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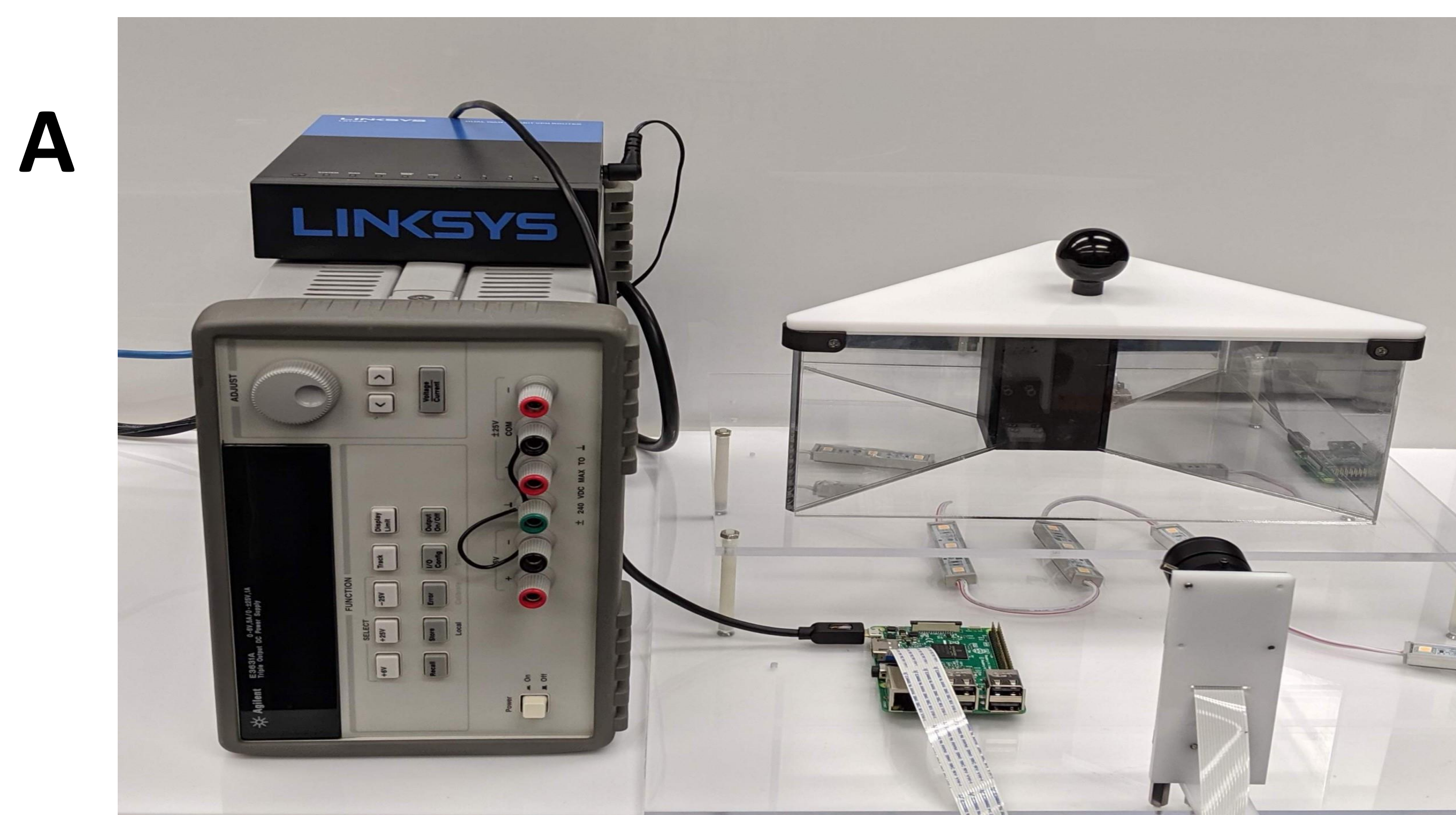
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## Background

About 20% of the population experiences chronic itch, which can be a symptom of illness. Currently, all chronic itch drugs target GPCRs and immune systems, and cause extreme side effects. Targeting R7BP (recently found to regulate itch without regulating pain) is a much more effective way to reduce itch sensation while also limiting side effects. To continue this progress, it is important to quantify scratches produced by itch-inducing agents in mice. In order to do so, a mouse monitoring system is being developed with automatic scratch detection using machine learning algorithms. Typically, to capture behaviors of interest from multiple angles, multiple cameras are needed to see every angle within the housing enclosures. We demonstrate a device that utilizes angled mirrors to avoid the use of multiple cameras while still retaining full-view of the mice. The video acquisition of the system is accomplished using a Raspberry PI camera module. We present the different iterations of the hardware setup, along with the tools used for video acquisition and annotation. Overall, the system will significantly cut down the time and man-power needed to analyze videos of the mice behaviors related to itch studies.

