
Middie Mercury: An Ambient Music Generator for Relaxation

Ivan Sysoev

Georgia Institute of Technology
School of Interactive Computing
Atlanta, GA
jsysoev@yandex.ru

Ramitha D. Chitloor

Georgia Institute of Technology
School of Interactive Computing
Atlanta, GA
ramithachitloor@gmail.com

Ajay Rajaram

Georgia Institute of Technology
School of Interactive Computing
Atlanta, GA
ajay.rajaram26@gmail.com

R. Stephens Summerlin

Georgia Institute of Technology
School of Interactive Computing
Atlanta, GA
st.summerlin@gmail.com

Nicholas Davis

Georgia Institute of Technology
School of Interactive Computing
Atlanta, GA

nicholas.davis10@gmail.com

Bruce N. Walker

Georgia Institute of Technology
School of Interactive Computing
Atlanta, GA
bruce.walker@psych.gatech.edu

Copyright is held by the author/owner(s).

Audio Mostly 2013, September 18-20, 2013, Piteå, Sweden

Abstract

We describe a computer application for relaxation that is based on music generation following users' actions with a simulated drop of mercury. Rationale for the approach as well as architectural, algorithmic and technical details of the implementation are included. We also provide results of a user survey evaluating qualities of application usage experience.

Keywords

music, meditation, relaxation, interactive visualization, music generation, game, stress, interactive application

ACM Classification Keywords

K.8.0 General

Introduction

We describe an interactive computer application for relaxation that generates music based on users' interaction with a simulated drop of mercury. The application was conceived as a tool for reducing stress in everyday life. The concept of interaction is inspired by a meditation technique called The Water Exercise, described in Paolo Coelho's book *The Pilgrimage* [1]. In the original technique, a person spills a puddle of water onto a flat, non-absorbent surface and engages in an open-ended and playful interaction with the puddle using fingers. Our application, called *Middie Mercury*, is intended to mimic this process on a touchscreen display, with the addition of procedural melody generation determined by actions of the player. The latter was introduced in an effort to increase the immersiveness of the application, which we considered an important factor for stress relief.

Application Behaviour

Middie Mercury presents a visual simulation of a liquid drop that the user interacts with to generate ambient music. We model a liquid of high surface tension, which behaves more like mercury than water. On a flat surface, such a liquid condenses into droplets, which easily slide along the surface, merge with each other on collisions and can be easily split again through a mechanical movement. We consider such behavior a better fit for visualization on a computer screen.

Drops are programmed to behave in a physically believable way. For instance, a sharp movement of the finger through a drop will cleave it into several separate parts, while a smooth movement of the finger will push the drop in the direction of movement. To prevent drops from growing smaller during

the process of play, they are attracted to the center of the screen as if the surface they are on is slightly curved. Because of that attraction, they will gradually merge when left unattended. A visual of the application is presented in Figure

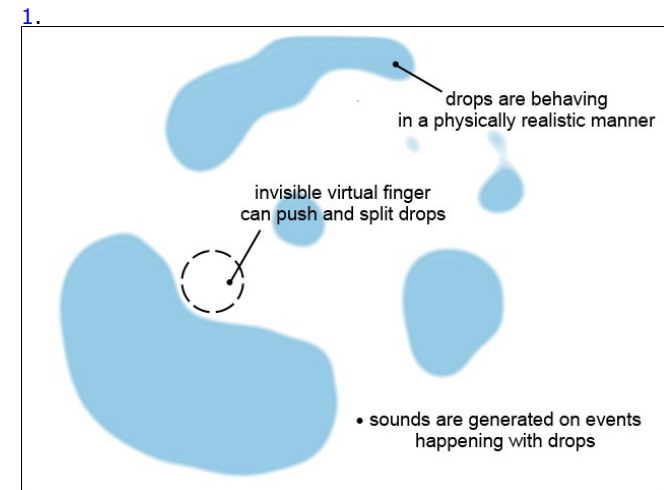


Figure 1: Application Interface

Sounds are triggered by events happening within and between the droplets. Currently, a sound is produced when a drop splits or when a number of droplets merge.

Implementation

Middie Mercury is a web-based application implemented using CSS, HTML5 and Javascript. The cross platform nature of the web makes the application more accessible to its users and facilitates a greater outreach.

Middie Mercury is composed of three components (Figure 2): the physics component, the visual component and the audio component.

