UPPSALA
UNIVERSITET

Human Computer Interaction

Final report on Emotion Control Earphones

Group 17

January 18, 2020

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1 Introduction

Music is a universal experience. music tends to hit on us a deep level. One cannot deny the power of music. Music can improve our mood, quality of life, and self-esteem. Whether it is sad music that helps us feel relatable when we are going through hard times or joyful music.
The Journal of Positive Psychology conducted a study in 2013 that discovered that individuals who listened to music could be classified as happy and upbeat and were able to improve their mood and overall happiness in just a few weeks.[1]

> " *Music is so naturally united with us that we cannot be free from it even if we so desired.*"
> — Boethius cited by Storr[2]

This year the projects which was asked for was on designing a wearable devices or small handheld devices that adapt to a user's emotional state.

2 Persona

Here, we describe a persona, whose character may tend to use our device to improve their lifestyle and relieve stress. Some pointers about the character of the user are:
Demographics:

- 20 years old, an undergraduate student in Computer Science.
- Lives in Uppsala, Originally from Stockholm, Sweden.

Identifiers:

- Stressful schedule with assignments and deadlines to follow.
- Unstable social-life as he is an introvert.
- Poor Emotion management.
- Familiar and proficient with the latest technology.
- Loves music.

Goals:

- Release stress and anxiety.
- Submit assignments on time.
- Manage emotional health.
- Satisfy the love for music as music helps him calm down.

Challenges:

- Unable to manage his emotions.
- Difficulties in meeting his deadlines causing anxiety.
- Unable to manage time and is exhausted every day due to stress.

3 Scenario

Erik is generally tired after a cumbersome day at his university but he has presentations and assignments to be completed for the following days. Despite of having less energy in his body to focus and complete his work, he cannot ignore the work. On his way back home he uses the Emotion Control Earplugs to calm himself and regain some energy by relaxing his mind therefore when he returns home, he can directly start working instead of taking a break to relax and make use of his time efficiently.
He is more productive and hardly misses his deadlines to complete his work since he has started using the Emotion Control Earplugs.

The earplugs made a difference in Erik's life as he was able to manage his emotions better by using his emotions statistics available on the application for this device which records your previous emotional health data and analyses it to help the user to control their emotions more efficiently in the future.

4 Elicitation Phase

4.1 Group Meeting

As per the course requirements we needed to develop a project focusing on wearable devices or small handheld devices that adapt to a user's emotional state. To start working for the project and getting the individual ideas on what and how to implement, we started with a group discussion. We came up with multiple ideas. After a little brainstorming, we concluded that we need to develop a prototype that helps control the emotions of people.

So, we decided to build a music device that detects the emotional state of a person and helps to calm them by playing the music depending on their emotions. But before proceeding towards the development of the product we had to make sure that our idea is good and the product that we are going to design will help improve the emotional state of people. So for that, we decided to conduct some surveys and follow some theories related to this. These theories are mentioned further in this article.

4.2 Surveys

We wanted to conduct the surveys in the real world so, we started with explaining our product idea to participants and asked a few questions related to our product development phase. Some of the questions were:

1. What is your mode of commuting daily?
2. Do you listen to music while commuting?
3. Why do you listen to music?
4. Which genre do you mostly listen to?
5. Does listening to music change your feelings?
6. What do you think of our product?
7. Do you think this product will benefit you?

4.3 Interviews

Initially, we had interviewed three people who may use our product and the following shows their responses and lifestyle stating if they are willing to use our device or not and some general questions were answered.(Their real names are not mentioned as per their request).

Interviewee A:

- I am from Syria and studying Masters of Computer Science with a specialization in Embedded System at Uppsala University.
- I use the bus as a means of transportation and spend around one hour daily.
- Due to the weather at Uppsala, I feel a little depressed at times.

- I listen to music during my entire travel journey. I listen to metal and rock music.
- Listening to this genre music makes me feel energetic and motivates me to study and I feel happy.

Interviewee B:

- I am from Greece and I'm studying Masters in Embedded System at Uppsala University.
- I use the bus and train to commute everyday. I travel from Stockholm every day to Uppsala. I use the train and the bus. I spend around 3 hours in travel every day.
- Travelling makes me tired and I enjoy listening to music during this time.
- I also have a lot of assignments to complete and I listen to music at home while I do them.
- I listen to metal, rock and reggae mostly. Listening to music makes me feel happy and relieves me of my tiredness. It keeps me going especially when I need to concentrate.

