ELECTRIC WIND

AN EXPERIMENT WITH DIFFERENT FIRE EXTINGUISHMENT METHODS

LSU COLLEGE OF ENGINEERING

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Introduction

Our group's original intent was to create a device to assist firefighters. That objective evolved into a household device for fire extinguishment. We ended up designing an experiment to extinguish fire. Using binary factor analysis, we will observe how much of an effect different factors have on flame extinction. These effects will be measured for two different extinguishment methods: an electric field generator and a mechanical sound oscillator.

Objective

To construct an automated sound generator and a electromagnetic field generator to put out a fire. The sound generator is composed of an amplifier and oscillator circuit connected on a PCB. The PCB should be able to hook up to a speaker to generate sound waves to put out a fire. The field generator system is composed of a high voltage AC and DC power supply. The two power supplies should connect to two aluminum parallel plates to create an electric field to put out a fire. A microprocessor should turn on the designated system when our sensor reads a certain temperature.

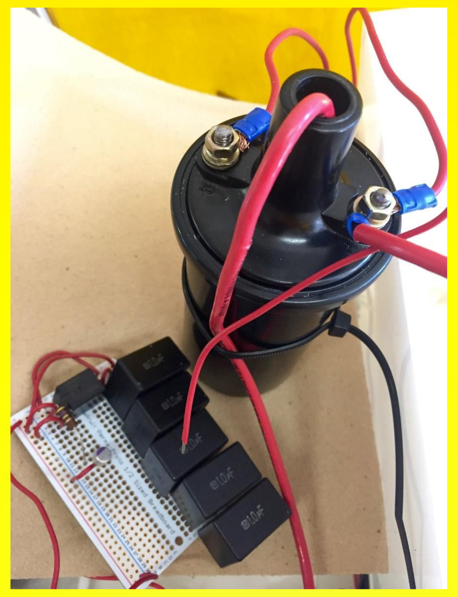
Electric Field

Engineering Requirements

1. System must generate output voltages >10kV
2. System must propagate waves at 600 & 1200 Hz

Design

A circuit was initially designed using a firing circuit and car ignition coil. Quick, large pulses across the primary windings generated large VAC waveforms across the secondary windings. This circuit generated around 12kV at 250Hz.



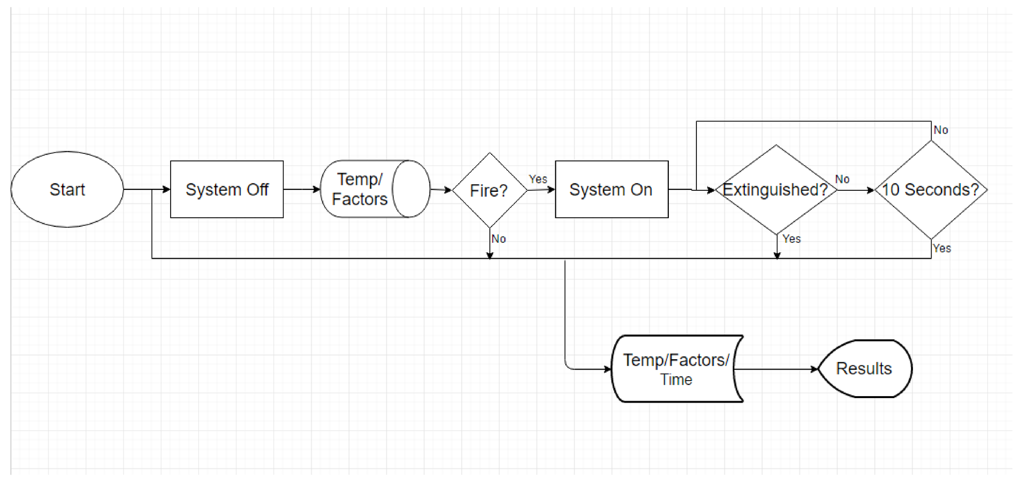
Later a second circuit was built, using a variable device called a triac to introduce a tunable frequency. The output produced 10kV at 450Hz, reaching up to 30kV at 800Hz.

Microprocessor

System Requirements

1. System response time is <1 second
2. System should respond up to 380 C
3. System shut off 1 second after extinguishment
4. System should turn off after 10 seconds if no extinguishment

Flow Diagram



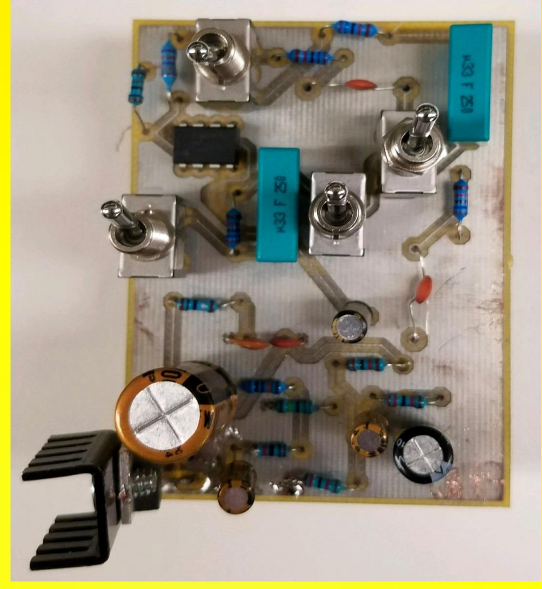
The microprocessor system supervises each run of both systems in order to ensure user safety and accuracy of results. Both systems are activated by relays controlled by the microprocessor. A temperature sensor is used to detect flame presence and extinguishment, timing the results and ceasing power to the relevant systems.

Sound Waves

Engineering Requirements

1. System must output signals at 30Hz and 100Hz
2. System must output magnitudes of 30dB and 70dB
3. System must incorporate two collimator designs

Design



In order to output 30Hz and 100Hz, we built an oscillator circuit which could switch between frequencies using switches mounted on the PCB. In order to output 30dB and 70dB, we built an amplifier that provided 20W which enabled us to output up to 80db.

Based on research, the speaker was placed part of the way into the collimator. In order to achieve maximum output, the distance from the speaker to the end of the collimator needed to be double the distance from the beginning of the collimator to the speaker. We used an overall length of 3 ft. We also designed a cap to minimize the output diameter from 10" to 4.25", giving us two collimator designs.

Experimental Results

Thermal limitations of the Beagle Bone Black and the ignition coils themselves never allowed for proper testing of frequencies greater than 600Hz. We were able to see the resulting flame stretch several times, but never fully extinguish.

Conclusion

Using factor analysis, we were able to identify the most influential variables in flame extinguishment for each system. For the sound system, high decibels, lower frequencies, and smaller output diameters yielded the best results. Our electric field tests responded best to higher frequencies and field strengths greater than 500kV/m. Both flame types were responsive, but the alcohol based flame was more responsive to the sound waves.
Future applications would involve increasing the magnitude of these tests to incorporate larger flames in order to work towards proof of concept for consumer or professional use of these methods to extinguish flames.

Experimental Results

Flame extinguishment was achieved multiple times.
Best results were achieved at:
Higher dB value (100dB)
Lower frequency (30Hz)
Capped collimator (output diameter of 4.25 inches)
Sterno flame (ethanol based)