Connection

A music sharing & emotion detection ball that allows users to communicate moods with others through various physical interactions

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Concept & Problem space

From cassette tape to iTunes, the way of playing and sharing music have been shifted from physical to virtual. Recently, smart speaker has brought a screen-free interaction, and the mental detection AI may help to sort out music based on our emotions, so that we can promptly and easily share our feelings through music. The future music streaming would more likely be immersive, collaborative and artificial intelligence. With the improvement of society, people have suffered more mental pressure than before. Those living alone, struggling with work and life tend to rely on more mental support and emotion detection in the social community. While nowadays, emotion detection technologies are limited according to the research[5], we attempt to create a novel way of communicating moods through music and connect people with their families and friends remotely. And CONNECTION is such a smart device with basic functions as follows:

1.Mood music: touch and play relevant songs based on your mood

2.Share or not: choose whether to share this song (positive or negative mental conditions) with others

3.Remote interaction: remote users receive lights feedback and touch to join in your songs

4.Share music, communicate feelings physically and remotely by using emotion detection technologies

5.Promptly receive other's emotion through music, integrate emotions from sharer and listeners and provide emotional comfort/support (change melody or note) anywhere/anytime

6.Touchable interaction that creates a novel approach to share emotions

Target users: individual use with partners, families, friends, relatives, roommate, classmates, workmates, schoolmates, other people with close relationships

Space: household, including living room, garden, bathroom, bedroom...and other personal spaces

Related works

• Audiovisual installation translates emotions into beams of light[1]-A device transforms the emotions of participants into different forms, colours and intensities of light. This device is equipped with multiple sensors to record brain waves, heart rate and galvanic skin response to analyze data of user emotions.

• The mood reflecting floor[2]-An interactive floor can display different patterns according to the user's emotion that were detected by different body language such as fast and powerful movement.

• Solo: "The Emotional Radio"-[3]Solo can recognize the user's facial expressions and play the music that matches the user's mood.

Link to video on YouTube

https://youtu.be/bwEPWWMTuLs

Design Process

Inspiration

In the initial stage of the project, we got inspiration from some existing physical computing examples. Our initial concept was deeply inspired by "Urban Lights Contacts"[4], which is a touch, sound and light interaction device that transforms the participant's body into a human musical instrument. Around the key inspiration, we generated the idea of a device that modulates music through touch interaction.

Brainstorming & Initial idea generation

We used several research methods including brainstorming and mind mapping to generate ideas in the team according to the target audience and the theme of music modulating. We have obtained many new ideas on aspects of domain problems, physical interaction and space. After this, we generated initial concepts, which is a music ball with touch and remote interaction. There will be no response when the first user touches the ball, but the ball will play music and respond to lights when more users join in and touch the skin of the first user. Also, remote users can touch the wall to add more sound effects to the ball.

Online Survey

In this stage, we aim to identify potential users and investigate their favourite music types, experience of listening to music and attitudes to music sharing. We have changed our concept based on the survey results that users' positive attitudes towards music sharing. Remote users can join the music that they received from other users' sharing.

Literature Review

Purpose: Explore the novel technologies related to music communicating feelings and emotion track.

Our project was inspired by Cespedes-Guevara[5], the view of "music not merely communicates basic emotions, but related to constructivist account" has inspired us to explore how music expresses core emotions and how to influence listeners' mental status. Our idea of developing concepts from the perspective of music expression and emotion detection was inspired by Maestri' research[6] that proposed to analyze human-computer interaction from a musical perspective. The several technologies of music emotion tracking and detection proposed by Lie Lu[7] provide support for our project to build emotion detection function and evaluation.

Interview

Based on the previous quantitative research, we conducted interview to further investigate the relationship between music sharing and emotion communication, and the reason of sharing or not sharing emotions with others. Most of the feedback on the mood that participants want to share is positive. There are also participants who are concerned about the types of moods that can be shared and the possible impact of sharing bad moods. Based on these attitude on good and bad emotion sharing from participants, we optimized our concept to make the remote user can comfort user who shared music that expresses the bad mood.

Prototype build

In the prototyping stage, we used the skill of soldering and Arduino to build our prototype. We have considered the modules and sensors that need to be used according to our concept (see Appendix 6).

- Speaker: The device plays different types of music according to the user's physical interaction.
- Light: The LED strip varies with the vibration of sound.
- Pressure sensor: Users can interact with the ball by squeeze, touch, shake, throw and roll with different pressure values.
- GSR sensor: Measure the electrical conductance of the skin to detect users' heart rate.
- Accelerometer: Measures the vibration and acceleration of motion of a structure to detect users' movement.

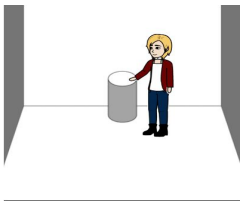
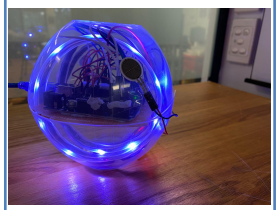
After coding and soldering, we used transparent plastic shells and Arduino components to complete the final installation.

Bodystorming

Purpose: evaluate the main functions and interaction flows. Collect information on users requirements. Obtain feedback on functions for improvement of the next iteration.

In the prototyping stage, we have conducted some tests to explore the user's attitude towards our prototype. We tested the user's feelings when listening to the music samples to obtain music that can accurately express the user's different emotion. Also, we acted how users would interact with the device when they are in different mood to get the better interaction mode.

