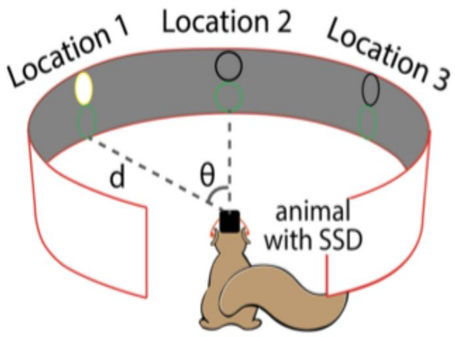

Converting Images To Sound: A Lightweight Sensory Substitution device

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Can Sound Activate Visual Areas Of Brain?

A sensory substitution device (SSD) translates visual input into audio output, enabling visually impaired individuals to understand their physical world through sound. Despite the prevalence of various SSD technologies for humans and their promising results in allowing blind individuals to regain visual abilities through sound, it remains a mystery which neural pathways are involved in this impressive adaptation. While SSDs exist, there are no lightweight versions suitable for animals. This miniaturized head-mounted SSD seeks to facilitate the development of animal models that study how the brain adapts to "seeing" through sound, the first step in understanding the neural dynamics underlying sensory substitution.

Image Processing- Too Heavy, Too Slow

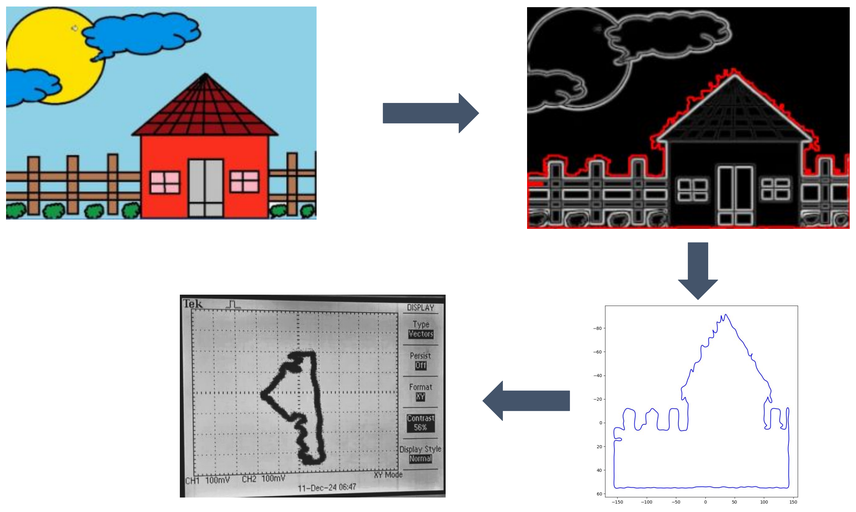

Figure 1. Visual-to-audio conversion using edge detection, Fourier series, and Direct Digital Synthesis.

Figure 2. Image after Sobel edge detection and subsequent contour extraction

One method for sight-to-sound conversion uses edge detection (e.g., Sobel or Canny) on video frames, extracts the largest contour, and approximates its shape using a Fourier series. Direct Digital Synthesis (DDS) then maps this shape to sound. However, this approach requires multiple components (camera, microcontroller, etc.) which introduces bulk and suffers from latency, making it impractical for lightweight, real-time applications.

