AudiHome

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Final report: Smart Cooking Helping Wearable

# **Introduction**

Most home fires start in the kitchen. Especially stove top is by far the most dangerous in the kitchen because cooking takes place with fire. In modern society, people are distracted by many sources, so they can not focus on cooking when cooking. To resolve this issue, we have designed smart cooking helping wearable so that people would not forget what they were cooking under any circumstances. In the course of developing the smart cooking helping wearable, we found out that a large number of people were almost ready to fire during cooking through the survey and background research. Based on the opinions of the people in the survey and the background research, we designed a prototype that detects the temperature of the stove top and informs the temperature change periodically. For the prototype's beta testing, we created a protocol, designed a study and tested it directly with people. Then, we have redesigned the prototype to reflect the result of wizard of Oz test on people.

# Background Research

According to National Fire Protection Association’s report in 2016, 74% home fire, 81% civilian fire death caused by home fire, 47% home fire were caused by unattended cooking. Especially, the report states that 38 percent of the deaths from the fire came from unattended cooking. It has also been found that in many cases the fire alarm had been turned off because the false operation of the fire alarm is noisy. This tendency was similar in the survey. In a survey of 32 people, 71 percent replied that they had left the stove while they were cooking on the stove and had a smoke alarm activated, and 56 percent replied that they had experience deliberately turning off the fire alarm.

# **Problem Summary**

According to the research and survey, people often forget their cooking in the stovetop and cause burning on the stovetop that could spread to a homefire, which is the number one cause of civilian fire death. Also, people sometimes turn off the alarm because the alarm is falsely activated, leading to the alarm not going off in the right time when an actual fire is present.

# Problem Solution

To solve unattended cooking and also take into consideration people might have turned off the fire alarms, a dynamic audio system that would inform users of the situation of the stovetop will help raise awareness of cooking and also inform users if the stovetop is still on even when they leave the location of the stovetop.

# Project Goals

To design a smart cooking helping wearable to inform users in real time who cannot concentrate solely on cooking for a number of reasons, and ultimately help prevent home fire. Even if the user leaves the kitchen while cooking, the smart cooking-help wearable will notify the user of the stove's temperature change and and help him / her return to the kitchen before the cooking burns that might cause a fire alarm to go off or a real fire itself.

# Prototype Design

The temperature sensor will be used to monitor the temperature of the four burners in the stove, and the smart cooking helping wearable sonifies the changes in the temperature of each burner and alerts the user of it. Based on the research, we have created a prototype. The prototype was tested on people and we surveyed the participants of the test. Based on the results of the Wizard of Oz test of smart cooking helping wearable prototype, we redesigned a new prototype to improve and complement the existing prototype's problems.

# **Prototype**

When the prototype is turned on, drum sound is played as the default. The drum sound indicates the average temperature of the burners that are on and is provided as a background sound once per second. The average temperature of the burners appears in the lower right slider. The higher the average temperature, the higher the pitch of the drum.

Each of the four burners has a different sound that users can distinguish. The temperature change of burner 1 is played in pipa sound, burner 2 is played in vibraphone sound, burner 3 is played in trumpet sound, and burner 4 is played in saxophone sound. The sound for each burner does not play if the burner knob is off. Each burner has its own knob at the bottom right of the prototype stove. The sound is played back in the order of burner 1, burner 2, burner 3, and burner 4.

The height of the temperature is represented by the number of plays, and the change in temperature is represented by a change in the pitch of the melody. When temperature does not change, there is no pitch change in the melody. When temperature rises, the notes of the melody gradually goes up, and when temperature drops, the notes of the melody gradually goes down.

When temperature does not change; if the temperature is less than 131 degrees, the major chord of c e g c is played once, if the temperature is greater than 131 degrees and less than 212 degrees, the major chord of c e g c is played twice, if the temperature is greater than 212 degrees and less than 325 degrees, the major chord of c e g c is played three times, and if the temperature is greater than 325 degrees, the major chord of c e g c is played four times.

When the temperature rises less than 10 degrees; if the post temperature is less than 131 degrees c and e are played back continuously once, if the post temperature is greater than 131 degrees and less than 212 degrees, c and e are played back continuously once and then the major chord of c e g c is played back, if the post temperature is greater than 212 degrees and less than 325 degrees, c and e are played back continuously once and then the major chord of c e g c is played back twice, and if the post temperature is greater than 325 degrees, c and e are played back continuously once and then the major chord of c e g c is played back three times.

