THE HONG KONG POLYTECHNIC UNIVERSITY
香港理工大學

COMP 5517

Human Computer Interaction

Subject Lecturer: Dr. Grace Ngai

Final Project with iCatch
-Musician Chairs

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1 Introduction

For this final project for Human Computer Interaction, our group designed a prototype of a ubiquitous computing environment by integrating iCatch with sound input and output devices on laptop. To be creative, our product allows users to communicate with computer by sitting position and spoken language.

Instead of using keyboard and mouse as input, user can talk to computer by nature spoken language and sitting position in our designed environment, and computer will response to users by English, Mandarin and Cantonese and adjust the volume of music player according to users' sitting position. To actualize this environment, a sensor of iCatch is embedded on the chair which will provide computer information about the distance between chair and human body. A prompt response to the user's position from the system is provided via the volume of the music and also change of LED light which enhances the clearance and effectiveness of the system's response.

There will be much fun when our system is applied in multi-users environment. Different chairs are represented with different music instruments; there will be different combinations of music tracks when different seats are occupied. Users can experience the feeling of playing music in a band or orchestra.

In this report, motivation of the system design, detailed description on the system development and functions, user tests results and discussion, and evaluation of system will be presented.

2 Motivation

Computer, which brings a lot of modern entertainment products, could also be integrated with classical entertainments. Many people enjoy listening to music when they would like to escape from their busy daily life; playing music by our own will be even more fun. However, that requires techniques and practices. How can we make more people get the chance to be a “music player”? Music changes when the position and power of players’ figure changes, our system does not allow users to change the tone and pace to ensure the output music is enjoyable, but allow different combination of sound from music instruments and change of volume to let user experience the change of music when they change their positions. We also designed the nature language communication to free the users from keyboard and screen and make necessary instruction.

This system can be used in various occasions in daily life. Two examples are discussed here. Education institutions and families can use this system in music appraisal education and stimulate the interests of children to music. Instead of just seating and listening to the music, children can play around with different chairs. This education model could make the classic music less boring to children and even develop their interest in it. Caf é and restaurant could use our system, especially music themed business, so that the background music of the caf é can be change by guests. The more guests, the more complete the music piece is. Our system could also save labor cost by providing welcome message via the system when it is detected that a guest is entering the caf é or restaurant.

When using our system, a single user will hear the welcome message and instruction from the system, may try to change the volume by moving their body and seat on different chair to hear the different sound of instrument. If there is more than one user, users can by to combine music tracks by sitting on different chairs. In our prototype system, there are three tracks embedded. So that the max people for playing will be three. The system will be better to developed with some support from music professionals to design how to separate the whole music into a certain number of music tracks.

3 Description

3.1 Hardware Specification

Our device is including the following stuffs.

Personal Computer x 1

Personal computer is connecting all Zigbee connector. It will runs program once receive data or signal from Zigbee.

Zigbee connector x 2

Zigbee connectors are connecting to personal computer for short-range wireless data transfer with iCatch.

Power supply set x 2

It will put in each chair for provides power to light sensor and LED matrix module.

