Validating Customizable Olfactory Functions in Virtual Reality Systems

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ABSTRACT

- Smell can be a powerful tool for **decision-making** and **navigation**. However, **olfaction** is still rather underdeveloped in virtual reality (VR) systems compared to visual, auditory, and haptic functions.
- We have created a **Smell Engine** that implements the **olfactory function** and allows for a more **programmable** synthetizing and customization of scents.
- We are creating **two user studies** to test the system: **(1) memory recall (2) path navigation**

MOTIVATION

Medical Screenings and Treatments

- Changes in **olfaction**, the ability to smell, can indicate brain damage and disease, especially in an aging population.
- Partnership with **Mayo Clinic**

Occupational Training

- More immersive experience means better training for real-world scenarios
- Ex: firefighting, outer space

PROBLEM STATEMENT

In what ways can we **validate** a VR system that incorporates more programmable odor synthesizing and on-the-fly mixing of odors?

METHODS

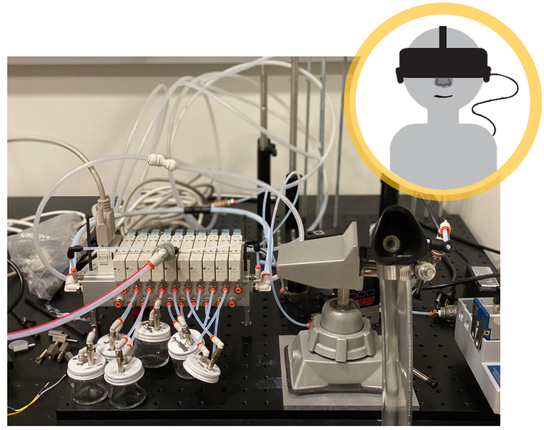
Smell Engine

Hardware

- Olfactory display
- Olfactometer

Software

- Smell composer
- Virtual environment in Unity



User Study #1: Health

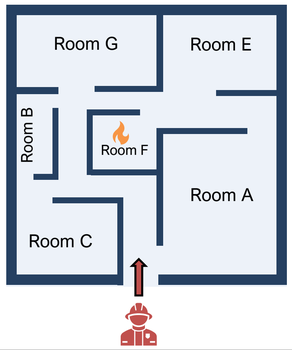
Memory Recall Game

- Compare Scratch & Sniff cards, premixed cartridges of odors, and scents mixed on-the-fly by our Smell Engine
- User has 4+ objects in a certain order. Each object has a distinct smell. After user smells each object in order, shuffle the objects. Now, user is tasked with putting them back in order.

User Study #2: Training

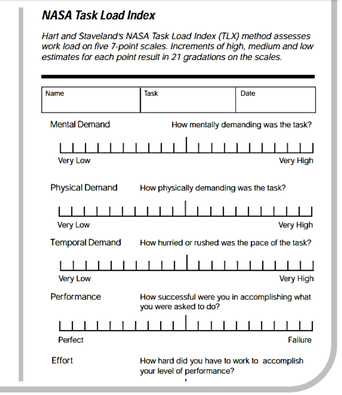
Path Navigation

- Firefighting training: locate the source of an odor or fire
- One profession that relies heavily on sense of smell



EXPECTED RESULTS

- Using **NASA-TLX** surveys to determine **workload** of tasks in each user study
- Results will ideally show very little difference between premixed odors and odors synthesized by our Smell Engine



NASA Task Load Index

Hart and Staveland's NASA Task Load Index (TLX) method assesses work load on five 7-point scales. Increments of high, medium and low estimates for each point result in 21 gradations on the scales.

Name | Task | Date

Mental Demand — How mentally demanding was the task? — Very Low … Very High

Physical Demand — How physically demanding was the task? — Very Low … Very High

Temporal Demand — How hurried or rushed was the pace of the task? — Very Low … Very High

Performance — How successful were you in accomplishing what you were asked to do? — Perfect … Failure

Effort — How hard did you have to work to accomplish your level of performance?

FUTURE WORK

- Continue to refine user studies in the next few months
- Build virtual environments for user studies
- (Hopefully) begin user testing in January 2021

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ACKNOWLEDGEMENTS

This work was made possible with funding from the Fulton Undergraduate Research Initiative (**FURI**) and the **ASU Meteor Studio** research lab.

Thank you to my faculty mentor, Dr. Robert LiKamWa, and my graduate student mentor, Alireza Bahremand, for their support and guidance.

FURI

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