When the temperature rises more than 10 degrees and less than 30 degrees; if the post temperature is less than 131 degrees c, e, and g are played back continuously once, if the post temperature is greater than 131 degrees and less than 212 degrees, c, e, and g are played back continuously once and then the major chord of c e g c is played back, if the post temperature is greater than 212 degrees and less than 325 degrees, c, e, and g are played back continuously once and then the major chord of c e g c is played back twice, and if the post temperature is greater than 325 degrees, c, e, and g are played back continuously once and then the major chord of c e g c is played back three times.

When the temperature rises more than 30 degrees and less than 60 degrees; if the post temperature is less than 131 degrees c, e, g, and c are played back continuously once, if the post temperature is greater than 131 degrees and less than 212 degrees, c, e, g, and c are played back continuously once and then the major chord of c e g c is played back, if the post temperature is greater than 212 degrees and less than 325 degrees, c, e, g, and c are played back continuously once and then the major chord of c e g c is played back twice, and if the post temperature is greater than 325 degrees, c, e, g, and c are played back continuously once and then the major chord of c e g c is played back three times.

When the temperature rises more than 60 degrees; if the post temperature is less than 131 degrees, c, e, g, c, and e are played back continuously once, if the post temperature is greater than 131 degrees and less than 212 degrees, c, e, g, c, and e are played back continuously once and then the major chord of c e g c is played back, if the post temperature is greater than 212 degrees and less than 325 degrees, c, e, g, c, and e are played back continuously once and then the major chord of c e g c is played back twice, and if the post temperature is greater than 325 degrees, c, e, g, c, and e are played back continuously once and then the major chord of c e g c is played back three times.

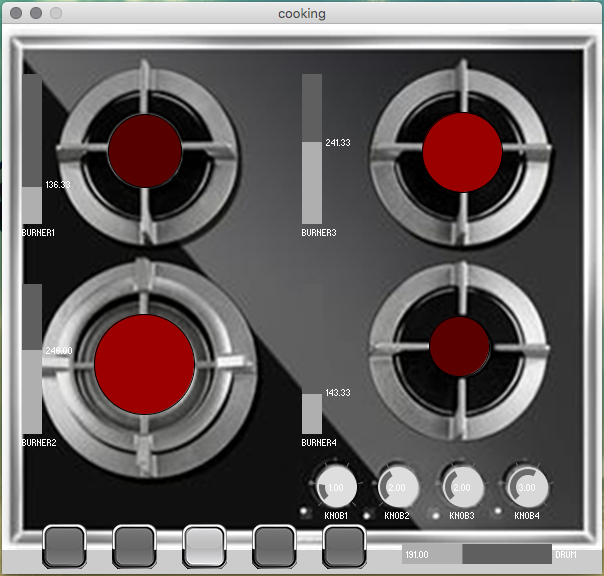
When the temperature drops less than 10 degrees; if the post temperature is less than 131 degrees e and c are played back continuously once, if the post temperature is greater than 131 degrees and less than 212 degrees, e and c are played back continuously once and then the major chord of c e g c is played back, if the post temperature is greater than 212 degrees and less than 325 degrees, e and c are played back continuously once and then the major chord of c e g c is played back twice, and if the post temperature is greater than 325 degrees, e and c are played back continuously once and then the major chord of c e g c is played back three times.

When the temperature drops more than 10 degrees less than 30 degrees; if the post temperature is less than 131 degrees g, e, and c are played back continuously once, if the post temperature is greater than 131 degrees and less than 212 degrees, g, e, and c are played back continuously once and then the major chord of c e g c is played back, if the post temperature is greater than 212 degrees and less than 325 degrees, g, e, and c are played back continuously once and then the major chord of c e g c is played back twice, and if the post temperature is greater than 325 degrees, g, e, and c are played back continuously once and then the major chord of c e g c is played back three times.

When the temperature drops more than 30 degrees less than 60 degrees; if the post temperature is less than 131 degrees c, g, e, and c are played back continuously once, if the post temperature is greater than 131 degrees and less than 212 degrees, c, g, e, and c are played back continuously once and then the major chord of c e g c is played back, if the post temperature is greater than 212 degrees and less than 325 degrees, c, g, e, and c are played back continuously once and then the major chord of c e g c is played back twice, and if the post temperature is greater than 325 degrees, c, g, e, and c are played back continuously once and then the major chord of c e g c is played back three times.