IR- Based System For Object Detection And Audio Generation

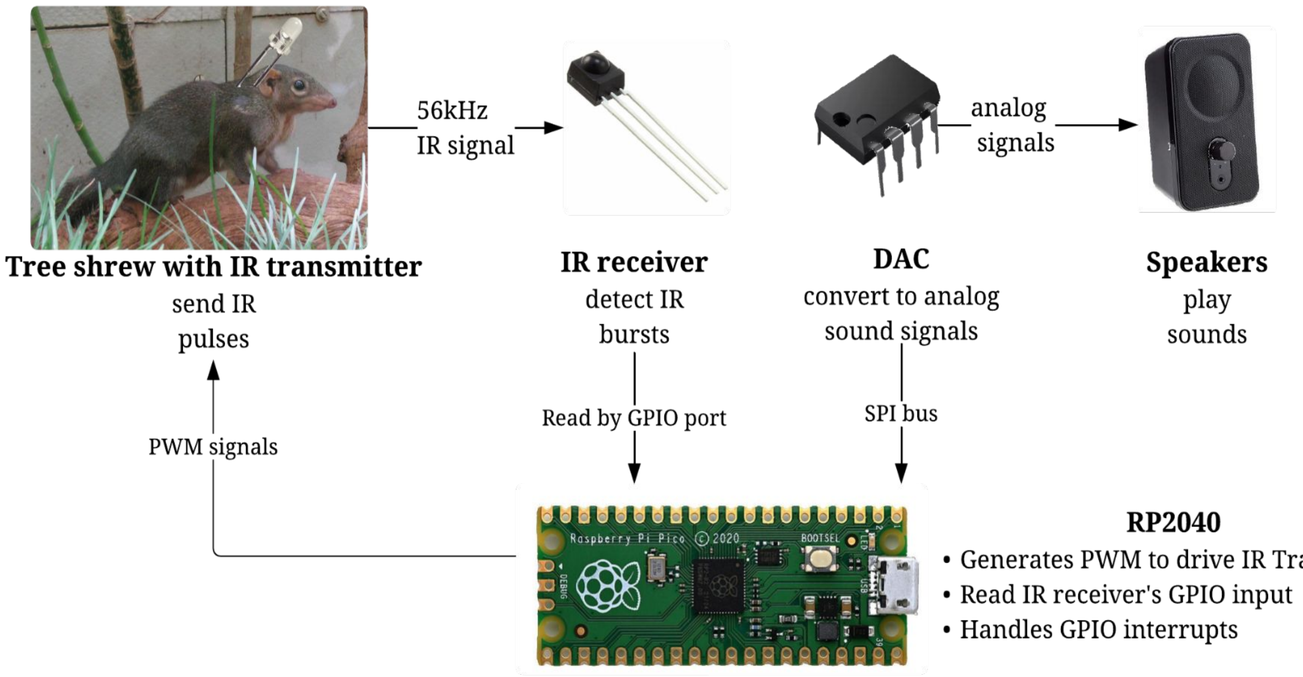

Figure 3. IR-triggered sound system for tree shrews using RP2040, DAC, and speakers.

Audio Generated In Response To IR Detection

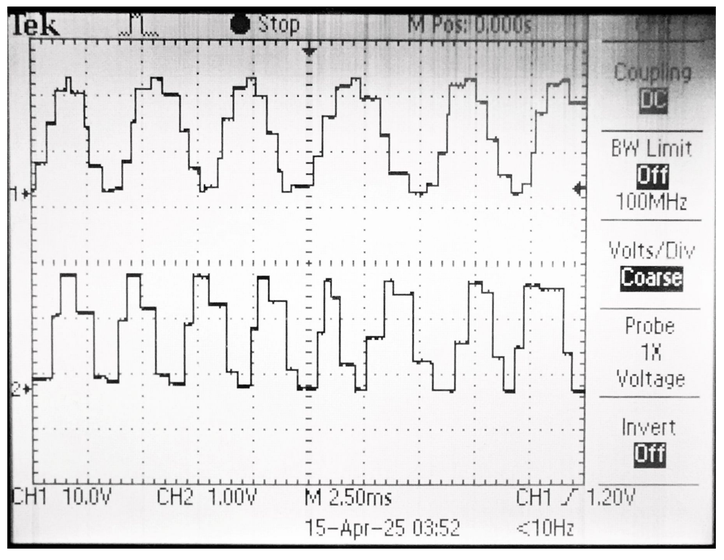

Figure 4. Sound signals when both IR detectors detect IR signals simultaneously.

In this implementation, the tree shrew wears only a small infrared (IR) transmitter. Multiple stationary IR receivers are placed throughout the environment. When a receiver detects the transmitter within its field of view, it triggers a sound output at the receivers location. This system provides a form of spatialized auditory feedback, creating a sensory substitution experience. As the shrew moves through the environment, the pattern of sound it hears changes depending on which receivers detect the transmitter. This allows for an association of auditory cues with spatial information, maintaining the core functionality of SSDs.

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