



Annunciator

ELECOMP Capstone Design Project 2021-2022

Sponsoring Company:

Phoenix Electric Corporation

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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/IEEE 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.



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Consulting Technical Director:

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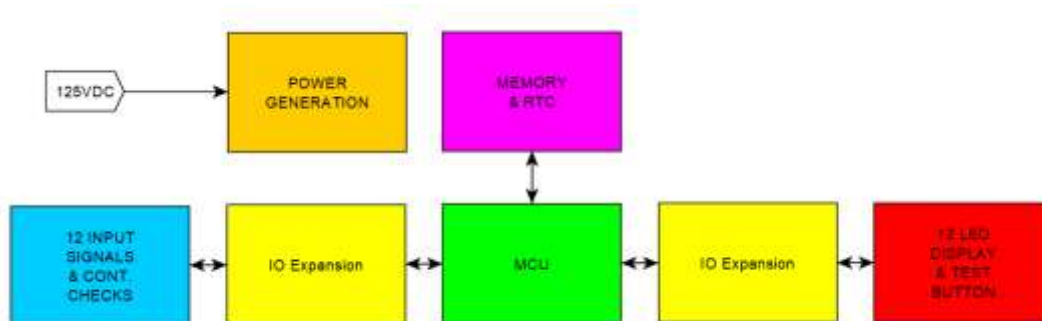


Project Motivation:

Our controls circuits are monitored by third party annunciators that collect data, alarm signals, and the health of our circuits and display that information locally via LED lights. Having an internally designed annunciator would reduce our dependence on third party hardware and allow tighter integration with our other equipment.

Anticipated Best Outcome:

PEC expectation for April 2022 is to have the team present a functional prototype of the Annunciator system that would be functionally equivalent and reliable in comparison to current options available on the market at a significantly lower cost.



Engineers will choose proper components, design, program, and build an appropriate system, and test at the components and system level.



Major accomplishment expected for 2021/2022 Capstone:

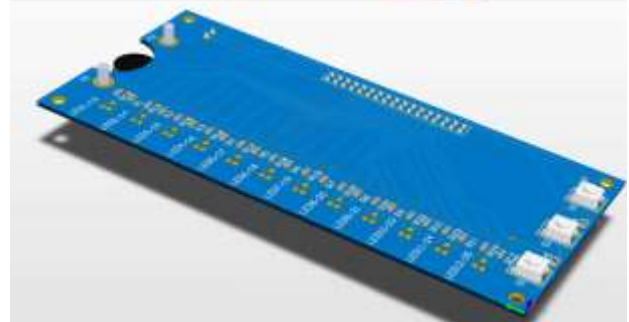
- Build Proof of Concept System using COTS hardware on a breadboard (Fall 2021)
- Design Annunciator Card PCB
- Update Display Board PCB design from last year's Capstone team
- Write Arduino Software to Control All Annunciator Features
- Fabricate, build, and test Annunciator and Display Board PCBs
- Develop a Graphical User Interface (GUI) for Configuring System Parameters

Project Details:

PEC expectations for April 2022 are to have the team present working prototypes of the boards and control GUI and demonstrate their full functionality. The two boards have distinct hardware designs, and one has significant hardware and software development.

The basic function of the Annunciator Board is:

- DC/DC Conversion:
 - 12VDC Input, Generate 5V
- 12 Channels of Configurable (NO/NC) Continuity Checks
- Non-Volatile Memory for storing system configuration
- Real Time Clock
- User Interface to GUI
- Alarm Sequences
- Time Delays
- Pushbutton interfaces



The basic function of the Display Board is:

- 12 LED Display
- 3 User Pushbuttons
- Alarm Horn

The GUI will allow the user to set the continuity type (NO or NC) and alarm delay for each of the 12 channels as well as the alarm sequence to use.



Composition of Team:

Engineering requirement for our proposal will be composed of 3 engineers, the team should consist of electrical and computer engineers. The electrical engineer(s) should be familiar with design, testing and debugging electrical circuitry. The computer engineer (s) should have GUI development experience and Arduino coding. This will require the use of such lab equipment as oscilloscopes, multi-meters, and soldering tools along with being able to understand data sheets. The engineers 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.

The URI Engineers will be supported by PEC Engineers and URI circuit board and component specialists.

Skills Required:

- Arduino IDE and GUI Development experience
- Knowledge in digital and analog circuit design with Spice simulation experience.
- Interested in PCB layout and design.
- At least one team member must be concurrently enrolled in ELE391, Printed Circuit Board (PCB) Design

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

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 a fully working Annunciator system that will help PEC diversify our product portfolio and will allow us to be more competitive and less dependent on other companies.

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

With further development and expansion of our system and circuits, we can see that this essential device being utilized to increase power grid safety and even municipal safety. We would envision improving the reliability of numerous electrical applications in the power grid workplace, and home for a more reliable and safer electrical supply system.