Company Information

Company Name	*ELK Products Inc*	**Date Submitted**	*11/17/2023*
Project Title	*Design of an Alarm Engine Voice Integration Module (ELK_VOICE)*	**Planned Starting Semester**	*Spring 2024*

Senior Design Project Description

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills.

Discipline	Number	Discipline	Number
Mechanical		Electrical	1
Computer	3	Systems	

Company and Project Overview:

ELK Products Inc is a leading designer and manufacturer of customized home and business security, energy management, and convenience solutions. For over 25 years, we have created a trusted brand with simple yet innovative products that have now become industry standards. Our customer service is world-class, and we stand behind the products we sell with industry-leading technical support and warranty.

We are focused on creating products that secure and simplify life. In the rapidly changing security and automation market, ELK offers an integrated approach that delivers full-featured and personalized solutions for security, lighting, environmental control, energy conservation, access control, and management of just about any electrical feature in the home or business.

Our corporate office is located in Connelly Springs, NC, where we manufacture and assemble all of our key components. All of our engineering and design are US-based, with engineering managed via our NC location. We have in-office and remote engineers. One thing to note is if a product requires firmware, then we exclusively handle the production, assembly, and testing completion in our NC location.

INDUSTRIAL SOLUTIONS LABORATORY

Our product offering consists of two major categories: universal devices that are commonly used in the security and automation industry, and control systems. This project is on our control system side, which is predominantly where more of our engineering time is allotted.

E27 Alarm Engine® is our newest addition to the controls family, it is a modern IP and cloud-centric hybrid control system with robust hardwire and wireless capabilities.

Our flagship control is called the M1 Gold. The M1 has been on the market for almost 20 years. One of the key features it offers is voice annunciation. The M1 has a 500-word vocabulary that allows technicians to select words corresponding to events. However, our E27 doesn't have a voice feature as of yet. This project aims to give it a next-generation voice.

INDUSTRIAL SOLUTIONS LABORATORY

The M1 control has always been limited by its vocabulary. Our customers have consistently requested more words and custom words. Additionally, the voice is very monotone. We would like to utilize text-to-voice, as well as some AI, to allow technicians to simply add the custom words as needed and have it incorporate tone and flow, depending on the urgency of the event.

NCMEP North Carolina Manufacturing Extension Partnership	This project is partially supported by a grant from the NC Manufacturing Extension partnership, an organization the helps to support business and job growth for NC companies. To learn more about the NC MEP, click on this link: https://www.ncmep.org/.

Project Requirements:

This project aims to create an RS485-connected text-to-voice module with AI for automation and security systems, emphasizing intelligent communication and incorporating sirens as needed. The challenge lies in developing a versatile solution that not only provides clear and context-aware voice alerts during non-emergencies but also integrates nuanced tones for emergency events. The module should seamlessly adapt to various automation and security scenarios, employing AI for dynamic alert generation. The challenge of the project is deciding what to say, when to say it, and how to say it.

Firmware Creation: Develop firmware for RS485 communication, AI-driven text-to-voice conversion, and tone modulation for different automation events. Ensure compatibility with ELK's RS485 protocol.

RS485 Control Integration: Utilize our API protocol to receive data from the RS485 interface and convert these strings to be read by the text-to-voice application.

Text to Voice: Develop a sophisticated voice synthesis system for clear and contextually appropriate alerts. Integrate AI-driven modulation to convey different tones suited for both emergency and non-emergency events. Implement AI algorithms for the dynamic interpretation of the API text strings provided by the Alarm Engine Control. Ensure the system adapts tone and urgency based on the nature of the event.

Hardware: Utilize RS485 transceivers, a microcontroller, and high-quality audio components suitable for varied tones through automation systems.

Powered by 12V DC supplied from the main control as part of the RS485 Bus connection.

Must have two independent outputs to accommodate up to a 4-ohm speaker load. One output is full voice (interior), and the second is limited voice (exterior).

Need to have the ability to supervise outputs to identify if a speaker is not connected.

ELK will handle integration into the main control. For this project, we provide test equipment to allow our control's commands and broadcasts to be sent via USB to an RS485 interface for testing development.

Expected Deliverables/Results:

- Working prototype PCA board with RS485 interface and two speaker outputs
- Text-to-voice annunciation
- Incorporated siren outputs (Siren types will be provided)
- Ability to configure specific message groups to be spoken or not based on API Strings.
- Copy of all source code files, drawing files, project files, etc.
- Bill of materials for components utilized

Disposition of Deliverables at the End of the Project:

Students are graded based on their display and presentation of their team's work product. It is mandatory that they exhibit at the Expo, so if the work product was tested at the supporter's location, it must be returned to campus for the Expo. After the expo, the team and supporter should arrange the handover of the work product to the industry supporter. This handover must be concluded within 7 days of the Expo.

List here any specific skills, requirements, specific courses, knowledge needed or suggested (If none please state none):

- Ability to code in C
- Interest in controls and automation design
- Access to Zoom, Teams, etc., for project discussions
- Test Equipment will be supplied
- D-Bug Software will be provided (Laptop with USB required for program)
- Travel to Connelly Springs, NC may be required.