The Electro Tree

UAH Spring 2023 ECE Senior Design Project

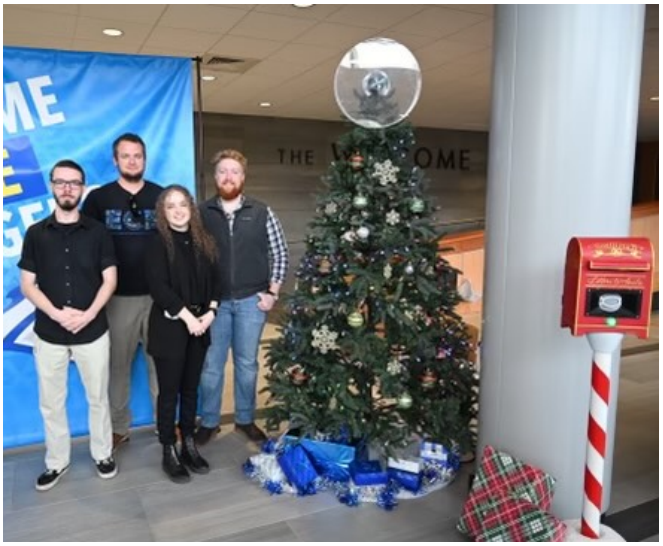
Project Overview

The senior design project is widely considered to be the culminating event for a UAH engineering degree. Teams are formed, projects are selected, and the work begins. Over the course of a single semester the teams design, build, redesign, adapt, and hopefully complete their projects.

Our project was originally designed and built in the Spring semester of 2023. The original system allowed for voice control of a Christmas tree, with the ability to change the songs and light shows with voice commands.

While the original system worked very well, our objective was to improve the system. Specifically, the ECE department wanted an integrated tree topper, improved audio volume, improved voice command accuracy, and a weatherproof design.

Electro Ensemble



Our team was the Electro Ensemble. The team members from left to right are Robert McLaughlin (Audio Lead), Ryan Absher (Team Lead), Emily Beck (Hardware Lead), and Duncan Patterson (Software Lead).

Technical Specs

For the tree topper we selected a persistence-of-vision "holographic" fan display. This rotates at a high speed while constantly updating LEDS to form smooth images and video. Communication for this was achieved with the use of an ESP-32 via Wifi.

The system hardware was simplified, consolidating redundant components while improving robustness. A new, non-blocking, software system was written which allows the separate system (lights, voice control, holographic fan, music) to operate in parallel.

Audio output quality was dramatically improved, and the volume requirements for accurate voice detection was decreased by an average of 10dB. The speakers are weatherproof.

The audio input is taken thriough a USB mic and fed into a Raspberry Pi. Software called Rhasspy proccesses the voice command and executes the appropriate actions, which in turn controls the lights, music and fan.

The communication method for the fan topper had to be reverse-engineered from an decompiled Windows application.

An enclosure for the system was created in the form of a weatherproof Christmas themed mailbox. This holds the Raspberry Pi, ESP-32, amplifier, microphone, and power supply for the system. All cables emerge from the mailbox base with specific canon plugs to allow for ease of assembly and to prevent incorrect connections. Setup and breakdown are quick and easy.