Design Process

Version (sketch)	Source (feedback)	Outcomes	Solutions & Requirements	Iterative Changes
Initial 	Feedback on the context of use from the conversation with teachers Online survey & interview (see Appendix 1&2) relevant to the users' attitudes towards music sharing	1. A modulating music device with playful interaction that can people can play together 2. Public in a small group 3. 2 or more participants	Perform second round qualitative research including semi structured interview based on the previous quantitative research	Change the context of use to public in a small group Add the music sharing function. The user can share their favorite musics on the ball. The remote user can receive the music shared by the user and join.
First 	Feedback from the conversation with teachers	1. A music sharing instrument 2. Private and personal places 3. Families and friends	Perform user research to improve the next iteration based on the concept Data analysis and documentation	Limit domain space Narrow down potential users Focus on the specific domain problems
Second 	Feedback on the methods of mood detect from the conversation with the tutor Feedback on emotion communication from interview	1.Combine multiple elements to detect emotion 2. Glass may be broken when the user is anxious	Design Low-fi prototype Perform user testing including bodystorming based on the newly proposed method of physical interaction	Add a variety of physical interaction methods including shake, hug, pat and squeeze to allow users to express their mood Change the material of the ball from glass to plastic
Current 	Boystorming was conducted in the prototyping stage to understand the user's preference for the music type and interaction method	1.Music that expresses bad mood makes users feel worse 2.Single music makes users tired 3.Different strength of users affects physical interaction	Design and develop digital prototype with main function of emotion detection Perform second round user testing to improve the next iteration	Realize remote interactive function (in the next iteration). The join and comfort from the remote user can change the music if the user shares a bad mood Add pressure test when the user uses it for the first time

Interaction Plan

Interaction paradigm

Connection is a Ubiquitous Computing technology that combined computational capability of emotion detection with a series of sensors or microprocessors. It provides a novel way of mood music sharing. It can be used at any time, in any places. Nowadays, as the number of people with mental pressure is increasing, we hope this device can be regarded as a healthcare technology that people can get mental support from connecting with their families and friends through music.

Interaction flow

1. Detect the user's emotion through three ways, and play the corresponding music and lights

User A touch: the emotion detection sensor is working, the ball play relevant songs based on the mood after receiving user's emotion data

2. Choose whether to share the mood music with friends/family

User A touch: the emotion detection sensor is working, the ball play relevant songs based on the mood after receiving user's emotion data

3. After sharing, remote ball receive the same music and lights feedback

User B touch: receive mood music and light from User A

User B shake/rotate/wave: light shining, provide mental support such as change sad music to happy melody and send to User A (This function will be built in the next iterative prototype)

According to the responses from the bodystorming (see Appendix 4), we found that different user interactions represent different emotion.

Touch the ball: calm (5/9)

Shake the ball: energetic (5/9)

Throw the ball: angry (5/9)

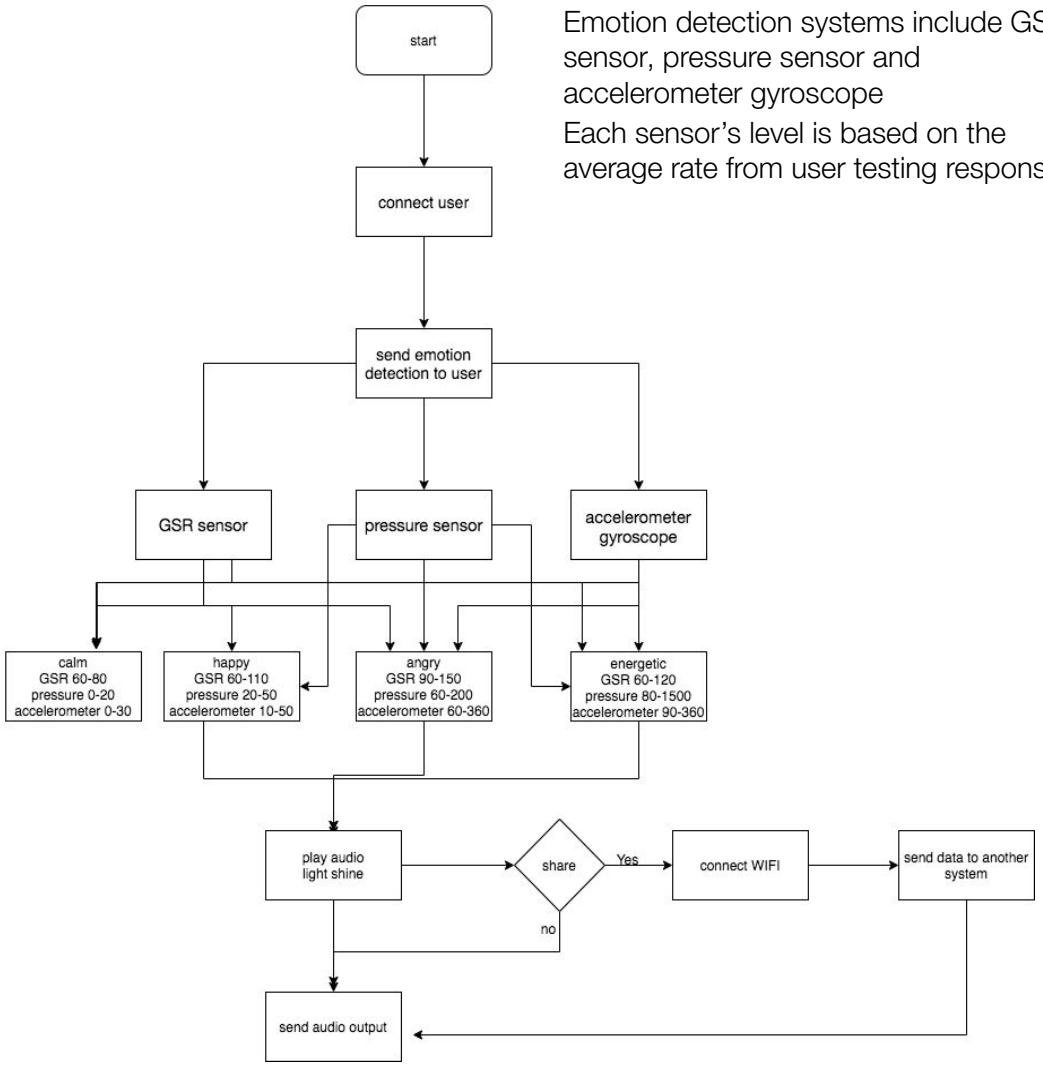
Roll the ball: happy (5/9)

Based on the data, we decide to evaluate users physical interaction in three parameters including heart rate, touch pressure and rotation rate to ensure music and light feedback in high accuracy. These three parameters can identify user's four emotions including calm, happy, angry, energetic. Each parameter should be at a certain level.