## Hardware

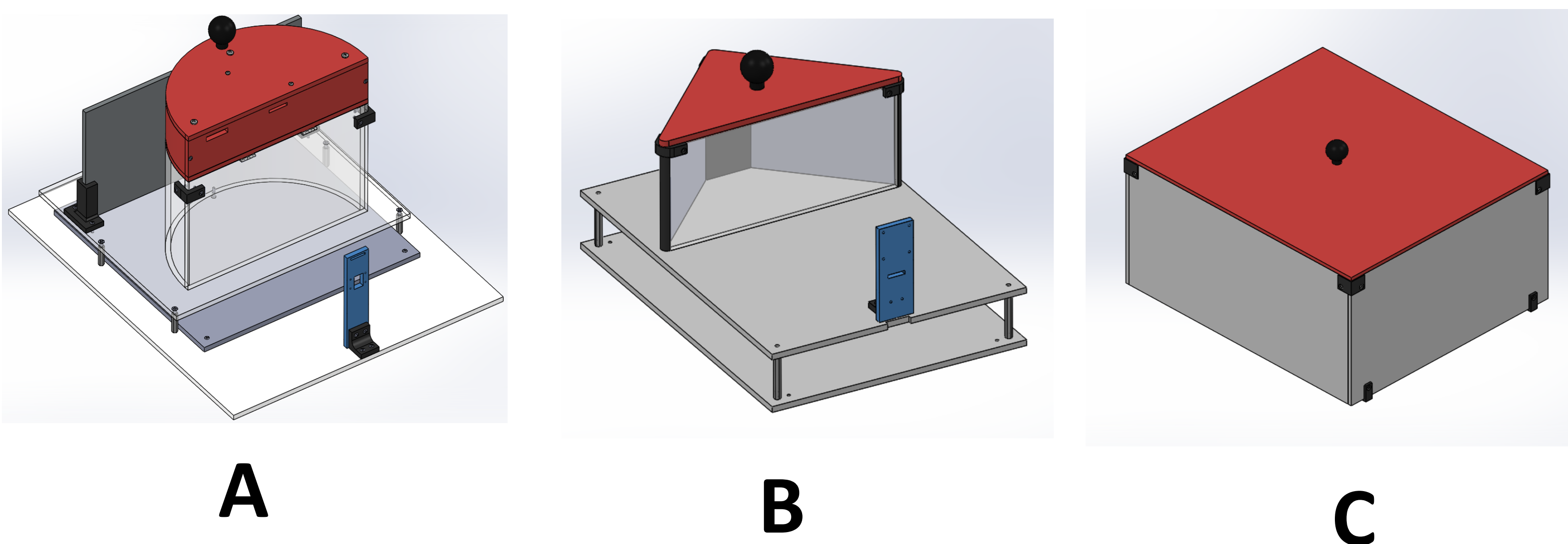


(A) Arena setup with Raspberry PI board, camera, power supply, ethernet hub, and LED lights.



(B) Design progression for mouse arena from oldest (left) to the most updated (right).

## CAD Design



(A) Initial Design for the mouse arena. After testing, it was found that multiple mirrors were needed to see additional view points. (B) Updated design in a compact system with angled mirrors for perspective. (C) Outside view of the enclosed arena to eliminate ambient light.

## Video Acquisition



Python-based GUI for real-time video acquisition from the Raspberry Pi's camera of the arena to monitor the mouse's response to the administered itch drug.

## Video Annotation and Analysis



CVAT annotation software powered by OpenCV to create test data for machine learning algorithms. This is done by splitting the video into separate frames and annotating key attributes of the mouse such as ears, nose, hind legs, and tail.

## Goals

1. Generate a training set for utilization in machine learning algorithms to detect mouse key point and behaviors.
2. Develop machine learning algorithms to detect behaviors of interest.
3. Assess accuracy of behavior detection and adapt hardware (e.g., multiple cameras, higher frame rate, greater magnification) to achieve desired accuracy.