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10/20/2021

ECE 411 Product Design Specification

Executive Summary/Concept of Operations

The intended design is to be a two way communications system housed in two tin cans. Each can will have a microphone and speaker for the two users to communicate. The goal is to create an intentionally LoFi two-way communication system to demonstrate the electronics involved in radio frequency systems. This project treats the classic tin cans and a string as a prototype and adds electronic components as its next iteration.

Brief Market Analysis

This product targets young people with an interest in learning electronics as a novelty. The most likely consumer would be a rural kid with access to a subscription service like Kiwico or similar novelty STEAM oriented learning platforms.

There are similar systems on websites such as www.instructables.com. However, these tutorials do not include all the necessary component pieces as a curated/cohesive system.

The greatest competition is a 5 year old with 2 cans a string and the ability to tie a knot.

Requirements

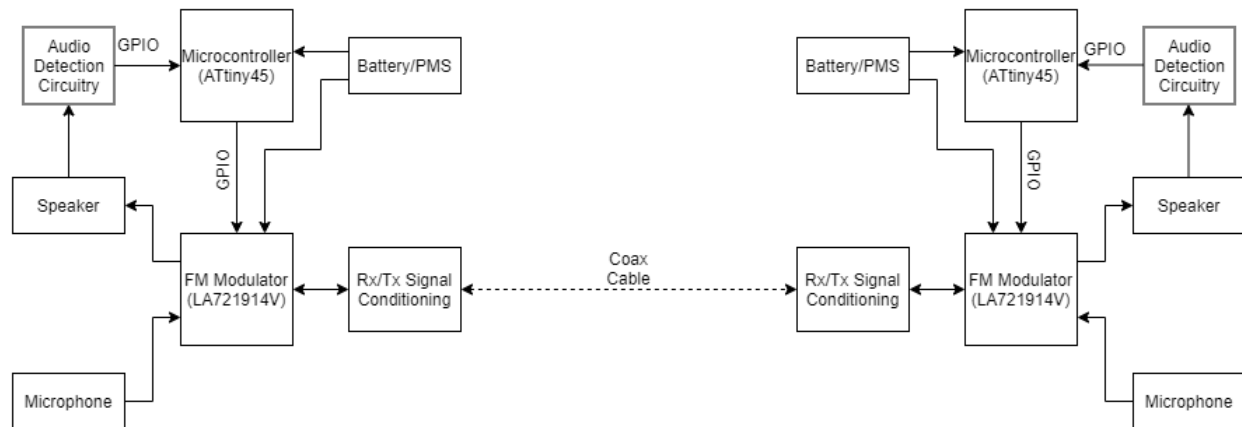
- Must fit all components in a standard #300 size can.
- Must have audio send/receive capabilities at either can.
- Must use a 2 layer PCB, with an area less than 900cm^2 and no more than 30cm in length.
- Should use a single cable for signal path between cans
- Should automatically cut microphone with audio output is active
- Should have mostly surface mount components
- May use an antenna instead of a coaxial cable
- May have intentional audio distortion circuitry
- May have adjustable audio output volume

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System Architecture

Below is the level 1 block diagram draft intended for future iteration considerations.



Design Specification

- Each handheld unit consists of two cans with the same PCB and hardware connected by a coaxial cable
- Sensor: Audio Detection Circuit
 - Audio detection circuit transmits a signal to the microcontroller when it senses audio being played on the speaker.
 - Audio detection circuitry consists of a rectifier and low pass filter that feeds into a comparator, that then triggers the microcontroller if above a threshold. The specific cutoff will be tuned by adding a gainstage to the filter
- Processor: ATtiny45
 - Sends signal to FM Modulator when audio playback is detected on speaker
- Actuator: FM Modulator (LA721914V)
 - Cuts microphone when signaled by microcontroller
 - Uses filters and a wilkinson combiner for separating frequencies transmitted through coaxial cable
 - Rx and Tx frequencies will be set via jumper
- Power: Battery (LiPo or 9V battery) and necessary DC-DC voltage regulators
 - Each handheld unit will have an independent battery/power management system
 - PMS will not include onboard battery charging