System interaction structure

Emotion detection systems include GSR sensor, pressure sensor and accelerometer gyroscope

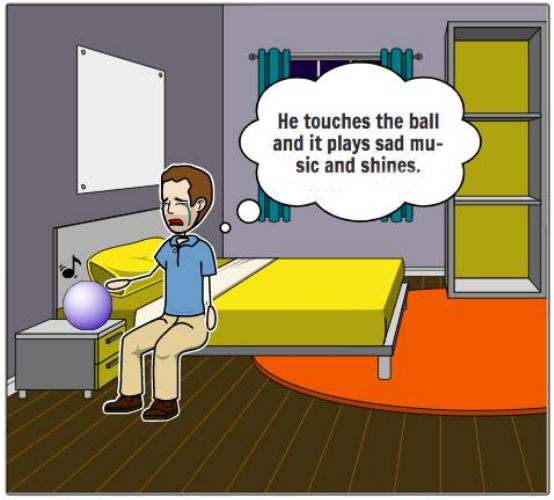
Each sensor's level is based on the average rate from user testing responses



Interaction Plan

User journey

Harry felt sad one night, because he broke up last week.

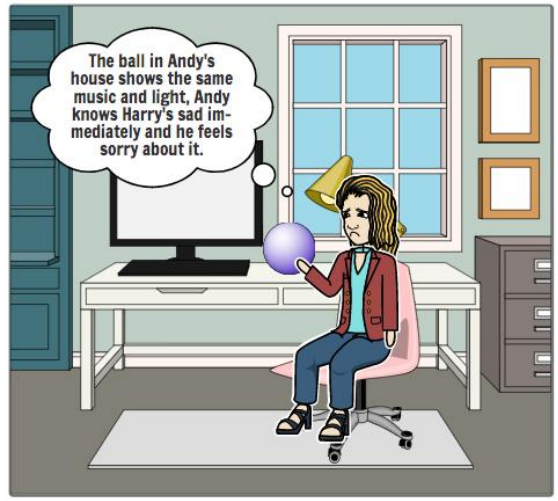


He touched the ball. The ball detected his mood and played a sad song.

The ball was shining. He shaked it and shared this sad song to his friend Andy.

Andy's ball was shining that means he received the song sharing from Harry.

He touched the ball and listen to this sad song.



He felt sorry about Harry and sent a calm melody to him.

Project Objectives & Success Criteria

Objectives		Success criteria	Measures
Physical construction: develop the complete function and display full functions on the final Exhibit	All sensors work smoothly	The accuracy of the sensors more than 90%	Prepare same type of sensors or different sensors with same applications to ensure every function works, check Arduino and electricity circuit connection, program and coding debug before Exhibit, perform effective hardware testing with users
	Emotion detection works well	80% of users can input mood successfully with different interactions The matching accuracy of music and user mood reaches 90%	Conduct user evaluation and record the process of emotion detection activity Explore users the feeling when they listen to the music after interacting with the device through bodystorming and think aloud Compare the data received from the GSR sensor with the users response to see if they have a gap and change the algorithm of emotion learning functions
	Remote interaction works well (music and emotion sharing with light & music feedback)	85% of users can successfully complete remote interactions within 30 seconds 50% of users are attracted by remote interaction and willing to share music/emotion	Record the number of users who use the remote interaction function and the time they complete the whole process Conduct bodystorming to explore user's behaviour and attitude towards remote interaction (how to join others music sharing activity and how to comfort others) Summarize and analyze data collecting from the users for further research and iterations
Research and Evaluation: Find potential users and willing participants in a proper way Collect data and users feedback for iteration through effective and efficient evaluations Provide academic support for final product		Go through every physical evaluation activity smoothly no longer than 2 hours Collect useful data that can be used in our project, Effective data and data usage rate must be higher than 80% Data documentation should be completed promptly within one day after receiving data	Start early research, investigate the target audience through interview or survey and keep in touch with them Plan a strategy for users authority, every evaluation activity should be voluntary with users consent Propose guidelines and regulations related to privacy and security If users worry about security and privacy, provide a way for them to make choice use this function or not Use Miro to record data as team journal after conduct evaluation activities
Project management: Finish final prototype on time or correspondence with the timeline Well cooperate with other (internal and external) team members		Each member should engage in team project minimum 20 hours weekly Follow the task plan, 100% complete each task on time, 100% submit assessment document before due date	Start early and organize the progress two days behind timetable Weekly progress report to the team member and tutors and get feedback Review the work achievements for the previous week Plan a task list for the work need to be completed in the coming week by using Gantt Chart project management (see Appendix 5: Gantt Chart)

References

[1]Dezeen, *Audiovisual installation translates emotions into beams of light*. 2017. https://youtu.be/8FkBA3xTne0

[2]visualcraft, *The mood reflecting floor - Interaction design project*. 2014. https://youtu.be/JOg4chJAgn8

[3]Guardian News, *Solo, the "emotional radio" that plays music to suit your mood*. 2017. https://youtu.be/-8nVJ3Zz_SE