Light sensor x 2

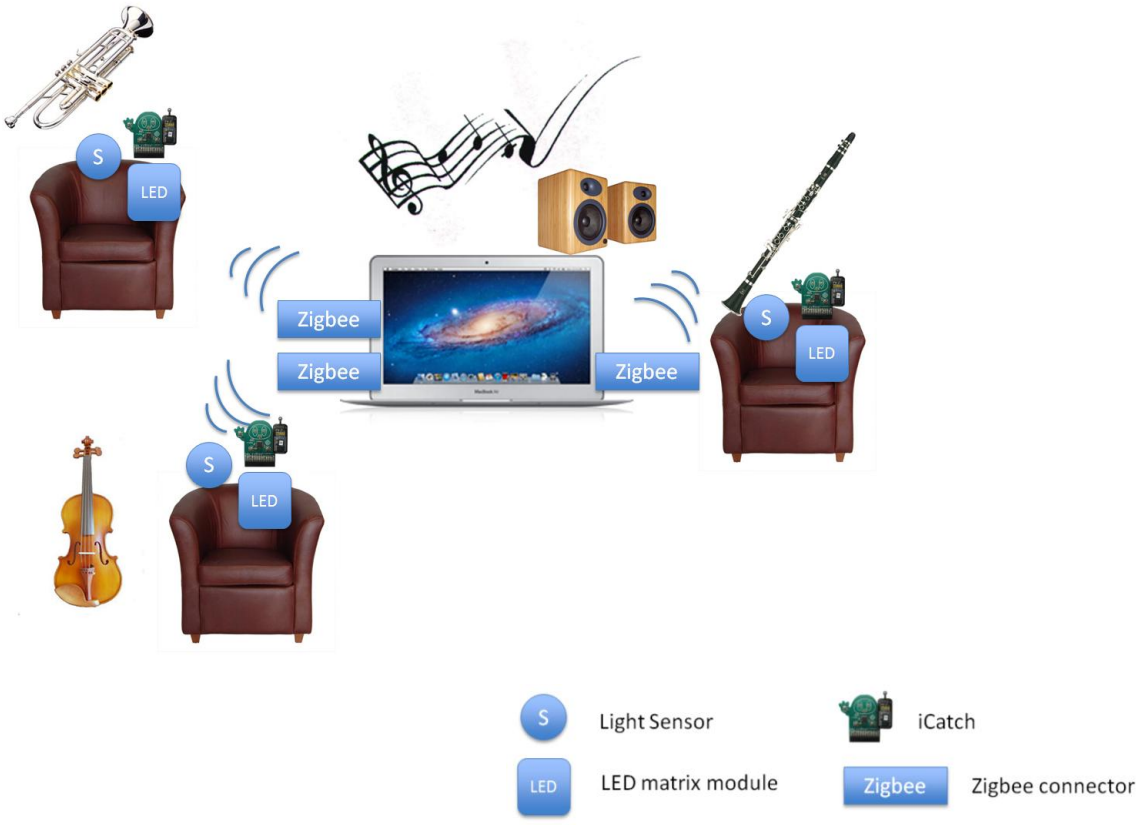
Light sensor is putting on the chair to detect light. When someone sitting on the chair, the sensor cannot detect light, then the iCatch will call the program and the instrument music sound track will comes out.

LED matrix module x 2

LED matrix module is putting near the chair for display the volume signal of that instrument music sound.

3.2 Device Design

User movement is the main input of our device, when user sit on a chair, the light sensor detects no more light, when Zigbee received the data about light sensor signal, program will be run automatically; first will comes out greeting with English, Cantonese and Mandarin language and operating instruction, then one music instrument sound track will be played. When another user sits on next chair, the next music instrument sound track will be played together. Once the user leaves, that sound track will be stopped. Our device can add on more set of iCatch within 6 meters distance and design picture is as follow:



3.3 Program Structure

We use Java programming language, iCatch and sound Java library to develop our device as Java is fast, secure and reliable. Our device also needs MAC OS's "say" or FreeTTS program (for the platform not MAC) for voice output.

3.3.1 Hardware Part

In hardware part, there are 3 classes for operating:

