

Voice assistants are used daily in many machines in efforts to help those with hearing impairment hear a message that needs to be delivered (or for those who have trouble reading as well). It's rare to see such systems designed within the soccer field for those with the same issues. My investigation only studied 4 participants, 2 males and 2 females each of which contained diverse levels of experience within the sport. We found that the associated sounds that went with each tactic were easily distinguishable and that they were relatively easy to decipher in real time. Multiple instances of a tactic given at once was rather difficult for the participants to note and distinguish the two sounds between the overlap. The final verdict received from the participants involves them agreeing that my sonification system was difficult to determine how much it was beneficial towards the user and what could be done differently.

Introduction

When it comes to watching sports, for experienced users, it can sometimes become difficult to see every action and reaction taking place within a game, which can be sonified with various sounds representing each tactic used in soccer. The domain of choice was athletic performance in providing real-time continuous auditory feedback (i.e. sonification) of a user's physical movements and physiological state and/or the movements, locations, and actions of the player.

In this investigation, I chose to focus on sonification systems developed for soccer players since I was already familiar with the sport. I simply focused on keeping the sonification simple to answer several basic research questions. The first question to be explored is whether or not the player or user will be able to differentiate between the different sounds used for each tactic. This is important as it will determine whether my sound choice was appropriate and if it is useful for the user. Answering this will be done through quantitative and qualitative analysis of the participants to see their accuracies during testing. The next question is whether the sound used for each tactic is easily decipherable in real time. This is important as we need to know if the user is able to identify and match the appropriate sound with its respective tactic, which indicates how effective the sound choice was. Simple quantitative analysis will be done to determine the conclusions for this question. The next important set of questions is whether the sounds used are distinct and memorable and if multiple sonifications can be sent to the user during the simulation. These will be answered in the same way as the previous set of questions through the use of quantitative data collection

and analysis. The final question will be analyzing the rest of the sonification usages (i.e., location of player during the given tactic, action of the tactic, etc.) and their effectiveness. This will be both qualitative data and quantitative data collected where the qualitative data will also focus on other concerns and comments from the users on my simulation.

The participants recruited were between the ages of 19-22. I reached out to over 100 people in hopes that at least 10-15 would reach back to help, but only four did. Of the four participants that reached back, two were male and two were female. Between the males and females, on male/female at least played high school soccer and the other two have street soccer experience.

Methods

The main focus of this project is to explore the following questions:

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- *Will the player be able to differentiate between different sound tactics?*
- *Will the sonifications be difficult to decipher in real time?*
- *Are the sounds distinct and easily memorable/aesthetic to the ears?*
- *Can multiple sonifications be sent simultaneously to the player?*
- *Can a user make the appropriate sonifications (i.e., location, sound, action, etc.)*
- *What is the player's overall opinion of the sonification?*

The answers to these questions will determine the overall effectiveness of my sonifier and will let me know what needs to be done, what should have been done, and the current benefits the system has to offer to its users. The more users one has in an experiment, the better and more credible the results and conclusions of the experiment will turn out to be. Sadly, as stated before, I intended to get more participants but only used the amount I was able to work with. Each of these questions will be explored using quantitative and qualitative measurements. Quantitative measures will explore time elapsed during pre-evaluation, number of correctly identified tactics during evaluation (single and simultaneous), number of correctly identified sonification overall (metrics, sounds, location), tactic used the least, use of custom tactics (number of custom, and what it is). Qualitative analysis will examine any outspoken comments regarding the simulation (direct or indirect), and patterns amongst all participants.

Protocol:

The evaluation will begin with a preprocessing explanation and demonstration of the simulator. The system designed is meant for soccer players and soccer fans to simulate a live

game in session by providing real time feedback of in-game events. You initially start by selecting your game (game1, game2, or game3, where “PAUSEALL” will stop the event. Next, we will make a custom setting using the tactic, timestamp, location, tag, flag, priority, and note fields within the UI (User Interface). When finish, the player then selects “PUSHTHESEINPUTS”. The user can also create their own json file once they have all the satisfied data inputs.

Consent will be received from the participants after I explain their role and purpose for evaluating my sonification system. We will be moving through a couple of tests to help me better understand the pros and cons of my simulator and system. The volume levels will be adjusted to your liking as I’m looking for feedback more so on sound quality and sound relevance, rather than loudness. At any point where you are feeling discomfort, please tell me and we will make necessary adjustments/accommodations. Your answers and feedback will all be recorded but your identity will remain anonymous. You may take a break anytime you want during the pre-processing phase and the evaluation phase. Consent will be received verbally and written on a document.

Each test below will be timed and recorded from start to finish

- Training Phase: This will begin with basic wizard of oz techniques. I will do a demo run of my simulator coordinated with a live soccer video (same video will be used for each participant for sake of consistency). I will input the commands as I see them live and then simultaneously simulate the video with the sonifications to see if it was accurately depicted, listing all the hits and misses. I will limit my time to 5 minutes to not prolong the experiment as this is just a demonstration.

After the training phase, we will then switch roles and begin the first main test. The purpose of the main test is to determine whether the sounds are easily differentiable and if the system is appropriate for its usage (I.e., the user is able to list and take use of other metrics such as location, action, or anything else the simulator offers to give to its users). We will focus only on the main tactics given and the information required will be recorded. For time's sake, we will do 10 minutes for the main test. As the tactic is demonstrated, I will mimic the tactic with a designated sound as the participant relays the tactic to me along with the location, action, and other information listed within the metrics.

The next test will be used to watch the video and identify any additional tactics used that I missed that could be listed amongst the others (and eliminate any that is not used as much if any). This will focus on any other tactic besides what is listed. The same process will be followed except we will be using the custom json maker for this portion. Once

finished, the relative data will be collected and recorded (what additional tactics were used, the amounts, etc.).