[4]Scenocosme Gregory - Anais, *Urban Lights Contacts - oeuvre interactive - Scenocosme : Gregory Lasserre & Anais met den Ancxt*. 2016. https://youtu.be/P_NQXJ-XDVU

[5]Cespedes-Guevara, J., & Eerola, T. (2018). Music Communicates Affects, Not Basic Emotions – A Constructionist Account of Attribution of Emotional Meanings to Music. *Frontiers in Psychology*, *9*, 215. https://doi.org/10.3389/fpsyg.2018.00215

[6]Maestri, E. (2017). A Typo-morphological Approach to Human–Machine Interaction Analysis in Music. *Organised Sound*, *22*(3), 315–323. https://doi.org/10.1017/S1355771817000474

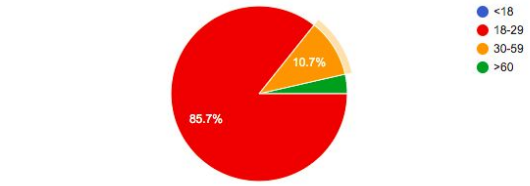
[7]Lie Lu, Liu, D., & Hong-Jiang Zhang. (2006). Automatic mood detection and tracking of music audio signals. *IEEE Transactions on Audio, Speech and Language Processing*, *14*(1), 5–18. https://doi.org/10.1109/TSA.2005.860344

Appendix 1: Online Survey

https://docs.google.com/forms/d/e/1FAIpQLSf6YjWdU3bkb_9b1s4X0nE1e0jEG27CjXjSk5PtmphAK9L2Rw/viewform?usp=sf_link

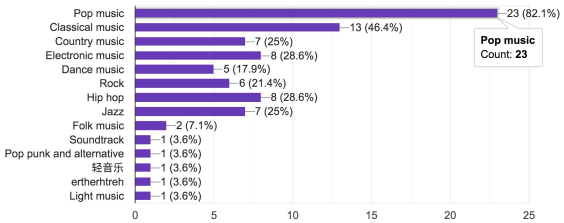
1. What's your age?

28 responses



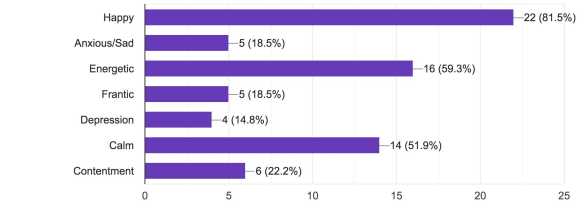
2. What types of music do you like best or you find yourself listening to most?

28 responses



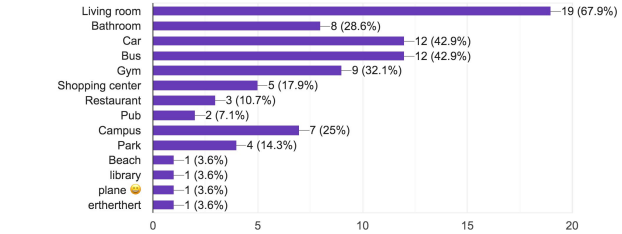
3. What is your mood when you listen to this kind of music

27 responses



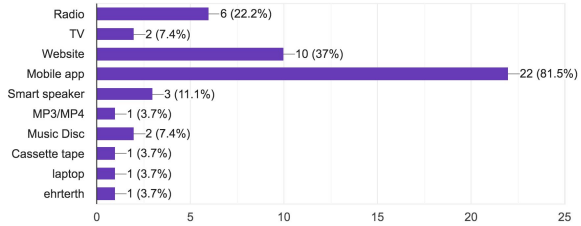
4. Where do you listen to your favourite music?

28 responses



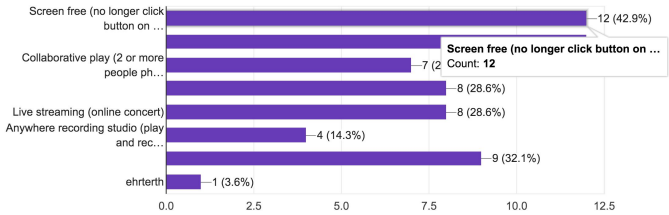
5. What are the ways you listen to music currently?

27 responses



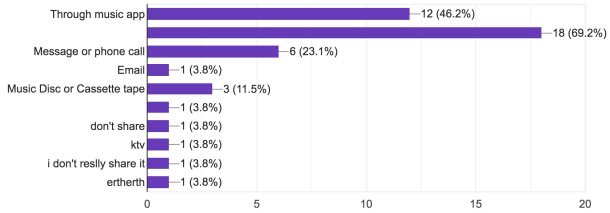
6. About the way of listening to music, which technologies would you like to experience in the near future?

28 responses



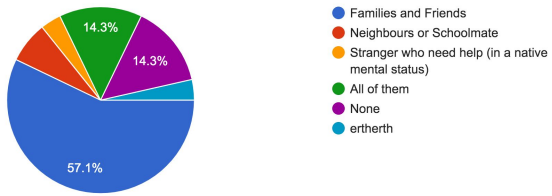
7. How do you share your favourite music?

26 responses



8. Who do you want to share your favourite music with?

28 responses



9. Why do you want to share music with them?

18 responses

share good things and feelings

because I want to share my happiness

There is a moving story behind it or its lyrics is what I want to say

Hope them can enjoy the same music

music is art

Share mood

I do not like share music with others

Sometimes, they want me to share music since they feel good.

don't - music ia already easily accessed by most

share my feelings with them

It's good

they like my music

I always share the music I like to my friends because we like the same type of music.