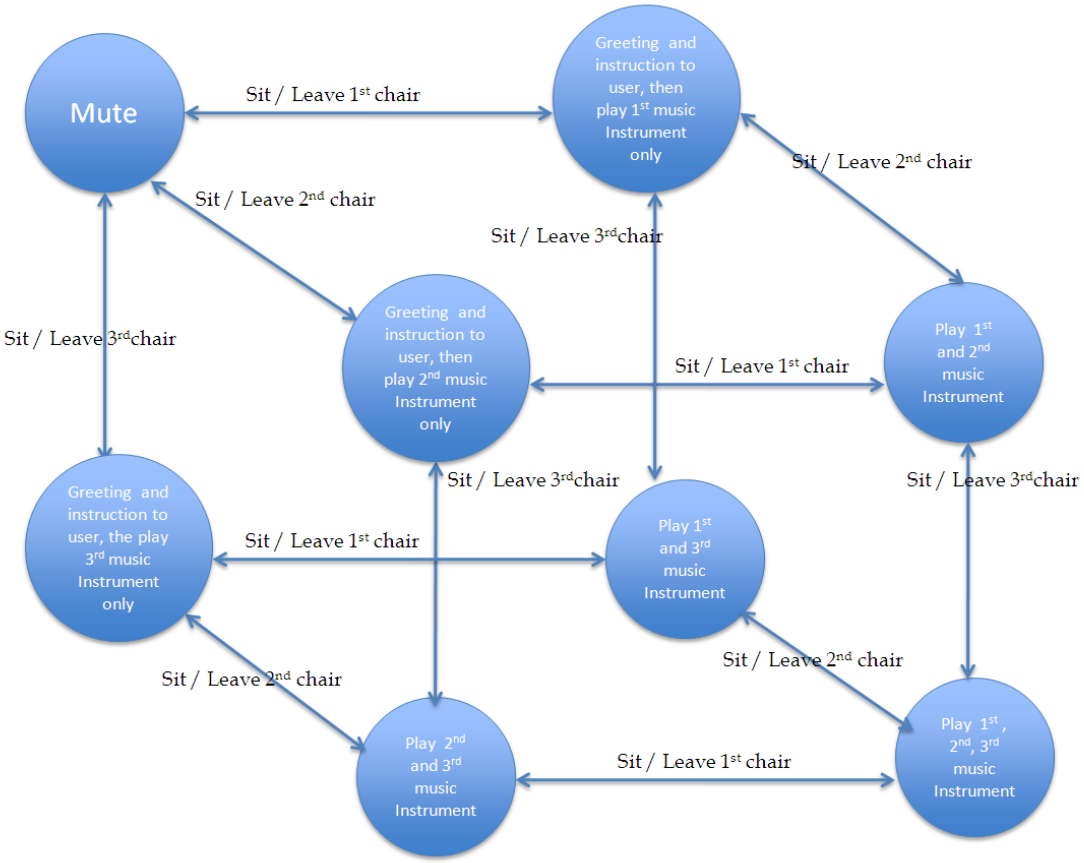
Java class name	Purpose
iCatchManager	To monitor all hardware network, which including iCatch, light sensor, LED matrix module and Zigbee.
iCatchManagerTask	For network communication and data transfer. Zigbee will detect and collect light sensor signal and signal strength every 2 second.
iCatchNetwork	Contain all value object

3.3.2 Software Part

In software part, there are 2 interfaces for operating:

Java interface name	Purpose
TTSEngine	It has a speak function that to speak English, Cantonese and Mandarin language
Player	It store sound track and control the sound track to "play", "mute", "set volume", "set pan" (left or right of the speaker) and "stop".

3.3.3 State Transition Networks (STNs)



4 User Tests

We have designed two scenarios for the user testing, one with only empty chairs and another with someone already seated there. In both scenarios, no formal instruction is provided. No detailed feature of our device is introduced to testers. There are two reasons. Firstly, tester will have more thoughts when they know little about the actual function of the device, it could be easier to discover user's expectation in this situation. Thus, we could collect this information for further improvement. Secondly, it might be more fun for the testers when they know little about the device, it will be more exciting if they could find the feature by themselves for example: changing the volume.

After user is sitting on the chair, a welcome speech plus a simple instruction will be provided:

"Hi! Welcome to the music lab. You are now sitting on the musician chairs. You may adjust your sitting position to turn one or mute the music. Or try another chair for different music track."

And after user is left the chair, a thank you speech will be played:

"Thank you for trying out our musician chairs. Have a nice day!"

Both speeches contain English, Cantonese and Manderin.

