Nose Gym: An Interactive Smell Training Solution

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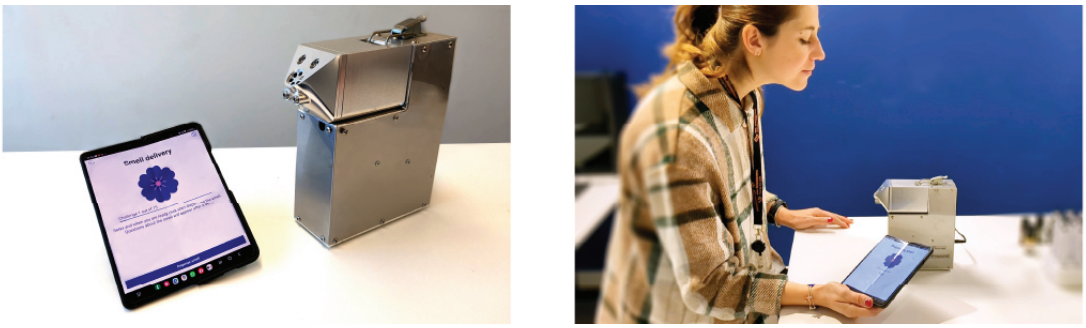

Figure 1: ***Left:*** **Digital smell training solution (hardware and software components) developed by OWidgets and used as part of the I-smell research project. Photo Credit: OWidgets LtD** ***Right:*** **The smell training solution using the device and dedicated App.**

ABSTRACT

When was the last time you had your sense of smell checked? Smell is one of the most neglected senses in daily life and in HCI. In Europe and the USA, around 22% of the general adult population has some form of smell dysfunction. This number rises to 75% for people aged between 70–80 years and negatively impacts peoples' quality of life and well-being. Regular smell training can make a difference. Today, smell training is done by sniffing essential oils in jars or scented pens. Based on advances in digital technology, we present a new interactive smell training solution to help people train their nose. At CHI, users will have a chance to try out the scent-delivery device and companion App at the 'Nose Gym' booth. We will combine the interactivity with additional information on the I-smell project that is using this digital smell training solution in a real-world deployment to establish a culture of care for our sense of smell.

CCS CONCEPTS

• **Human-centered computing** → *User interface toolkits.*

KEYWORDS

Smell; Smell training; Smell care; Smell-based interaction design; Scent design; Odour interfaces; Olfactory experiences; Digital smell health: Digital smell technology.

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1 INTRODUCTION

Our sense of smell is a commonly overlooked part of our daily lives, despite being an early warning system for hazards (e.g., gas, spoiled food), closely linked to psychiatric disorders, and enriching our lives through social bonding and memories. However, *when was the last time we got our sense of smell checked?* We care for our vision and hearing with yearly check-ups, but *why does our sense of smell, often called the forgotten sense, not hold the same value?*

The importance of smell is often not realized until it is lost, with the COVID-19 pandemic recently highlighting these issues to the wider public [17, 19, 22]. Millions of people worldwide experience smell distortions and the resulting taste distortions, often due to traumatic brain injury or viral infections. It is estimated that approximately 22% of the general population in Western countries suffer from smell dysfunction [9], which is much greater for people who smoke (60%, [1]) and especially high for those over 60 (75%, [21]).

The loss of smell not only impacts our physical health but also results in reduced Quality of Life (QoL) and psychological well-being [12, 15]. One way to mitigate these effects by improving smell function is through *smell training* [20]. Regular smell training – mindfully, actively smelling different scents twice a day over several months, can help people to better understand their ability to detect, identify and discriminate between different odours, notice any changes to their olfactory ability and encourage them to make more use of, appreciate, and value their sense of smell. It is an effective method in rehabilitating smell function, has positive effects on well-being and cognitive function, promotes longer independence at home, and enhanced QoL in older age [3, 11].

Existing smell training methods are often limited to pens soaked in scents or jars filled with essential oils. These methods fall short of providing control over the scent delivery [7, 10], measuring adherence to a training program, and conveniently tracking experiences (e.g., do people become more accurate at recognizing the scent of rose over time?). A digital solution can overcome these drawbacks by providing precise and controllable scent delivery, as well as trackable performance and progress. As part of this interactivity paper, we present a novel digital smell training solution (Figure 1) composed of a scent-delivery device with six channels and a companion Appto easily track performance [8]. This digital smell training solution was developed by OWidgets Ltd (OWidgets Smell Made Digital), a UK-based University spin-out, supported by the European Research Council Proof-of-concept (ERC PoC) SmellHealth project. The evaluation of the solution was carried out by the research team at the University College London (UCL) and is now further developed and evaluated as part of the I-smell: Engaging Users in Smell Self Care at Home research project.