So they can listen to the songs i like and i can listen to the songs they like

the music is good

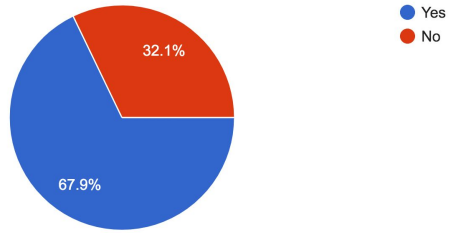
ehrewh

Show my feelings to sb. through a song, for example show my love to sb., or apologise to sb.

music bridge gap

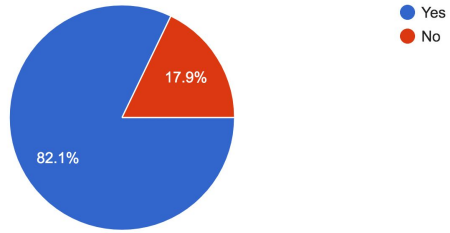
10. Can you play a musical instrument?

28 responses



11. If you and your friends can play musical instruments, would you like to play with them?

28 responses



Appendix 2: Interview Transcript

https://docs.google.com/document/d/1Urva2tSQmAKaccqLtAdVJrG_0AvCQtGG0hNS0AaThDQ/edit?usp=sharing

date

15-04-2020

research approach

Semi-structured interview

onsite/remote

Remote

name

Participant 1

gender

F

age

24

institute and dept

UQ Business (Hotel and Event Management)

position

Student

Location

Australia

"1. Who do you often share music with? What type of music would you like to share with them, why?"

I would like to share songs with my friends on online social media. Well, it depends on my emotions. Usually, I prefer to share happy songs and fresh songs that we all enjoy, because I know what type of music my friends like. We both enjoy pop, country and blues, and our favourite stars are Maddie & Tae, Ray Charles...Yeah, that song named *Georgia On My Mind.* Well, when I heard this song in a coffee club once, I messaged my friend, Lily. I want to share my relaxed and leisure feelings at that moment.

"2. Have you tried any smart technologies to track your emotions? If so, what are they?"

Not sure. I don't know any emotion detection devices, but I have used Apple Watch to detect my heart rate for health evaluation.

"3. What do you think of emotion sharing through music?"

Well, I think music is a good way to communicate with others with happy or sad feelings. When I need to apologize to someone, I like to share one song to say Sorry. When I am in a good mood, I want to quickly share my happiness through music.

"4. What's your favourite song? Why do you like it?"

I like many country and blues music, piano songs such as Canon. I also love Canon in cello as well. It makes me calm down and feel relaxed.

"5. When do you mostly listen to it, in positive or negative mental conditions?"

Along. Just enjoy myself in my individual time. I think most of the time I was happy when listening to this song.

"6. If there is a technology that can detect your emotions, play mood based music and share with others, would you like to try? Why?"

Yeah, I think I will try it. It seems interesting and I want to experience how accurate it would be to detect my feelings and I want to further explore music that is relevant to my emotions in different situations. And I also want to share my feelings with my best friend. It will be interesting and playful if I can share music with lights.

date

15-04-2020

research approach

Semi-structured interview

onsite/remote

Remote

name

Participant 2

gender

M

age

26

institute and dept

UQ ICTE student (Information Technology)

position

Student

Location

Australia

"1. Who do you often share music with? What type of music would you like to share with them, why?"

Friends and families, such as my best friend Tom and my little brother John, are most people I share music with. I love pop music, so I like to share pop music with them. There is a moving story behind it or its lyrics is what I want to say. And I want to share good things and feelings with them.

"2. Have you tried any smart technologies to track your emotions? If so, what are they?"

Yes, I have tried VR physiological treatment last semester. It is our course project that we use camera to read users face for emotion detention. But it is not as successful as we expected because the deep learning algorithm is very hard to use.

"3. What do you think of emotion sharing through music?"

Oh, I think it is really cool. So interesting and it is really a novel way to share feelings but how to detect people's mood is a tough thing.

"4. What's your favourite song? Why do you like it?"

I like pop music and my favourite singer is Jay Zhou. I love all songs from him and he makes me remind of my young age. It makes me feel happy.

"5. When do you mostly listen to it, in positive or negative mental conditions?"

When I was in the high school, I always listened to these songs with my classmate, at the moment of doing homework, reading books, or playing basketball.

"6. If there is a technology that can detect your emotions, play mood based music and share with others, would you like to try? Why?"

I would like to try, but what it is used for? I am concerned about what kind of music or emotions it would be shared. Actually, I don't want to share my bad moods. And I would rather share happiness and joy with my dears.

Appendix 3: Evaluation Protocol

https://drive.google.com/file/d/1liUMOTN4sxoNkA5JWMx9qDfNV0aU6Zlg/view?usp=sharing

EVALUATION PROTOCOL

Evaluation ID	TEST001
Creator	Xiaodan Liu, Liqian You, Ziyi Xu, Zhiyuan Zhang, Zhutianyu Yu (Team Pop5)
Date	16/04/2021
Purpose	• Evaluation of the main functions and interaction flows • Collect information on users requirements through prototype interaction • Obtain feedback on functions for improvement of the next iteration • Make guidelines and decisions for the construction of the final product
Prototype	Link:
Participants	Shelly, Shane, Liu, Vincent, and Peiwen

Preparation

1. Digital/Video prototype
2. Consent forms
3. Task sheet (PDF file)
4. Video camera
5. Observation sheet

Introduction

I appreciate your volunteering time for this evaluation activity. Today, I am going to collect your feedback on the physical experience of the digital prototype in the situation for ideation. I will investigate how smoothly you use this device, how well you understand the process of interaction, and whether there are any struggling with the device.

First, let me introduce this product. Connection is a music ball that can detect and share the mood of the user. The system will first play the music that matches the user's mood. After that, the user can choose whether to share this piece of music and lighting with remote users. Remote users can choose to join or comfort this user after receiving the information.