Case 1

Preparation	Empty all chair		
Steps	**Expected feedback**	**User 1**	**User 2**
1. User sit on 1st chair	Welcome speech and 1st music instrument sound track will be played	As expected	Takes about 5 seconds to have the sound from computer because of the position of user
2. User leave 1st chair	1st music instrument sound track will be stop and thank you speech is played	As expected	As expected

The different results from user1 and user2 are due to the first sitting position. If the user is seated but there is still some distance between human body and the sensor on chair,

the welcome speech will not be played (user2 in this case). It could be better to have another sensor to detect there is people coming into the room, and the welcome speech will be played before the user sit on chairs. So that necessary instruction can also be made via the speaker.

Case 2

Preparation	1st chair occupied and 1st music instrument is playing		
Steps	**Expected feedback**	**User 1**	**User 2**
1. User sit on 2nd chair	1st and 2nd music instrument sound track will be play together.	As expected	As expected
2. User leave 1st chair	1st music instrument sound track will be stop; 2nd music instrument sound track will keep playing	Two users left chairs together so that two tracks stopped together.	As expected
3. User leave 2nd chair	2nd music instrument sound track will be stop and thank you speech is played		As expected

Devices work well when people sit there one by one: the other two tracks are played one by one. And the tracks will stop when people leave the chair. From the observation, it is found that when people find the music track is short and when the track is repeated, testers would leave the chair. No one is trying to sit again, but actually we might play another set of tracks when user leave the chair and sit again. This may indicate that users are not expecting that another different track will be played if they try again to sit.

Four testers filled a questionnaire and the main findings of the questionnaire summary are as following.

All four testers did not understand the capabilities of our device before they actually try. It is understandable because we did not communicate with testers about the functions of the device. However when we talk to the testers after the testing process, they revealed that they understood that the chairs are for them to sit. That's why all four testers can successfully hear the music after they sit on the chairs. Although one tester did not hear the music immediately after sit on the chair because of the sitting

position which makes device do not recognize there is already people sitting on the chair. Later when tester changed the position close to the chair back, the device works

Three of the testers heard the welcome message, and one did not. But actually there should be two testers who did not hear welcome message as designed because there will be no welcome message if there is already a user sitting on one of the chairs. The reason why one tester in Case2 can hear the welcome message might be that the first user changed the sitting position and the device functioned as he was left the chair. Thus, the second user is treated as a new user.

All four testers expected that the music will stop when they leave the chair and one tester expects a Goodbye message. The function design of our device can meet their expectation. And the function work properly during the testing because all four testers found the music stop soon after they left the chair.

Three of the testers felt that our device is interesting and two of they thought it was fun. All of them are willing to try our device again and will introduce it to friends. The feedback from tester about our device is positive.

For the implementation of our device in daily life, testers felt the device could be used by children for fun, music lover, and music education. No one choose the option of for “conductor to arrange and organize music instrument matching”. The reason might be that the needs of professional musician cannot be meet by our device.

5 Evaluations

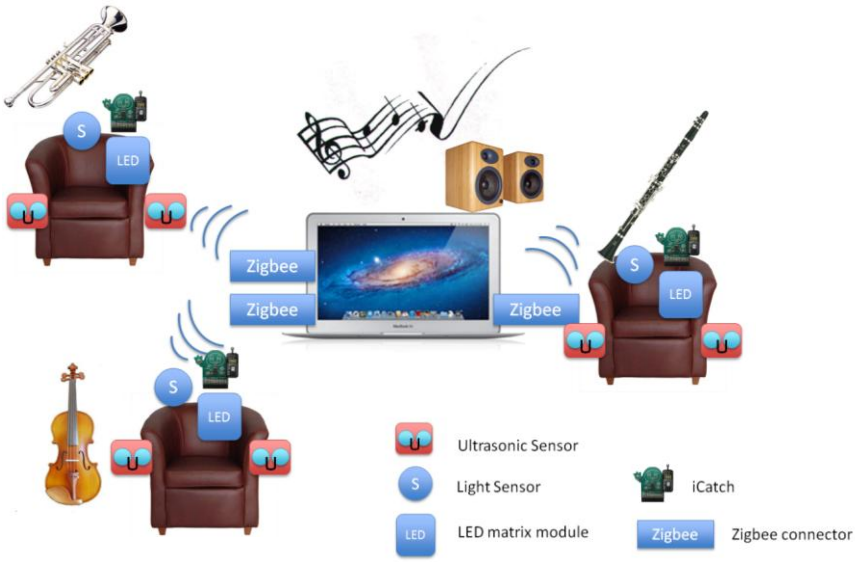
There are mainly two problems found during the testing: there is no way to remind tester about the effect of their position on the speech and music; and the length of the music will affect the time of sitting. The sensors are work well with the whole set of device, so that the main function playing music is performed will in the testing. However, if there are more sensors to enable us to identify the position of the user, there could be reminder to users about the relationship between sitting position and the music playing. For the second problem, music tracks can be played in rotation, so that users can enjoy different music if they keep sitting. There comes another possible application of this device, restaurant design. Faster food restaurant intentionally do not design the chairs very comfortable because they don't want customers to seat for a long time. By using our device, fine dining restaurant can keep playing different music piece to make the customer will to sit there and enjoy the music, while fast food restaurant can use the same music so that people may want to leave when they finish the meal.