When the temperature drops more than 60 degrees; if the post temperature is less than 131 degrees, e, c, g, e, and c are played back continuously once, if the post temperature is greater than 131 degrees and less than 212 degrees, e, c, g, e, and c are played back continuously once and then the major chord of c e g c is played back, if the post temperature is greater than 212 degrees and less than 325 degrees, e, c, g, e, and c are played back continuously once and then the major chord of c e g c is played back twice, and if the post temperature is greater than 325 degrees, e, c, g, e, and c are played back continuously once and then the major chord of c e g c is played back three times.

The user can select and listen to background music through the buttons at the bottom. If the user does not want background music, the user does not have to play the background music.





# **Study Goals**

The goal of this study is to get feedback on: whether users can distinguish different sounds of the burners, whether the sonification helps users multitask between cooking and other, and whether the sonification is effective in informing users of what is happening in each burner while cooking

# Study Design

**-**Wizard of Oz evaluation

-Walk through a scenario with subjects

-Half control group, half test group

-Control group will run through procedure without distractions and only sonification

-Test group will run through procedure with distractions

-Ask subjects to think aloud

# Study Procedures

Explanation of Design:

1. Explain to subject which sounds are associated with which location of burner
2. Explain to subject what changes are made to the sound of burners with the change of temperature
3. Explain to subject what the background music is for

Task

1. Ask subject to put pasta on boil on the front left burner and start playing the associated sound
2. Ask subject to put stew on the right left burner and start playing the associated sound
3. Right away, ask subject to put boiling water for tea on the left back burner and start playing the associated sound
4. Right away, ask subject to put egg on the back right burner and start playing the associated sound
5. The tester should look at the timeboard and modify the sound as it changes
6. Change the sounds as time goes on and ask the testers to think aloud of what they think is going on

Distractions

1. When the subject puts pasta and stew on the burner, ask them to go to the bathroom and wash their hands
2. When the pasta reaches boiling sound, call out from another room and stall them with a fake emergency: youtube simulation of people fighting (2min).
3. When eggs are done, ask them to get the door for an imaginary guest

Task for tester:

1. Burner 1 (Tea): (not on for 3min) 3 min-130, 4min- 180, 5min- 212, 212 afterwards
2. Burner 2 (Pasta noodles): 1min- 120, 2min- 160, 3min- 190, 4min - 212, 212 afterwards
3. Burner 3 (Egg fry): (not on for 3min) 4min- 150, 2min- 230 (egg in- drop temperature 50), 3min- 280, 4min- 320, 5min -360 should be done (will burn if not turned off
4. Burner 4 (Stew):1min- 100, 2min- 150, 3min(subject needs to turn the heat to low at this point - 180), 4min (if subject turn it down 160, if not 200) - turn the temperature up and down 30F until pasta is done

# Measurements and Survey

During procedure, ask subjects to think aloud on:

1. Any thoughts about the tasks
2. What they think is nice about the sound system
3. How stressed they are - not really-some-very (measure at start, 5min in, and end)
4. What they do not understand or forgot about the sound (to see if they remember it or not, or to see if it is confusing)

After the procedure, ask subjects:

1. Was this audio system helpful for your cooking? hindering-neither-helpful
2. Did the audio sound effects distract your cooking? Yes or No
   1. If you answered yes for 2, how do you want it to be improved?
3. Were you able to notice the temperature change better with this audio system? Yes or No
4. Do you think it is easier to keep up with cooking while being distracted with tasks with the audio system? Yes or No
5. Were you able to distinguish 5 different sound effects? Yes or No
6. Do you want the sound effects to be delivered less frequently or more frequently? Less-good-more
7. What was the most helpful part of the sound system?
8. What was the most confusing part of the sound system?
9. Any comments?

# Findings

1. 5 out of 7 people found audio system helpful for cooking, 1 out of 7 found it not helpful
2. 5 out of 7 people found the audio system distracting from cooking
3. 5 out of 7 people were able to notice the temperature change better with the audio system
4. 5 out of 7 people found that it is easier to keep up with cooking while being distracted with tasks with the audio system
5. 7 out of 7 people found that they are unable to distinguish the different sound effects
6. 6 out of 7 people wanted the sound effects to be delivered less frequently
7. 4 out of 7 people commented on the drum being the part that should be improved
8. 3 out of 7 people commented on the temperature change sonification as the most helpful part of the audio system
9. 2 out of 7 people commented on the drum as the most confusing part of the audio system
10. 4 out of 7 people commented on the different types of sounds that represent different burners to be the most confusing part