Music can represent and communicate different types of emotions. According to the chart below, we can find that music with various intensity, timbre, pitch and rhythm show different feelings. In this project, we need to collect data of users' emotions, including happy, exuberant, energetic, frantic, anxious/sad, depression, calm and contentment. So, you are asked to complete several tasks to express your feelings when listening to some different types of music and analyze your physical interaction with the ball. Please note these data are only used for research, we won't share your personal information with the public in any form.

Mood	Intensity	Timbre	Pitch	Rhythm
Happy	Medium	Medium	Very High	Very High
Exuberant	High	Medium	High	High
Energetic	Very High	Medium	Medium	High
Frantic	High	Very High	Low	Very High
Anxious/Sad	Medium	Very Low	Very Low	Low
Depression	Low	Low	Low	Low
Calm	Very Low	Very Low	Medium	Very Low
Contentment	Low	Low	High	Low

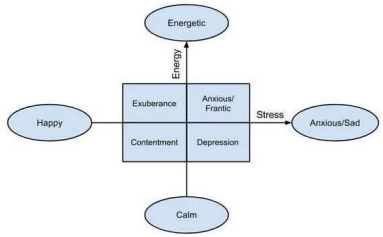
Now, you are asked to complete a consent form, which tells you the purpose of this evaluation and how to use these data. This is a voluntary activity and if you have concerns or feel uncomfortable, please let me know and feel free to stop at any time. I am going to evaluate the interaction flows and functions to improve the design and development, but won't evaluate you in any condition through this activity.

Consent

(Participants read through and fill in and sign on the consent form. I sign my parts.)

Thank you for your consent and just a reminder, you are allowed to withdraw from this activity at any time.

Task Instructions



In this section, you are asked to play 4 different types of music. Please use any interaction you like to play with the ball and tell me which type of music do you mostly listen to or favourite when you in the following moods. Please write down the number below.

a. Energetic / Exuberant:
b. Happy/ Contentment:
c. Anxious/Sad:
d. Calm:
e. Angry/Frantic:
f. Depression:

Please match the physical interaction modes with the functions in your preference:

a. Touch the ball	1. Energetic / Exuberant
b. Shake the ball	2. Calm
c. Hold the ball	3. Happy/ Contentment
d. Throw the ball	4. Angry/Frantic
e. Squeeze the ball	5. Anxious/Sad
f. Roll the ball	6. Depression

Task notes

Roles

Facilitator	Ziyi Xu
Videoing of the Task	Ziyi Xu
Observations of the person & discussions	Ziyi Xu
Recording time and steps (interaction flow)	Ziyi Xu

Body Storming

In this activity, You can write down any remarks/feelings on the paper or speak aloud when you interact with the ball and get music responses. I will record anything you provide for the device. Here is the link:

Other Questions

Finally, I want you to answer three questions for further investigation:

1. What's your general idea about *Connection*?
2. Where are you confused about or what do you think should be improved?
3. Do you consider *Connection* is helpful? Why?

Closing

This is the end of the evaluation, thank you again for your participation and for providing valuable data. Please note you are free to withdraw anytime in the process of activities.

Bodystorming Observation Notes

Participant	**Date: 23/04/2021**
Shelly	Observations

Appendix 4: Body Storming Notes

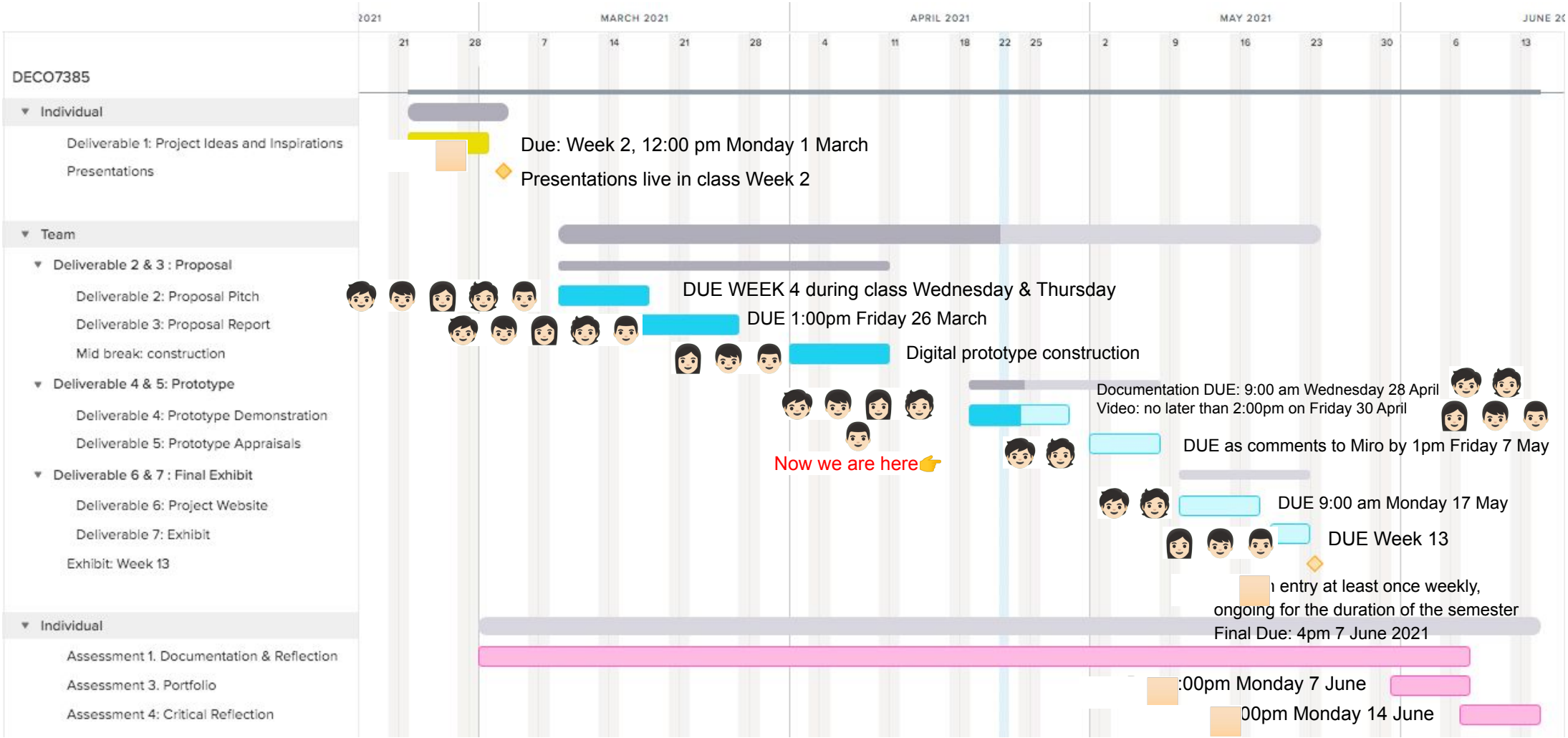
https://miro.com/app/board/o9J_lJIJxpQ=/