6 Further Enhancement

To make our device more usability and interactive with human; increasing music playing realism and effectiveness, we can do the following for our device enhancement.

6.1 Volume Control and Sound Surrounding

In existing system, we have only one input device (light sensor) from user. We can add on two more powerful input devices "Ultrasonic Sensor" for more sensitive and accurate to detect user's distance to control the speaker volume. For example, user moves their body to left, the volume of left side speaker will be louder then right size; when user moves their body to right, the volume of the right side speaker will be louder. So, the device can make music sound surrounding. When user moves front and back, device can control the music volume.



6.2 Music Instrument Selection

In existing device, we prepare two set of music instrument combination for playing. To make the device more flexibility, the computer system will store rich music instruments sound tracks and let the user to make decision for playing by sound input. When user sit down a chair, greeting and brief introduction will comes out, and then device will play the specified instrument sound track until user tell the instrument name. For example, user say "guitar" in English, Cantonese or Mandarin language to the device, after the device identify the music instrument name, that music instrument sound track will comes out for user enjoying.

7 Summary

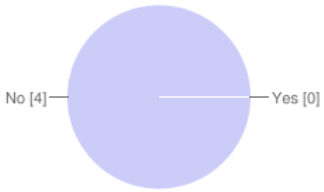
Our device is designed for people to enjoy the music in a new way. The device work properly in the testing stage for two chairs and can be potentially developed to be for chairs as much as the user needs by simply increasing the number of music tracks and iCatch sets. The comments from testers are positive, which means that the device can meet our design goal of bringing an enjoyable and interesting music listening experience. The device can be more sophisticated if there are sensors which can tell more precise distance between the sensor and human body. There is large room for development depending on the specific user needs and the hardware availability.

8 Division of Labor

Name	Role	Responsibilities
Lai Ka Man, Kaman	Device designer	● Proposal
09649980G	Documentation	● Documentation
Zhang Yu Lan, Elaine	Device designer	● Search different instruments sound track
11516753G	Documentation	● Documentation
Qing Pei, Edward	Device designer	● Search and test tools for voice output
11500811G	Programmer	● System coding (software part)
To Wai Lun, Ferry	Device designer	● Test the functions of all iCatch parts
09602469G	Programmer	● System coding (hardware part)

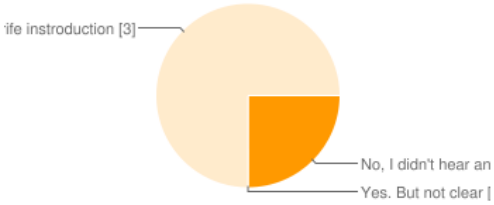
9 Appendix: Questionnaire

Do you understand the capabilities of the device before you try?



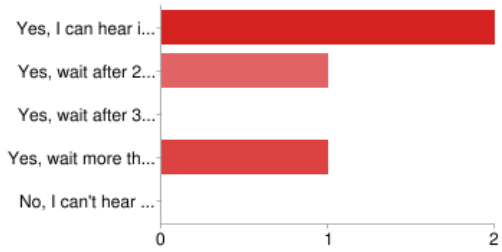
Yes	0	0%
No	4	100%

Do you hear the instruction when you sit on the chair?



