expectations for April 2018 is to have the team present a working Prototype that covers the following details:

- Develop two units that can Transmit and Receive 150 wires (300 signals)
- Seek out possibilities of creating VLSI, ULSI, GSI chip packages
- Develop a program in VHDL
- Develop an Asynchronous Receiver Clock
- Develop voltage step down and voltage step up systems
- 200 meters Fiber Length
- Fiber Optic cable to withstand 50 Kilovolts per meter
- I/O withstand to Electromagnetic Impulse (EMI)
- Bill of Material
    - Industrial Grade
    - Component Ratings
    - Enhanced Reliability

Composition of Team:

Engineering requirement for our project will be composed of two electrical engineers and one computer engineer. The electrical engineers must be familiar with testing and debugging electrical circuitry. This will require the use of such lab equipment as oscilloscopes, multimeters, and soldering tools along with being able to understand data sheets. The computer engineer should have knowledge of communications, analog and digital electronics. These team members will be responsible for designing, testing and resolving any related electrical or coding issues.

Skills Required:

- Interest in learning about fiber optics
- Strong understanding of C Programming
- Knowledge in digital and analog Circuits
- PCB layout and design experience beneficial

Anticipated Best Outcome's Impact on Company's Business:

PEC's vision is to be the recognized leader in the electric power industry for providing customized solutions tailored to specific customer transmission and distribution requirements, backed by unwavering customer service.

The best outcome for this project is to have two units that encodes the level of a wire either higher than the threshold or below the threshold, on or off respectively. This threshold is the industry standard of 125 VDC. That voltage is then going to be stepped down to a manageable voltage for the digital circuit designed. Also, to lower the effects of EMI, fiber optic cable will be used as the communication medium.

Broader Implications of the Best Outcome on the Company's Industry:

With proper development and expansion of our circuits, we can see that this would be the power control system of the future. With fiber optics replacing copper wiring for power control lines, we would see an increase in grid safety and even municipal safety. With further progress, we could even see this system in our own homes to control lighting. This would create a central control box for any digital controlled system for efficient wiring methods.