	Kaylee	Tong Jia	Hao Guo	Zu	Kristen	Flora	Danni	Shun	Viki
happy/contentment	roll the ball, throw it	shake it	throw it up/between two hands 960	touch gently 60	rub it 256	pat gently 15	pat gently 15	pat 850	roll it 10
energetic	throw it up and catch it	throw it up and catch it	throw it higher 1000	throw it up 950	throw it away and get it back 20	shake 900	pat 25	shake 940	throw it 800
anxious/sad	hug it	laid down my head upon it	laid down my head upon it 600	laid down my head upon it 1000	hug it 850	touch slowly 5	touch 10	throw it on the wall 1000	don't touch
calm	hold it in my hand and roll it	touch or push it	roll it on the desk 700	don't touch	hold it 10	throw it up 950	don't touch	throw it on the wall 1300	roll it with my hands and pay attention to it
angry	hit it	throw it out hard	hit 1500	throw it on the ground 2000	throw it on the ground 1000	throw it up hard 2000	hammer it 80	throw it everywhere 2000	throw it on the wall 1500
depression	similar to sad	hug it in my arms	similar to sad	similar to sad	shake it 10	squeeze it hard 1000	touch it with a finger 8	roll it 300	throw it away 900
									
What's your general idea about Connection?	I think it's good which can help me release emotions.	It's fun to play by myself but the share function is not my interest.	Good idea. It would be better if people from other places can do something to the users, such as comfort him/her. And the interaction with the ball can be more fun, for example, the light can vary with the touch.	I think the remote interaction is better because people usually know their emotions. And if the user is already very angry, won't playing angry music make him/her more angry?	I like the remote interaction which can let my families know my emotions in time. It enhances the efficiency of communication. For example, if I had a very bad day and don't want to talk at all, it can me express myself and my families won't bother me.	It can release my emotions. It may disrupt others if it makes a sound suddenly but I think the good friends and families don't mind.	interesting	the light is fantastic, looks high-tech	It's good and people can know your emotions in time which can reduce conflicts.
Would you like to share emotions with others? What kind of emotions? With who?	Yes; I'd like to share positive emotions like happiness, but I prefer digesting bad emotions by myself. With my friends.	No, I don't want to be bothered by others;	Yes; Sad (depends on different situations), happy, angry (may), fear (depends)...All in all, I'm more willing to share positive emotions, whether to share negative emotions depends on different situations. With friends mostly. I don't like to share bad emotions with my families because I don't want them to worry. But I can share it with intimate friends as they usually care about me.	Yes; Positive emotions; Friends or families.	Yes (Avoid conflicts); All; Families, friends, partners even strangers (welcome to chat with me if I'm happy; don't annoy me if I'm angry)	Yes; Happy; Good friends;	yes all families and friends	yes 30% positive and 70% negative emotions parents and few friends	sometimes depends on different situations with intimate people
Where are you confused about or what do you think should be improved?	I don't want to share some emotions sometimes.	Users should be able to choose whether to share their emotions or not.	Visually, there can be more interactions about the shape of the ball. The ball can be bigger and softer to comfort users. It can also have a character such as puppy.	It's better to let users' friends do something to users, such as comforting. One user can only put one remote ball in other place? Can he/she put different balls to different friends' home?	If these songs don't change, I may get tired of them and don't want to play it at all.	The difference of light and music between different emotions should be big.不同情绪下灯光和音乐的区分应很大 The light of different emotions should be different. 灯光颜色不同	appearance: users can paste their favourite stickers	touch of the material should be improved 像皮球那种手感更好	it would be great if there are different types of shape or light I can choose. 个性化定制 硅胶材质会更好 appearance can influence the interaction of users 灯最好平均分布在球内部
Do you consider Connection is helpful? Why?	Yes. It can help me release emotions.	Yes, very interesting to play with.	Maybe, at lease it's very playful.	Actually, it will help more if the ball can be squeezed a lot. Of course, if the goal is to share emotions, it's fine to just letting others know your emotions. And your friends/families may call to ask.	yes, it can improve the efficiency of communication	If the appearance of it is more attractive, such as stuffed toys, it will be more useful.	my movement of the same emotion may be different everytime.	may I may use it when I'm boring, but when I'm extremely happy or sad, I may forget it.	It would be great if it can show whether the user's mood is healthy, because sometimes the user does not realize that his/her mood is not healthy. And a reminder is needed.监测用户情绪是否健康，出现异常及时提醒，预防心理疾病