In our demonstration, we invite the CHI community to engage in a short smell training session at our 'Nose Gym' booth, where they can smell scents and rate how they perceive them (e.g. perceived intensity). Next to the technology demo, the community will have the chance to learn more about the *forgotten sense* of smell, reflect on its place in their life, engage in conversations with the team, and try out other smell-related experiences (e.g. smell-taste relationship).

Caring for our sense of smell should be part of our everyday routine and be part of *proactive*, not reactive care. In this sense, engagement with the CHI community holds unique value. Our demonstration will allow us to gain the outlook of HCI researchers and practitioners on regular engagement with smell training, as well as inspire other smell-based interaction opportunities based on emerging digital smell technology [13, 14, 18], such as that demonstrated for I-smell and developed by the project partner OWidgets - a University spin-out born out of advances in HCI over the last decade.

2 I-SMELL PROJECT OVERVIEW

The ambition of the I-smell research project is to understand if and how people engage in regular daily smell training. Our project brings together an interdisciplinary team with expertise in Human-Computer Interaction (HCI), Digital Health, Medical Sciences/Rhinology & Olfactology, and Built Environments (Architecture & Interaction Design). The latter is key to account how novel digital technology solutions are integrated into people's homes, private spaces that can open up new design opportunities for the CHI community [2]. Using this holistic lens, key questions our research project aims to answer is: *"How people engage with daily digital smell training? Why do they keep using it, or not? Where and when do they engage with it? How do they describe/share their interaction experiences with others?"*

We hope to gain key insights into the technology adoption and acceptance. We all know that setting up a routine is difficult, and keeping it is even harder. Previous studies have shown adherence rates to smell training can be relatively low, with a lack of perceptible improvements being a key issue [16, 20, 21]. Therefore, there's a need to develop solutions that communicate the importance of daily smell training, maximize adherence and possible positive outcomes, and support smell training to become part of the self-care daily routine [8, 20].

In this sense, engagement with the CHI community holds unique value, as experts in the field of designing, developing, and evaluating novel interfaces and interactions are at the heart of the community. The attendees will interact with the scent-delivery device using the companion App shown in (Figure 2). This demonstration will allow us to gain the perspective of HCI researchers and practitioners on regular engagement with smell training, as well as inspire other smell-based interaction opportunities based on emerging digital smell technology [4, 6, 13, 18], such as that demonstrated for I-smell and developed by the project partner OWidgets - a University spin-out born out of advances in HCI over the last decade [14], and demonstrating a successful transfer from research into practice.

2.1 Hardware

The smell delivery device can deliver 6 individual odours which can be selected via a cloud-based App, both developed by OWidgets [14]. Up to 3 odour channels can be activated simultaneously. Chemical odorants are contained in a carrier material and placed in a cartridge made from a chemically resistant material that can be cleaned after use (Figure 2, Left). A system allows easy removal

and swapping of odorant cartridges between use. A miniature air pump provides odour flow with a minimum flow rate of greater than 6 L/min. Individual outlets help prevent cross-contamination between channels. The unit can be easily interfaced with a computer, tablet, or mobile using USB or Bluetooth and includes an integrated battery for standalone operation. A key contribution of the current prototype is the consistency of airflow, delivery direction, and short-term smell delivery (e.g., does not fill the room) allowing temporally and spatially precise delivery. Moreover, the current device is distinct in that it does not use proprietary scent cartridges, but allows the user to choose their own scents (e.g. 'off the shelf' natural essential oils).

2.2 Software

A key contribution of this prototype is the seamless integration of software to deliver the smells. The dedicated companion App ("Smell care") allows convenient digital control and delivery over the odours in each channel and keeps track of the smell training performance over time. Users first connect their phone and their smell device through Bluetooth, and can then start their training session (see Figure 2, Right). A scent, randomized for each session, is dispensed for 10 seconds followed by the rating of the perceived intensity. This is repeated for each scent twice (12 individual ratings) and can be completed in max. 5 minutes. For the CHI demo, we will reduce this to a few trials per attendee.