The final test will be similar to the first main test except it will focus on the sounds and whether the participant can distinguish and identify multiple cues and list multiple cues from the video. In this part we will do a 5-minute split of time on the video, where the first 5 minutes is dedicated to identifying multiple cues visually and verbally listing them and the next 5 minutes matching multiple cues with their respective tactics.

Each test will be followed by a series of questions to help answer some research questions and gather useful statistical data:

- Which sound tactic(s) were most pleasing to the ear?
- Which sound tactic(s) were least pleasing to the ear?
- Which sound tactic(s) needs to be present?
- Were there any sound tactics that lacked connection to the actual tactic?
- Is there a better way to present the sound of the tactic appropriately?
- Can two or more sounds be played at the same time?

Final comments / concerns:

- I will finalize the overall experiment with general questions for the participant to answer:
- Please discuss the difficulty of the task.
- What aspects were too hard to understand or were frustrating?
- Did you find the system to be too overwhelming?
- Would you see this system providing use in a studio, or would it be too distracting?
- Did you enjoy the sounds of the sonification?
- Was it annoying or too intrusive?
- What were the most helpful parts of the system? Least helpful?
- May rephrase or follow up as clearest aspects and most confusing
- Please provide any additional insights or comments you have about the system.

Debriefing: Finally conclude by thanking participant

Analysis:

Analysis of the data will begin with the calculation of central tendency measures for each of my quantitative and qualitative data taken during the evaluation phase of my sonification. Each of these measures includes the pre-evaluation phase (time elapsed), overall response time

to tactics, correct mapping of tactics, and use of alternative tactics. Patterns will be searched for amongst participants for each of these measures in hopes of finding any positive/negative trends throughout this project. This will help further understand the complexities of my sonification along with the cognitive load of the system. The percentages of correctly identified tactics will help me, and the player know if they can distinguish the differences between each tactic (and whether the sounds are even appropriate). Lastly, relevant qualitative data will be noted especially if there are common comments made amongst participants.

Results

The video used to conduct the experiment is from the 2019 world cup (Germany vs Brazil) [Brazil vs Germany - FULL Match - Men's Football Final Rio 2016 | Throwback Thursday](#)

The team being observed will simply be the Brazilian soccer team.

The second column represents correctly marked tactics, location, and overall feedback. The third column list all correctly listed tactics only. The fourth column represents the total missed all together. The fifth and last column represents the total number of maneuvers identified by the participant (incorrect or correct).

	NULL Correct:	Correct Tactic:	Missed:	Total:
Experienced Male 1:	5	3	0	3
Inexperienced Male 2:	8	6	2	8
Experienced Female 1:	7	0	1	9
Inexperienced Female 2:	4	4	6	0

This table represents the results of the second test conducted on the participants.

	Additional Tactics:
Experienced Male 1:	
Inexperienced Male 2:	

Experienced Female 1:	
Inexperienced Female 2:	

The third and final table represents the results of the last test conducted for each of the participants. This table is like the first table except it involves only simultaneous tactics as correct tactics this time.

	NULL Correct:	Missed:	Total:
Experienced Male 1:	6	1	7
Inexperienced Male 2:		0	9
Experienced Female 1:	2	3	5
Inexperienced Female 2:		9	2

Anecdotal Results:

The most preferred sound was Pressure and Offensive with unanimous agreement, and the least pleasing sound was Defensive (2 complaints). The sound tactics most agreed that was missing that could be beneficial includes player change and “penetration”. The final question, whether two sounds can be played at once, was agreed that it is possible, but very hard to do. On top of that, it was confusing for the participants since they are focusing on one team at a time. The sounds were overall enjoyable from each of the participants with minimal complaints as the complaints were made for the sake of complaining (as stated by the participants).

Discussion

The results of my study shows that my system proved to be effective, but not necessarily beneficial. This is because my system is a very basic sonifier that assists with simple tasks. This was demonstrated through the experiments conducted and feedback I have received from the participants involved. The inexperienced soccer players (mainly street soccer players) had lower success rates with each experiment compared to the actual soccer players, which makes sense as they should be more familiar with the events taking place within a real soccer game. The main difference in results from the test came into place when we compared the results of the experience with the inexperienced players, to which the experienced players each requested more tactics to be listed as opposed to the street players. This may suggest that someone with less

experience in soccer may find less fault within the sonification system as opposed to someone who played in organized games. This is important and shows the flaws in my system as it should be able to accommodate the requests for a more legitimate soccer player. The biggest downside came from the lack of development overall of this system as it was created very last minute and late. That made it harder to fully identify what could be tested for participants using my system in general, which is the reason for the simplicity of the system overall. Some of the procedures within the protocol were dropped for time's sake as well such as pre-evaluation time elapsed and overall response time. These factors would have been good data to collect to bring about more statistics involved in this experiment, but the major downfall comes with the lack of participants which indicates a small sample size. Smaller sample sizes are useless when using it for statistics.

Conclusion

The participants for my study performed the task with few issues and scored very well on the test laid out for them, which deems my hypothesis on my research questions as correct. Generalizing all of the comments received from each participant, the consistent statement made was the fact that they had a hard time truly finding the benefit of my simulator. One participant in particular claimed that this simulator possesses good basic functionality but simply lacks development and usage. The experienced participants did better on all of the testing than the inexperienced participants. They were also able to give me more constructive criticism as they were able to see the flaws of the system better by identifying more tactics to use and listing more concerns in regards to the benefits the system has for its users. With more time spent on the planning phases of this system, there could have been a better flushed out sonifyer that easily benefits all users, both experienced and inexperienced.