Issues

Sad is similar to depression
Playing music in an angry mood makes users feel more angry, sad as well
If the music does not change, users will get tired of it
There is a big gap of physical interactions between men and women (with different strength)

Appendix 5: Gantt Chart

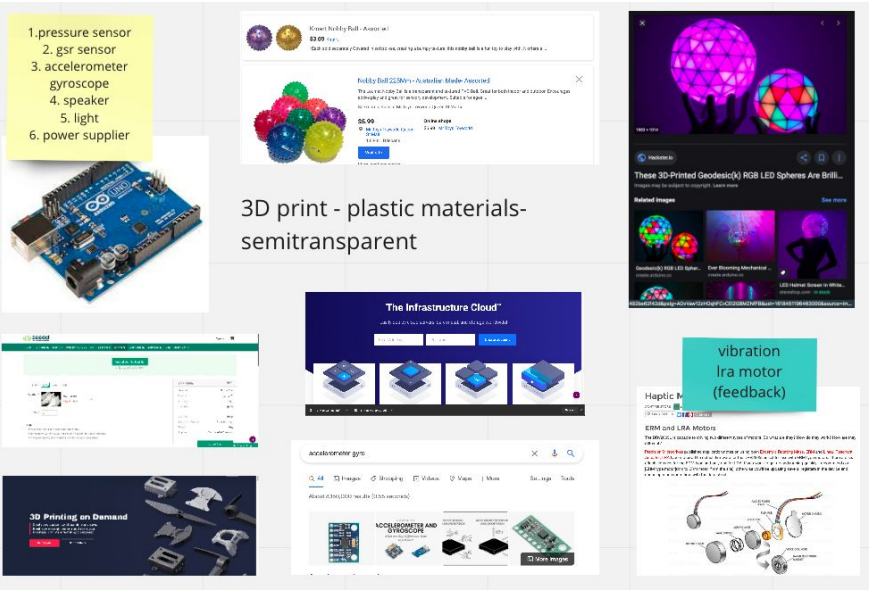


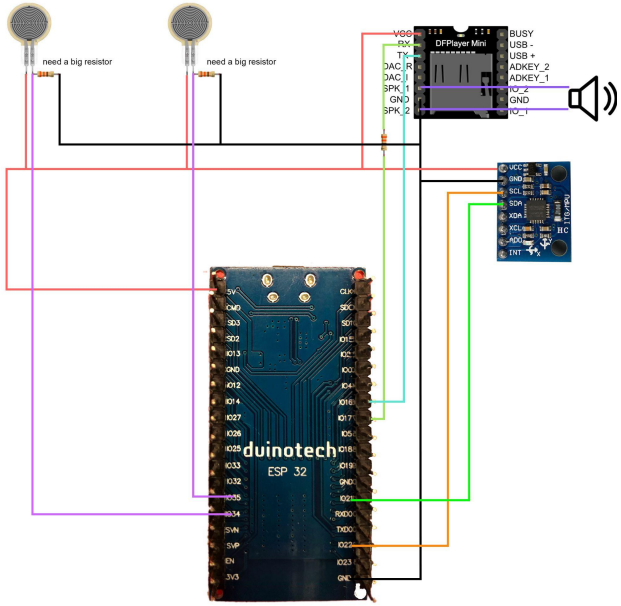
Zhiyuan Zhang Ziyi Xu Zhutianyu Yu (Construction & Exhibition)

Xiaodan Liu Liqian You (Design & Documentation)

Appendix 6: Prototype build

https://miro.com/app/board/o9J_lJIJxpQ=/






```
Users > candlinyou > Desktop > final2.ino
1   //NOTE:-ADJUST/SET BY POTENTIOMETER OF SOUND SENSOR IF LESS NUMBER OF PATTERN OBSERVE
2
3   #include <FastLED.h>
4   #include "SoftwareSerial.h"
5   #include "DFRobotDFPlayerMini.h"
6   #include "Wire.h"
7
8   // LED and sound sensor
9   int r=152;
10  int g=0;
11  int b=10;
12
13  #define LED_PIN     5           //CONNECT DATA PIN OF PIXEL WITH 5 NUMBER PIN OF ARDUINO
14  #define NUM_LEDS    16          //CHANGE THE VALUE IF YOU WANT TO USE DIFFRENT NUMBER OF LED
    IN YOUR STRIP,HERE IN MY STRIP NUMBER OF LED IS 60 SO I SET IT 60.
15
16  CRGB leds[NUM_LEDS];
17  CRGB led[NUM_LEDS];
18  int s=0;
19
20  // DFPlayer
21  static const uint8_t PIN_MP3_TX = 2; // Connects to module's RX
22  static const uint8_t PIN_MP3_RX = 3; // Connects to module's TX
23  SoftwareSerial softwareSerial(PIN_MP3_RX, PIN_MP3_TX);
24  DFRobotDFPlayerMini player;
25
26  // accelerometer
27  const int MPU_ADDR = 0x68; // I2C address of the MPU-6050. If AD0 pin is set to HIGH, the I2C
    address will be 0x69.
28  int16_t accelerometer_x, accelerometer_y, accelerometer_z; // variables for accelerometer raw
    data
29  int16_t gyro_x, gyro_y, gyro_z; // variables for gyro raw data
30  int16_t temperature; // variables for temperature data
31  char tmp_str[7]; // temporary variable used in convert function
32
33  // // set up a flag to determine if the music has been played
34  bool isMusicPlayed;
35
36  // smoothing factor (moving average declaration)
37  const int NUMREADINGS = 10;
38  int reading1[NUMREADINGS]; // declare a int reading array with the size of NUMREADINGS
39  int reading2[NUMREADINGS];
40  int readIndex1 = 0;
```