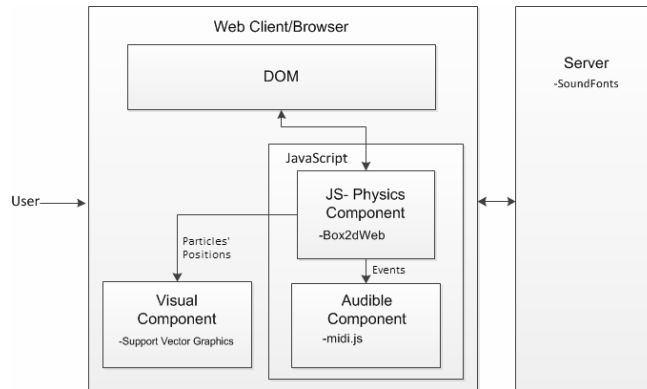


Figure 2: System Diagram

Physics

Incompressible liquid is modelled through a set of similar, non-overlapping circle-shaped particles of small radius. The particles' movements are affected by two kinds of forces: surface tension forces and central forces. In addition, Box2D calculates transfer of impulses on collisions between particles. 'Droplets' are formed by sets of particles located in close proximity to each other, where 'close proximity' means that the distance between particles is less than particular threshold. A circle of larger radius (with repulsive forces) follow the user's movements and acts as a 'finger' that interacts with the drop.

Visuals

The principle behind the visualizing the drops from its base particles is a kernel method: each particle is associated with a gaussian hillock, these hillocks are combined to produce a relief which is then thresholded to produce the outline of the droplets. The advantage of such a method is the continuity of droplets' border changes: a small displacement of the particles result in a small change of the borders.

The applied technique actually uses a modified version of the principle above, achieving the same effect with SVG filters (Figure 3)

1. Associate a black visual circle with each particle
2. Apply a gaussian blur to each circle and threshold to get the outline of the droplets
3. Apply SVG specular filters to provide the droplets with a 3D look
4. Apply a component color transfer to get the desired color of the liquid

We selected light shade of blue, as fitting for a gentle relaxation experience.

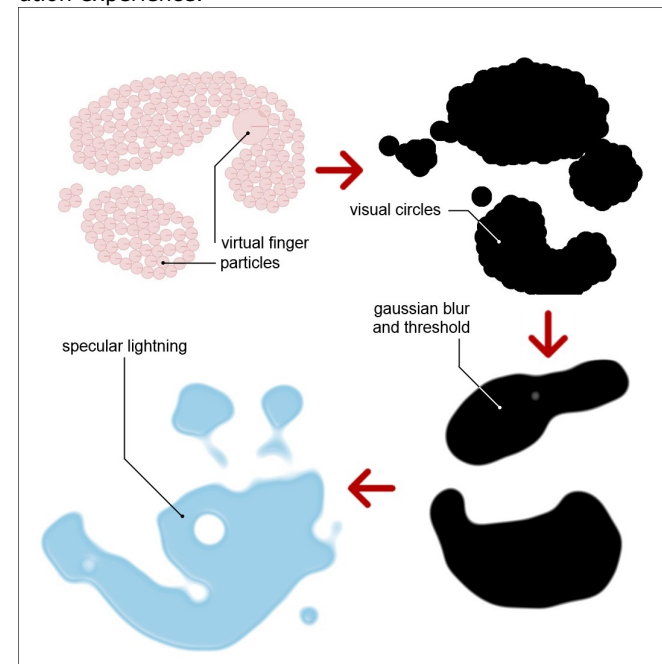


Figure 3: Visualization Stages

Sound

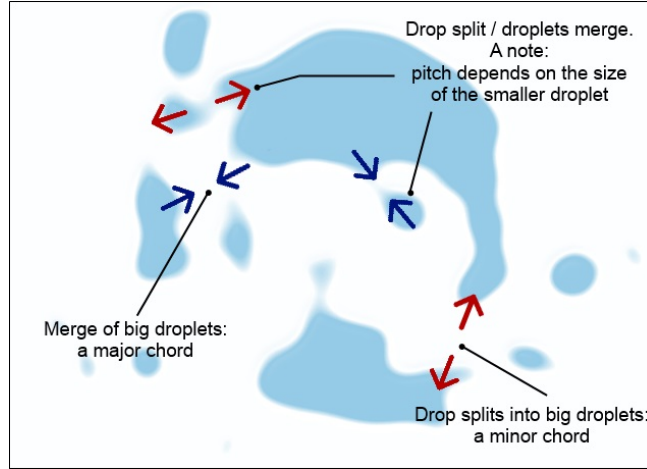


Figure 4: Sound corresponding to Events

Events of droplets merging and splitting trigger sounds according to the rules shown in Figure 4 and Table 1. Notes are taken from a single scale which was manually selected and encoded into the application. Piano sounds are a good candidate for the Middie Mercury audio component because they provide quiet and harmonious background melodies.