# Analysis

* From findings A and C, we can conclude that the audio system was helpful for cooking in the part where they are able to notice the temperature change of their cooking.
* From findings B, E, and F, we can conclude that the audio system was distracting because there were too many different sounds being played too frequently
* From findings A and D, we can conclude that the part of the audio system where it helps people cook on the stovetop while being distracted is effective
* From findings G and I, drum sound proved to be the most improvement-needed part and even cause confusion
* From finding H, sonification of the temperature change was the most helpful out of other parts
* From finding J, the design of playing of many different sounds continuously at close speed was the top contributor for confusion
* Strengths: the change of temperature sonified by octaves going up was effective
* Weaknesses: understanding and listening constantly to the changing pitch of drum sound was perceived as a distraction and annoyance to most people; the constant loop of alerts playing was perceived too frequent to subjects

# Conclusion

The sonification of the temperature change by playing different octaves and repeated sounds to indicate the current temperature was received positively and was perceived as effective, especially when distracted. However, the drum that is supposed to change pitch and play constantly during the whole sonification was perceived with negativity, and was voiced as the part that should be changed if there should be any improvement. Also, the continued playing of sounds coupled with the playing of different types of sounds every 3 seconds was received with negativity and contributed to people’s negativity towards the whole sound system. So in conclusion, the negativity towards the part of continued playing of sounds and the part of different sounds assigned for different burners overrode the effectiveness of the temperature change sonification. Therefore, this is the part that needs most improvement, while the sonification of temperature sound change should be emphasized more compared to the prototype.

# Redesign Process

|  |  |
| --- | --- |
| **Negative/Ineffective parts** | **Redesign improvements** |
| Constant playing of alerts is too frequent | Notify the users with different octave only when there is a temperature change. Notify users when any one burner reaches 212F (boiling temperature) and 375F (frying temperature) by a long lasting, sparing alert. Goal is to alert user strongly but sparingly to make the user tend to the cooking. |
| Different type of sounds assigned to each of the 4 stovetops makes it difficult to know which is which | Unify burner alert into one sound(Vibraphone) to get rid of confusion since users can check which burner is boiling or on high heat by going to look at the burner. |
| The meaning of the drum pitch(average temperature) is hard to understand and even seem unnecessary | Remove the Drum sound, and change the pitch of the notification sound when there is temperature change. |
|  |  |
| **Positive/effective parts** | **Redesign improvements** |
| The way the different octave is played going up when the temperature rises | We will focus on having one octave sound change the pitch as the temperature rises and falls. We will notify the user sparingly when the temperature reaches a certain point and make the alert a higher pitch so that the alert is heard with more attention. |

# Redesign/Final Prototype

All of the alerts are now one type of sound only (vibraphone). Whenever there is a temperature change up in any of the burners, one sound that goes up in octaves is played. Whenever there is a temperature change down in any of the burners, one sound that goes down in octaves is played. When any of the burners reach a temperature above 212F (boiling temperature) but below 375F (frying temperature), two high pitch tones are played twice in 1min intervals starting from the time it reached the temperature. When any of the burners reach a temperature above 375F (frying temperature), three high pitch tones are played three times in 1min intervals starting from the time it reached the temperature. The high pitch sound alerts is to make the user be more alert of the sound and eliminate the need to play the sound constantly. The background music is set to optional for whoever wishes to implement it to be on for 3min time intervals.

# Final Thoughts

The reduction of negativity and the emphasis of positivity should have improved the audio system. Also, we must take into consideration personal preferences of people and accept that we cannot satisfy everyone but must work to satisfy the majority.

# Contribution

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|  | Dasom Eom | Ji-Won Jung |
| Work Plan | O | O |
| Brainstorming | X | O |
| Sample research | O | X |
| Sound samples>samples | O | X |
| Sound samples>sample2 | X | O |
| Survey Questions | O | O |
| Survey Result | O | O |
| Old Testing Scenario | O | O |
| Old Results from Initial Runthrough | X | O |
| Progress report | O | O |
| Progress Presentation | O | O |
| Outline<Modified after the Progress Presentation> | O | O |
| Modified Test Scenario | O | O |
| Sound samples>Soundsamples | O | X |
| Processing>cooking | O | O |
| Test Result Survey Questionnaires | O | O |
| Test Result Analysis | X | O |
| Processing>Final Prototype>cooking | X | O |
| Audihome\_cooking.mp4 | O | X |
| Final Report | O | O |