Interviewee C:

- I am from India and studying Masters of Computer Science.
- I mostly use the bus but sometimes I walk. I usually spend around 2 hours everyday in travel.
- I have lots of chores to complete everyday. I get tired at the end of the day and I listen to music to keep me calm.
- I listen to music when I travel. I listen to pop and R&B music.
- Listening to music gives me energy and gets me going. I listen to music when I feel stressed. Listening to my music sometimes reminds me of some good times I have had and keeps me happy.

After explaining the details and uses of our product, the interviewees concluded each of the following points:

- A: I really love this product. I would use it in the morning when I wake up and while commuting. I would also use it when I feel low. It's going to make me feel happy and keep me entertained.
- B: This product seems really interesting and since I listen to music most of the time. It's going to help me stay focused in what I do everyday. I'm sure this is going to help me as I love music. I am excited to see how it goes.
- C: I enjoy this product and the idea behind it. I found it to be a smart solution as it is just like my earphones, but it helps me track my emotions and keeps me happy when I feel low. I enjoy music and this is a cool device.

5 Design

"*Being human-centered is an additional cost to any project, so businesses rightly ask whether taking so much time to talk to people, produce prototype designs and so on is worthwhile. The answer is a fundamental 'yes'.* "

—**David Benyon**

After the elicitation phase, we came up with two prototype designs. First design uses a wired connection to send the data for processing to the mobile application. It has a sound source via wired headphones and an EEG (Electroencephalography) sensor attached to detect the brain waves. EEG sensor is placed on the forehead for detection as it needs a minimum of two contact points on the scalp for detection of brain waves.

The second design is a much smaller design and it scans the brain waves using an EEG sensor which is placed on the back of both of user's ears. It sends the data for processing to the mobile application wirelessly. It has a sound source to play the music via Bluetooth earphones.

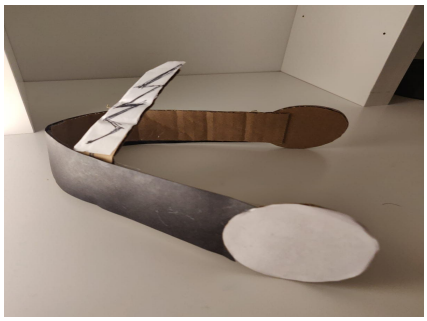

Figure 1: Prototype 1

5.1 Prototyping

Our first prototype was a pair of headphones made using cardboard and coloured papers and some tape. It was made as headphones with a sensor attached on top (EEG sensor) made by cardboard. As shown in **Figure 1**.

Figure 2: Prototype 2

The second prototype was made with an improved design by adding a wireless feature and a portable design with earphones and an EEG sensor. Same materials were used to make the prototype for this design as well. As shown in **Figure 2**, two black earphones with sensors meant to be held up behind the user's ear, is shown.
We decided to choose the second prototype as it transmits signals wirelessly and it is a portable design that adds a comfort level to the user. It is also a stylish and fashionable design as recommended by our users.

The mobile application with our prototype designs are based on D.Benyon's 12 design principles[3] as stated in the following points:

Visibility and Affordance

Our mobile application follows D.Benyon's[3] 12 principles as the functions and features are mentioned very clearly in the application. Options like selecting the mood, settings and user account details with other options are visible on the application. The device is specifically designed to detect noise-less brainwave

signals and interpret them to play music and change the user's mood or feeling accordingly.

Navigation and Control

Navigating between the pages of the application is very simple. The user can effortlessly navigate through the pages and find the required option or features they are looking for with the help of well defined buttons. This gives the control exclusively to the user. The user can also change the settings from the emotion/mood detection mode to a music mode to use it as ordinary earphones. In the emotion/mood detection mode, the device plays music according to the user's mood.

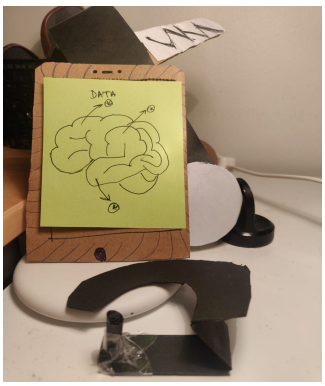

Figure 3: Application

Feedback and Recovery

If the application does not work for a user, i.e. when they are not able to manage their emotions with its selection of music, the user can report it in the application and it will generate an error in the learning algorithm of the application and try to solve the error by using another approach to learn from user's data and play preferred music for the user.