Event: No. of Particles	Sound Produced
Merge/Split: Small droplets (<20)	Note from scale in relatively high octave
Merge/Split: Intermediate droplets (20-50)	Note from scale in relatively low octave
Merge: Large droplets (>50)	Major chord (one of I,IV,V in selected key)
Split: Large droplets (>50)	Minor chord (one of II, III, VI in selected key)

Table 1: Events and Sound Mapping

User Evaluation

In order to evaluate Middie Mercury, we made it accessible on the Internet as a web page and asked users to take a survey powered by Google Forms. The application's web page provided very basic instructions (such as mouse movements can be used for playing with droplets) and did not give detailed explanations on how the system works. We believe that this was necessary in order to capture users' reactions without any preconceived biases. The survey included select-option-from-list questions to assess user qualities of the application and its suitability for relaxation. In addition, it had an open ended text box where users could provide additional comments to gain insights about such aspects of the application as its style, elegance and well-craftedness. Data was collected from 25 participants, the majority of whom consisted of students across different US universities.

How easy is it to create music with the droplet?				
Difficult	2	3	4	easy
21.74%	13.04%	13.04%	21.74%	30.43%

Table 2: User Study Question 1

From Table 2, we can see that the larger part of the users (51%) found the way of music generation with the application intuitively understandable. However, for some of them the connection between the interaction and the sound turned out to be unclear. It could be seen in some of the comments: "I didn't feel I had that much control over the music", "could not understand the pattern based on which the music got generated so was not able to make any custom music other than random sounds". It is important to note that Middie Mercury was not intended to be treated as an instrument for conscious music creation.

Did you find the system engaging? How many minutes did you spend playing with the droplet?			
0-1 min	1-3 mins	3-5 mins	>5 mins
20.83%	41.67%	16.67%	20.83%

Table 3: User Study Question 2

Since we supposed that immersiveness is an important factor for a relaxation application, we tried to figure out how immersive Middie Mercury is. We assumed that the time spent for playing with the system can be an objective indicator of immersion degree. The results (Table 3) show that nearly 40% of the users played with the system for more than 3 minutes. Since the time needed to get familiar with the system estimates in about 30 seconds, we can say that they were to some extent engaged with the interaction. One comment was: *"In the whole quite an impressive application. I was truly engaged playing with it for about 5 - 10 minutes"*.

	Yes	No	Maybe
Would you use Middie Mercury again?	53.85%	38.46%	7.69%
Would you use this as a relaxation tool?	30.77%	61.54%	7.69%

Table 4: User Study Questions 3 4

Relaxation qualities of the application were assessed through two questions (Table 4): whether the user would like to use it again, and whether he/she would like to use it for relaxation. A surprising result was that while 58.4% of the users said that they would use the system again, only 33% said that they would use it as a relaxation tool. The rest of them considered the system as a game or as an application for fun. For instance, we encountered comments: *"I think I was especially engaged by trying to work out how the system mapped actions to sounds"*, *"I played it more like a game. I am curious to know how Middie mercury works!"* Some

participants provided advice on enhancing the gaming side of the application, for instance, *"Add social widgets to allow people who likes it to share with friends"*.

User comments give us important insights on how relaxation qualities of the application can be improved. Two problems hampering relaxation experience were reported: (1) Low frame rate, caused by SVG taking a lot of time to apply filters. (2) Too aroused sound style, as reflected in the following comment: *"It was nice to hear the calming parts of the music, but then I would hear the loud bangs from the piano and that 'ruined' my relaxation I was in"*.

Discussion

Experience of implementing Middie Mercury provides some insights into creating applications for relaxation. One is that significant attention should be paid to potentially disruptive details such as sudden, unexpected events (as piano "bangs" mentioned in comments), or too aroused-sounding music instrument. In particular, piano turned to be not the best choice of instrument for our application.

Another interesting observation is relatedness of relaxation and immersive qualities of application. User study results suggest that people who found the application immersive and people who found it relaxing were generally the same. Making the application more immersive was one of our design objectives. The means to facilitate it were combining audio, visual and kinesthetic perceptions in a single interaction process and making interaction process continuous and smooth. In fact, the disruption of smooth interaction by low frame rate was one of the reasons for poor relaxation qualities of existing prototype. It highlights the importance of continuous interaction for relaxation application.

User study revealed potential uses of Middie Mercury as a game or amusement tool. A useful step in this direction would be creation of multi-user version of the application. In a multi-user version, different players would be able to take up parties of different instruments and synchronize efforts in order to achieve melodiousness sound.

In addition to everyday relaxation, the immersive and creative interaction offered by Middie Mercury may be useful in clinical applications, such as stress relief for child medical care.

References

- [1] P. Coelho, J. Arias, and A. McLean. *Paulo Coelho: Confessions of a Pilgrim*. HarperCollins, 2001.