Context-Aware Sound Alerts

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1 INTRODUCTION

Although many human interactions with computers utilize senses such as vision and touch, the realm of auditory interaction is equally important. Notifications, regardless of medium, serve as a reminder that interaction is needed or as a response to an action taken. With respect to sound alerts, they are a significant part of how we interface with our machines. These help to guide users as they interact their devices, and can even be leveraged to assist those with visual impairments. [2] This project is important because effective notifications are beneficial to our productivity as opposed to silent interactions [4], they improve the usability of our devices, and can even be lifesaving depending on the situation. [11] We became interested in looking into the effectiveness of sound alerts after discussing how certain notifications can cut through a noisy environment more effectively than others. We are looking to explore this relationship between humans and audio notifications with our research to better identify key attributes of sounds that are most effective in these different noisy environments. Because our devices have limited ways of communicating with us while our attention is diverted elsewhere, we look forward to using this project as an opportunity to find the common thread that makes certain notifications more noticeable and apparent than others.

2 RELATED WORKS

Notifications and the response individuals have to differing types of notifications have important implications in the real world. This is device notifications and alerts demand the user's attention, and as Mehrotra and Musolesi point out, this should be largely considered when sending alerts within different contexts within the real world. [9] Gallud and Tesoriero understood that notifications interrupt users and stop what they are doing. Although they studied sound and visual notifications, this paper will focus solely on alert sounds. [5] Even though one would think multiple alert cues would disrupt a user, Warnock and McGee-Lennon ran a separate study which showed that regardless of visual, auditory, or tactile cues, the disrupt in the users task was the same. [13] Mashhadi and Mathur importantly note that

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notifications do not all hold the same importance level to the user. [8] This study proceeds with the assumption on the notification sounds goal is to distract the user from the task at hand; similarly to a study by Iqbal and Horvits, which focused on notifications whose goal was to disrupt the user from their current tasks on their desktop computers. [7] Arfvidsson found shorter and congruent sounds perform better when subjects are listening to pick out the notifications against an ambient background noise. [1] Though while two notification sounds may be similar in harmonics, one may drastically outperform the other due to random variables such as an individuals general attentiveness or familiarity with the notification noise. This reinforces the importance of choosing a set of notification sounds that will provide clear results. In another study, researchers focused on designing sound identity for building brands and "corporate sound" and they focused fully on sound semantic descriptors, but were able to illustrate it to their users through communication tools to find appropriate sounds. [3] Hanam, Tan, and Holmes found that they could even improve actionable alert sounds and rank them by finding patterns within static analysis alerts. [6] This study focused on not only finding actionable alert sounds, but on alert identification techniques. On the other hand, to find the effectiveness of how disruptive a notification can be to working a task, Mehrota [10] found numerous confounding variables which may have a substantial influence on gathered results. The psychological traits of an individual and the implicated importance behind the notification can have a deep impact on the response time and how much of a disruption there may be on the given task. Gathering relative demographic data will be necessary to account for these inherently random variables. Not surprisingly, Singer [12] showed that in order to be obviously noticeable against a background noise environment, the notification sounds should be played at a higher decibel volume though did not find a specific range that is an ideal condition. It was also noted notification sounds in the higher frequency range performed better than those at lower frequencies though a larger sample size of sounds may prove this otherwise.

3 METHODOLOGY

Our experiment will study the noticeability of different alert sounds to a human subject when they are engaged in an activity in differing aural environments. This investigation is designed to study the aural interface between humans and the devices presenting notification sounds. The experiment will be administered as a web application in a controlled environment. The subjects will be presented with a typing test, meant to occupy their attention. This strategy to distract the subject with a task is meant to simulate a realistic everyday situation in which a human is engaged in an activity and prompted for action by a sound when they may not be expecting it. We believe it is important to engage the participant's attention to study the context of the notification. At the beginning of the typing test, we will play an audio recording meant to simulate an acoustic environment. The environments are presented as different contexts, within which the notification sounds will be played. The subjects will be instructed to click a button when they hear a notification sound, under the pretense that doing so advances them to the next level in the typing test. In reality, the performance of the typing test is not important, though both average typing speed and number of errors will be collected as data. A series of different notification sounds will be played at levels designed to be barely noticeable. After a period of time, the typing test will end and the subject will start a new instance of the typing test with a different background noise environment, repeating this phase for all aural environments.

This experiment will have two independent variables, the different sound alerts and the environmental background sound (i.e. traffic, cafe, library, etc.). The dependent variables will be the sound alert recognition speed and missed notifications (if any). Each of the notification sounds will be presented during a phase of the background sound environment and the order of the alerts will be randomized. In between each background/environmental sound phase, the user will have a break with the screen showing a timer countdown until the next group of sounds begins. The experiment will be delivered in a within-subject design. Each subject will go through the same sound alerts and environmental sounds but both the order of the environmental phases, and the order in which the alerts sounds are played within each environmental phase will be randomized.

4 PROCEDURE

Users will first complete their consent form before beginning the experiment. Our experiment will take place utilizing a React web application presented on a laptop provided to all subjects one at a time in a quiet room. There will be a number of different pages displayed in the application to the subject during the experiment. First, users begin with a simple start screen explaining to them the context of the experiment and what is required of them. The instructions will say that they are going to play an office game and their performance will be measured. Next, the subject will be instructed to put on headphones and a simple hearing test will be administered to verify the participant's ability to hear various sound frequencies from the application. Next, a demographics survey will be presented prompting the user to convey information about age, gender, and the amount of time they spend using a computer on average. Next, the independent variables will be tested in the gamified typing test. They will be given a prompt of text and told to type it in the provided text box. At the same time, various sounds to mimic remote work environments will be played in the headphones. When they hear a sound alert, they will stop typing and click a button to acknowledge the alert. Each 'work environment' will have visual differences on the page to show the environment the sound is mimicking. After a phase of a given environmental sound is complete, the user will take a short break and be presented with the next environment. Concluding all environmental sound phases, the data will be collected.

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