2.3 Preliminary user engagement and feedback

The first prototype from the ERC PoC SmellHealth project has been iteratively developed and evaluated with participants aged over 60 years of age, with no or some olfactory disorders (N = 29). The focus was on the usability and user experience of the hardware and software, combining both quantitative and qualitative methods. It would go beyond the scope of this interactivity paper to describe all the details, however, we would like to highlight that the overall feedback was positive and participants found it easy to use. We received valuable feedback on improving the design of the device as well as the App, which fed into the I-smell project. We closely work with charities such as Fifth Sense, the UK-leading charity to support people with smell and taste disorders, as well as Future Care Capital, focused on innovation for social care, alongside our clinical experts Prof. Carl Philpott and Dr. Matt Lechner. In addition, we are currently running participatory design workshops to further understand the requirements for the real-world deployment of the smell training system in people's homes, closely working with all the I-smell partners and collaborators.

Figure 2: *Left:* Illustration of the OWidgets scent delivery device prototype, *Middle:* App interface to dispense the smell for an interactive smell training session. *Right:* Illustration of an example performance result available to participants at the end of smell training session. Photo Credit: OWidgets LtD.

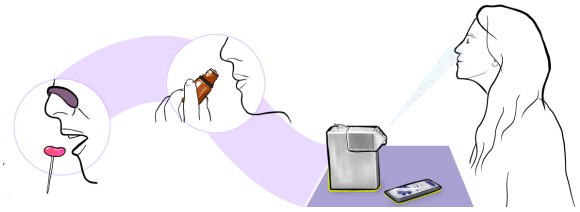

Figure 3: An overview of the demonstration that starts with a smell and taste experiment, followed by experiencing the analog smell training methods and finally, our digital smell solution.

3 EXPERIENCING DIGITAL SMELL TRAINING AT CHI

We invite the CHI community to join our Nose Gym booth and explore the opportunities around the advances in digital smell training. Everyone is invited to interact and exercise their nose when at CHI 2023.

Our demonstration provides attendees with a unique smell training experience (Figure 3). First, we will invite people to explore the relationship between smell and taste with a small experiment (e.g., eating with a nose clip). Following this experiment that underlines the importance of our sense of smell, we will bring in the current methods for smell training. Then we will introduce our device and the companion app. The participants will engage in smell training, where they can rate the perceived intensity of each scent available on the device. The attendees will part our demo by reflecting on where the sense of smell is situated in their lives and why smell self-care is not a common consideration.

4 FUTURE STEPS AND OPPORTUNITIES

We have used and evaluated the new digital smell training solution in controlled laboratory environments so far. The next step will be to deploy the technology solution in peoples' homes over six months. By doing so, we will be able to not only understand possible issues in the process of deploying a new technology solution but also learn about how people will or will not engage with the technology on a regular basis. We aim to identify roadblocks to daily use, different perspectives (e.g., *what motivates people with and without smell disorders and how does it affect the interaction experience design?*), and approaches to increase adherence to smell training. It will also inspire us to better communicate the value of smell and establish a broader culture of self-care centred around our sense of smell[4, 6, 13, 18, 19]. The I-smell project will also apply a collaborative sense-making process to map out future research directions for larger scale clinical trials, in-the-wild home design explorations, and advances in digital health and care technology development.

5 CONCLUSION

The ability to smell and detect changes and dysfunctions in our smell perception is vital for our health and well-being[12, 15]. Smell training now has several studies showing it can help support smell function [20]. Whilst more people are aware of the importance of smell in the wider public due to the COVID-19 pandemic, it is easily forgotten and lost when the sense of smell works or seems to work 'well' again. We argue that smell care should be part of our everyday routine (akin to checking our hearing and eyesight) and be part of proactive not reactive care. If self-monitoring of smell functions becomes part of proactive care and people's daily routine, we could help avoid undesired impacts on how people want to live their lives and stay independent living at home, with their family, and the local community. This is particularly important considering that smell (olfactory) dysfunction is present in a number of neurological disorders (e.g. Alzheimer's disease, schizophrenia, multiple sclerosis, and idiopathic Parkinson's disease [5, 8]). By showcasing our device, we will gain rich perspectives from the CHI community that will feed into our project ambition and help share a stronger awareness and support for the forgotten sense of smell.

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Declaration Marianna Obrist is the CSO and co-founder of OWidgets (OW) and Christopher Dawes is a part-time employee at OW. OW is a project partner in the I-smell project, developing novel digital smell technology.

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