Practicum Product Design Specification (PDS) Outline for the THUNDER BUDDIES

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Team #4

Team Members:

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Project Name:

Automated Lightning Detection System

Executive Summary with Concept of Operations:

The Automated Lightning Detection System (ALDS) will detect lightning within 60 miles. The ALDS is designed for anyone holding events in areas where lightning strikes are common or worrisome. By passively detecting RF that is emitted by lightning naturally, the device is able to alert the user of lightning in the area so they can follow their response protocol as needed.

Market Analysis:

The intended users are event organizers and hosts who need to be aware of lightning in the area with a specificity not met by monitoring weather alerts. The ALDS will be able to provide customers with the ability to be aware of dangerously close lightning, to allow them to respond urgently and effectively. While other lightning detection systems exist, their range is typically quite large (100-300 miles), which can cause critical events to be shut down unnecessarily. The price point we are targeting is $200, between rudimentary in-home detection systems and multi-point network style system units.

Requirements

- **MUST:** Detect RF energy pulses emitted by lightning strike.
- **MUST:** Operate without constant external power (have energy storage).
- **MUST:** Indicate to the user when a lightning strike is detected.
- **SHOULD:** Differentiate between RF emitted by lightning and RF emitted by other sources.
- **SHOULD:** Timestamp the incoming lightning strike using a globally synchronized time source (i.e. across multiple similar devices).
- **SHOULD:** Capture the detected RF power level over time and save a measurement of the power in a time region around the strike.
- **MAY:** Transmit data off-board using wireless technology.
- **MAY:** Have a weatherproof enclosure.
- **MAY:** Extract energy from the external environment for power (i.e. solar).

System Architecture

Level 0:

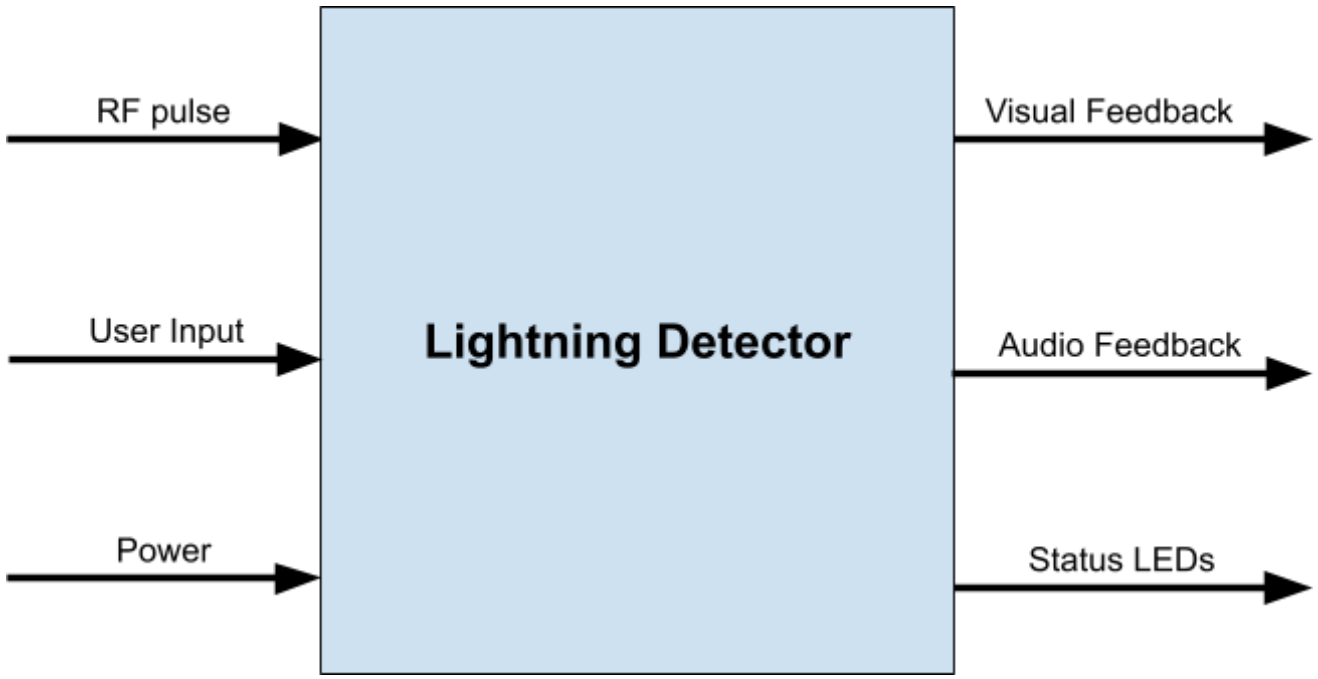

Figure 1: Block Box diagram; level 0 functional decomposition

Level 1:

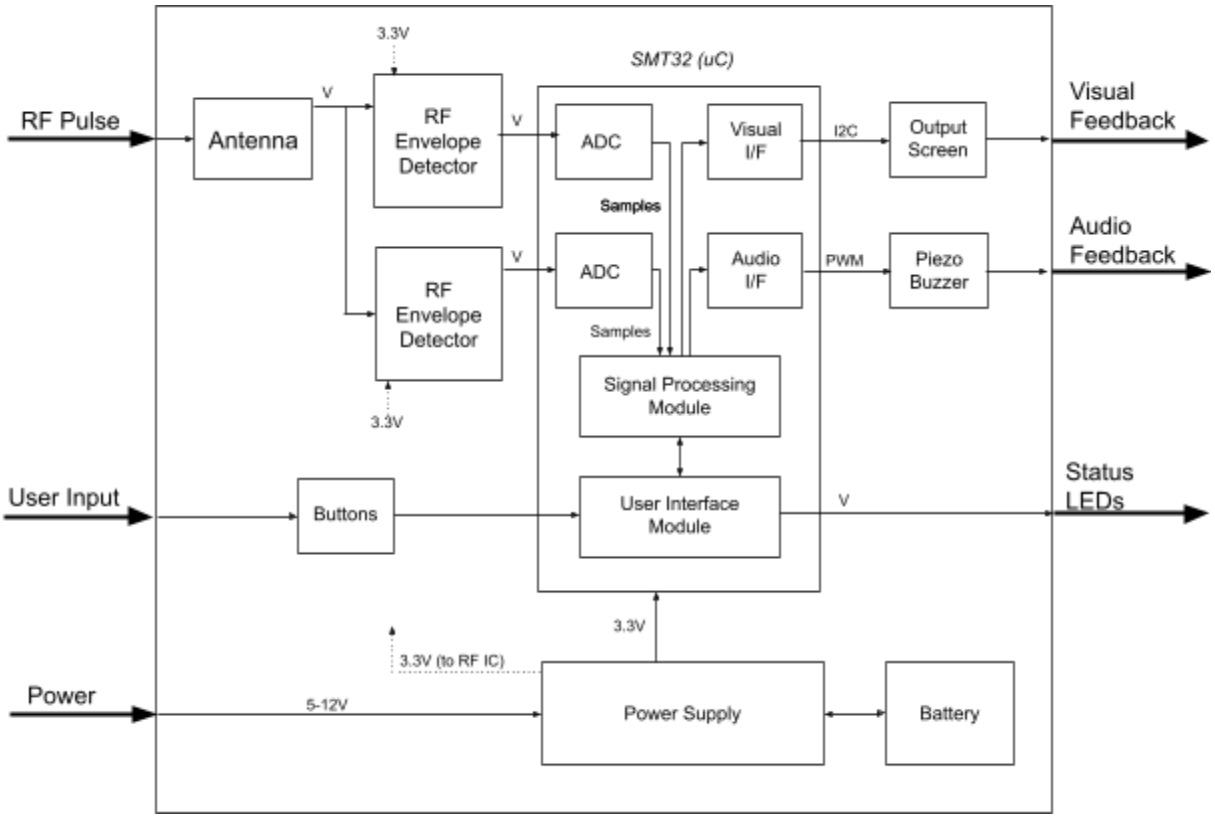

Figure 2: Block Box diagram; level 1 functional decomposition

The device will take in an RF pulse, emitted by lightning when it strikes a location, and alert the user through both visual and auditory feedback. The visual feedback will be through a screen, either on-device or through a mobile device. The auditory feedback will be provided by a piezo buzzer. Additionally, the device takes in power in order to charge an onboard battery; this may extract power from the environment, as listed in our requirements. User input is used to toggle the device on/off as well as to reset the device after an alarm has been acknowledged. Status LEDs will let the user know the state of the device; on/off, battery level, and possibly critical error status.

- **Design Specification**
  - **Sensor:** LMH2121 Series RF Power Detector, RF antenna
  - **Processor:** STM32
  - **Actuator:** Status LEDs, screen, speaker
  - **Power:** Battery
  - **Mechanical Design:** Enclosure that is able to be easily transported
  - **Development Environment:** STM32Cube
  - **Firmware:** STM32 Firmware