Familiarity

The application has been designed to be very user friendly. There are several symbols and common phrases that are used to make it more interactive for the user. Certain icons have also been added for simplicity. The Prototype of the device is also designed to be very

Figure 4: Application

Flexibility and Style

The mobile application is flexible as it is available in different languages and allows the user to select each sub-options in the app and customize their playlists. The wireless design is very stylish as well. It has a comfortable ear hook as a sensor and a stylish look.

6 Experience Design

These factors involve the engagement of the user with the product. Increases the interaction of the user and the platform.

- Design to ensure the safety and privacy of the user.
- Usability is made effective and efficient to keep the user satisfied.
- Individualization to optimize the pleasure of each user.
- Overall pleasurable experience for the user.

Learning's : Emotions are central to decision making. Emotions are important for motivation and attention. The hierarchy of design needs is useful in building an idea and a tool used for analysis[5].

"*Music is the universal language of mankind.*"
—Henry Wadsworth Longfellow[8]

6.1 Cognitive Walkthrough

1. Will the user try and achieve the right outcome?
-The user can achieve the right outcome, which is to manage the user's mood or emotional state by listening to the suggested music on the application. The suggestions are made using the user's emotion detection while listening to music.

2. Will the user notice that the correct action is available to them?
-The user will be very well informed through our mobile application that will display all the required data and the analysis of user's past emotion detection data. The application will make it very easy for the user to notice any changes within themselves or their routine.

3. Will the user associate the correct action with the outcome they expect to achieve?
-As the application is smartly designed, the algorithm will keep the user informed about their progress, achievements and history of emotions.

4. If the correct action is performed, will the user see that progress is being made towards their intended outcome?
-Yes, the user is always well-informed due to emotion data analysis performed by the mobile application's algorithm.[4]

7 Feedback and Evaluation

We conducted some user tests. We also got some feedback during the seminars. The following changes were mentioned by different users:

- Data can be protected by adding a login page. This will maintain the privacy of the user.
- Multilingual application.
- More control can be given to the user by expanding the range of emotions in the application.
- Connect or link another music app that the user has already been using. For example, Google play music, Spotify.
- Add a mechanism to detect when the user is going to be stressed according to the historical data analysis.
- The sensor on the headphones are bulky.

Based on the information we received form the feedback changes in the application,as well as the product, were made.
Adding a login page will give the user privacy for his data as they will have to log in with a password every time they access their app. This is an advantage because the emotion data can be used against the user to manipulate their emotions.
Giving privacy to the user makes it more secure. Making the app multilingual opens the app to a larger number of users from all over the world. It helps the device reach in every part of the world. Users feedback suggested to add more emotions to the list to be analyzed by the application.
Linking other music platforms to this application can expand the range of users as people use different platforms in different parts of the world. It gives an option to the user to choose from multiple platforms. A historic database of all the user's emotion data will be made available as the user can monitor and check various statistics to assess the user's emotions.
This helped us to design faster and effectively.

8 Application Design

Principles like similarity were implemented in the design of our application where we decided to keep certain things like the font and icons on the application. The focal point principle was also used as we made less use of capital letters in our application. Proximity was also one of the principles that were followed as we arranged all the elements that are being displayed clearly and simply so that people do not tend to group different elements.[11]

- The users start off by opening the application which brings them to the login page. Registration for security. (**Figure 5**)

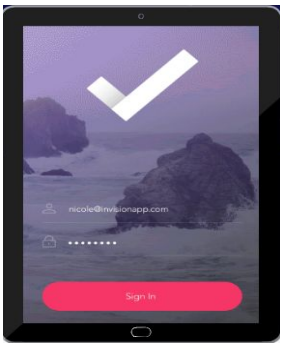

Figure 5: Registration

- Select language and link with the music platform to get music. Make a list of the music. (**Figure 6**)

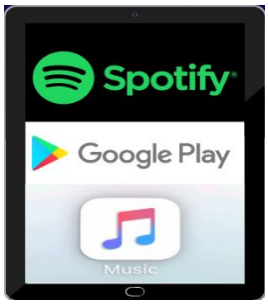

Figure 6: Sync Music Player

- Option to activate the EEG (Electroencephalography) sensor and display the list of emotions. (**Figure 7**)