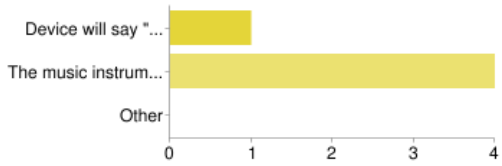
No, I didn't hear anything	1	25%
Yes. But not clear	0	0%
Yes. It's welcome message and brife instroduction	3	75%

Did you hear music when you sit on a chair?



Yes, I can hear immediately	2	50%
Yes, wait after 2-3 second	1	25%
Yes, wait after 3-5 second	0	0%
Yes, wait more then 5 second	1	25%
No, I can't hear anything	0	0%

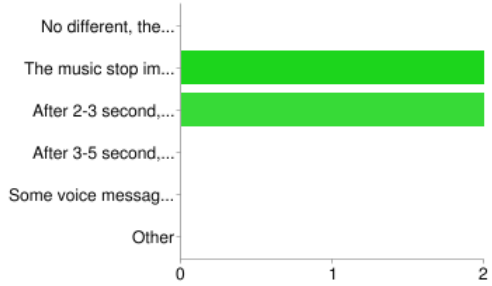
What will you expected when you leave the chair?



Device will say "Goodbye" to me	1	25%
The music instrument sound track will be stopped	4	100%
Other	0	0%

People may select more than one checkbox, so percentages may add up to more than 100%.

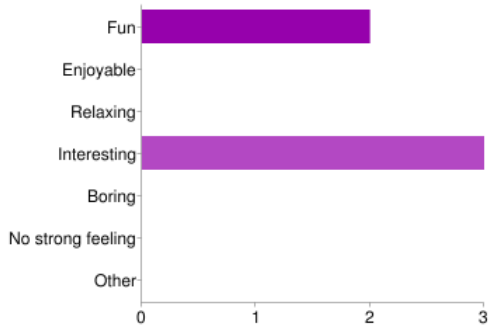
What happened when you leave the chair?



No different, the music still playing	0	0%
The music stop immediately	2	50%
After 2-3 second, the music stop	2	50%
After 3-5 second, the music stop	0	0%
Some voice message comes out	0	0%
Other	0	0%

People may select more than one checkbox, so percentages may add up to more than 100%.

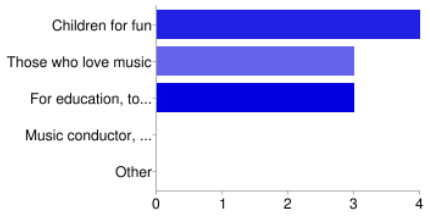
What is/are your feelings when you are using the device?



Fun	2	50%
Enjoyable	0	0%
Relaxing	0	0%
Interesting	3	75%
Boring	0	0%
No strong feeling	0	0%
Other	0	0%

People may select more than one checkbox, so percentages may add up to more than 100%.

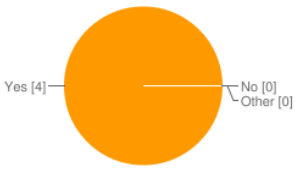
Which of the following is/are suitable to use our device?



Children for fun	4	100%
Those who love music	3	75%
For education, to understand different music insturment combination	3	75%
Music conductor, to arrange and organise all music instrument matching	0	0%
Other	0	0%

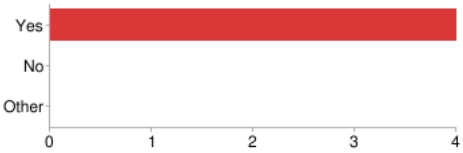
People may select more than one checkbox, so percentages may add up to more than 100%.

Will you use our device again? why?



Yes	4	100%
No	0	0%
Other	0	0%

Will you introduce our device to your friends?



Yes	4	100%
No	0	0%
Other	0	0%

People may select more than one checkbox, so percentages may add up to more than 100%.