Figure 7: Activate EEG

- A tutorial on how to use and control each emotion is present to educate the user about the application. (**Figure 8**)

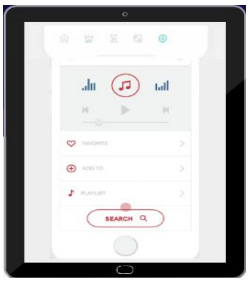

Figure 8: Music Sort

- User's emotion gets detected and analyzed. Appropriate music suggestion and linking occurs. (**Figure 9**)

Figure 9: Music Algorithm

- Track all the data and analyze stats using real-time. Manage emotions with your favorite music. (**Figure 10**)

Figure 10: Options

9 Final Design

After all the experiments and surveys conducted by us, we finalised the design using some theories mentioned in articles which are referenced below.
Our project is a prototype design of a set of earphones with an EEG sensor that detects the brain waves of the user according to which it helps reduce stress and tries to change the emotional state of the user. To design this, user review and feedback was important as it helped us to add more features to the design to optimize it.

Benefits of Prototyping is that It improves user communication, where the user has a brief idea about the performance and design of the product[13]. One way to make the prototype better was to involve the user in the process of prototyping. This was done by knowing the requirements of the user and interacting with the user. The interview taken in the initial phase helped us to know what the users expect from the product and are mentioned further in this report. Our Prototype is a Horizontal Prototype where we have shallow details of the earphones with some specifications required to demonstrate the outlook of the device. The prototype design was helpful for us to explain and understand the functionality of how the sensor would look like and what other options we could have to protect the sensor and not affect the functionality.
Experiments like recording the change in state of emotions of a participant while playing different genres of music to understand the behavior of the user's mindset with different genres were conducted.
We improvised our product by understanding the flow state of a user[10]. This helped us improve our application's music playback algorithm that understands the mood of the user by recording their brainwave (Using EEG sensors) and playing music accordingly that improves their mood or releases stress.

"*Intuitive design is how we give the user new superpowers.*"

—Jared Spool[6]

As developers, the first thing we must learn is what the users want. Emotions are the most to be considered. People seek personal happiness and pleasure all over everything.User feelings are directly related to the design. It is very important to make the user enjoy the design so that they don't lose interest and end up not using the product.To keep the user in the flow they must feel the pleasure and enjoy the product. It is necessary to keep the user in the flow but there is never a situation where two users experience the same thing in the same way and get equal pleasure. Since the experience

cannot be the same for all the users, we developed an interactive design for a broader audience that offers multiple choices for the user's preference.
User-centric design methodologies were also used in developing our idea.[14] After we interviewed and collected information from few individuals as part of the elicitation phase, we then used to brainstorm and decide the prototypes. After this, the prototypes were presented to individuals and some feedback was collected after which we made the final changes to our prototype.

Figure 11: Final designs

These theories helped us improve the design and functionality of our application[12]. The application does not have more than seven items per screen and the images/icons in the interface are placed towards the left for the user to process image better. The color combination of the background, icons, and the user interface does not have bright colors instead it has calmer colors like mauve, light blue, white, etc. The application use-cycle i.e. how the user navigates in the app to reduce movements, like scrolling or clicking, is well thought off before implementing the application which reduces the cognitive load on the user. The same principles are also included in the earphones design to have calmer colors, and reduce motor movements and give better control to the user. Implementing such theories presented in the articles increased our user's likability towards the product and the application.

10 Conclusion

We started by brainstorming on how to solve the problem of reducing the stress level and enhancing people's emotional state and came up with a device that understands the emotional state of a person and plays music accordingly to calm the user's mind and enhance their emotional state.
Every aspect of the device was well thought to improve the user experience. Using a User-centric approach, the chances of identifying problems in time to do something increases consequently, the chances of producing usable software increases[9].
The mobile application also follows certain principles that help the user to feel relaxed at all points while using the application. Some of the design principles mentioned in the articles can be related to the emotion control earphones that we designed during the course.
User-centric design methodologies were used in developing this idea[15]. The prototype is designed in a way that it is comfortable for the user to use it every day of their lives to manage their emotions or just use them as regular earphones.**Figure 11** shows the final design of both the prototypes. The one on the right(earphones) is the portable version of our prototype.

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