iBand

ECE1778 - Final Report

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Word count: 1936

Introduction

What:

The goal of *iBand* is to provide children (primarily,) people with accessibility needs, and music lovers in general with a creative and alternative way to make music, using gestures and hand movements, to record and create music anytime, anywhere.

How*:*

The user would start the application, and through a user interface they would be able to select an instrument and a set of chords to play and assign to different hand gestures. Once that's complete, the user would be able to apply these different gestures using their phone to play the different chords, thus encouraging the user to creatively make music by combining chords without learning how to play the actual instrument. Additionally, the user will be able to record the music played in their session, and will have an interface to view previous recordings.

Why:

The motivation behind this application is to provide children and people with accessibility needs with an alternative way to make music. There are existing apps that allow you to make music by tapping on the iPhone screen, but none exist that utilize the accelerometer and external gestures to the iPhone. People with certain disabilities may be unable to use their arms to their full extent in order to use an instrument, and may have limited use of their hand. This application will allow them to overcome that obstacle and still be able to make music.

In addition, *iBand* can also help music lovers record and create music anytime inspiration strikes. In this way, musicians will not be restricted by the lack of

suitable instruments or venues. Additionally, *iBand* can modify the instrument used to play the notes after the music recording is completed, this can help musicians determine the most suitable instrument for the music they created.

Expertise Link:

Due to the fact that we don't have a specialist on the team, we do not have a specific link to a research area (as discussed with the professor.) However, we are planning to target this app for children and potentially for people who have accessibility needs and are unable to play certain instruments otherwise. Two out of the three of us have some experience making music and playing some instruments.

Statement of Functionality

1) Set Up

When users load into the main page (*figure 2,*) they need to do the set up work first. Users start by selecting their desired instrument. So far, the instruments supported by *iBand* are *electric grand piano, acoustic guitar,* and *violin. (figure 3)* Then, users are required to select a key (iBand supports two keys, the key of C, and G.) Once a key is selected, the chords displayed below will adjust to chords that fit within that key. The user may now select four four chords for each gesture. All set up work has been completed.

2) Play (Create music)

This is the core functionality of *iBand*. When users finish setting up, they may click the "Play" button. This takes the user to the play page. (figure 4.) This page shows the chord corresponding to each gesture based on the users' previous selection. At this point, the user can create music by moving the iPhone in the desired gesture to produce the audio for each chord. Additionally, users can click the record button below the chords to record the music they play. At the same time, if they turn on the metronome, the screen will flash according to the metronome frequency set by the user, this is to help users play in time.

3) View saved

Saved recordings can be viewed and played by clicking the "View Saved" button on the main page. On this page (figure 5,) saved recordings are displayed. Users can click on the recordings to listen to them again. They can also rename the files by performing a long press, and they can edit or delete by swiping left on the recording's name. The edit feature allows the user to modify the instrument of the saved recordings (figure 6.)
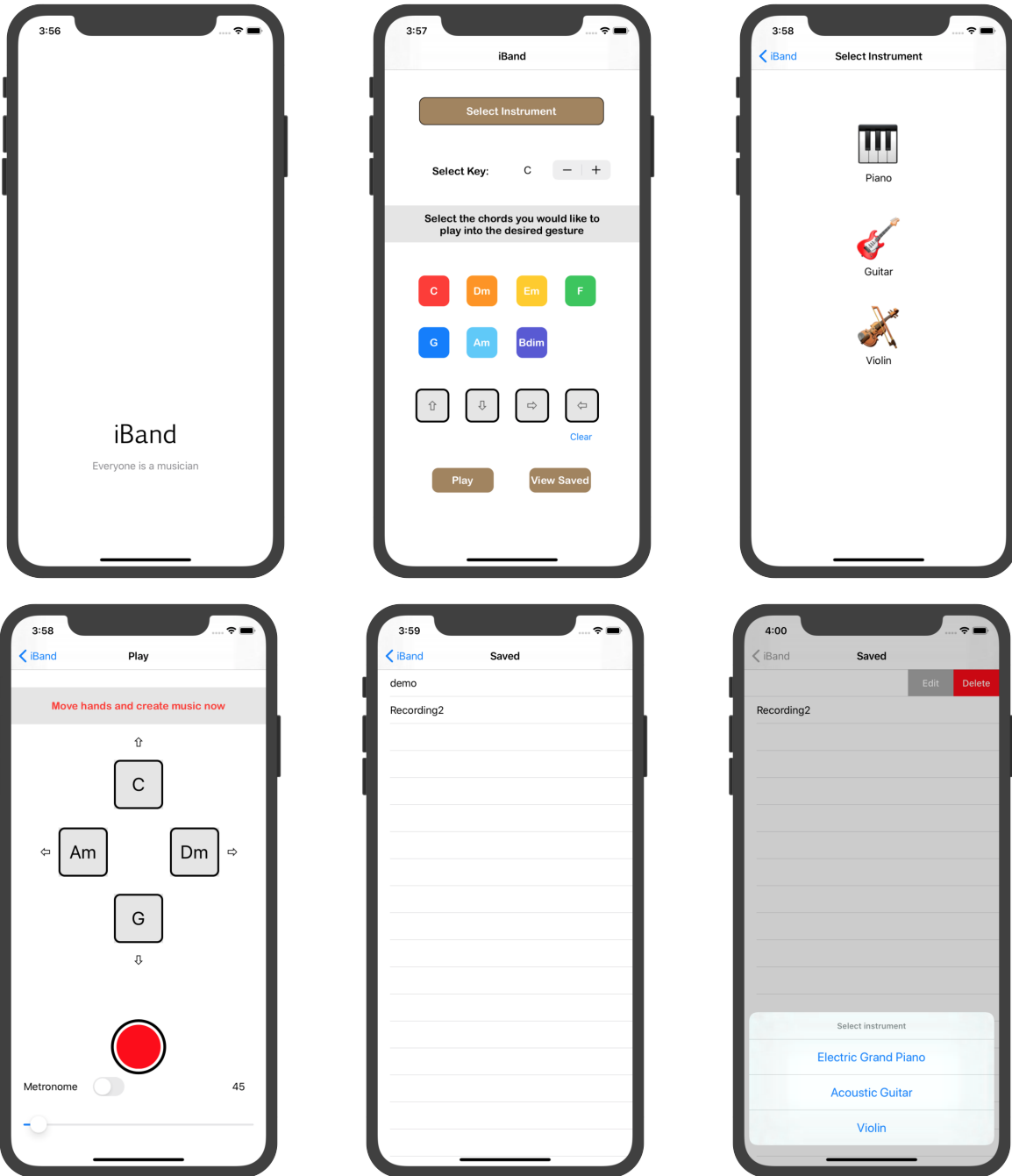
Figures 1-6: Screenshots of iBand at various stages

Overall Design

The figure below (figure 7) is a block diagram of the *iBand* application. The **User Interface** consists of the views that the user would be able to see and interact with (see the previous section, *Initial Design.*) These are the collection of views that together create the GUI for the application. The only logic that lives at this layer is the logic to display the keys, chords and instruments to be selected.
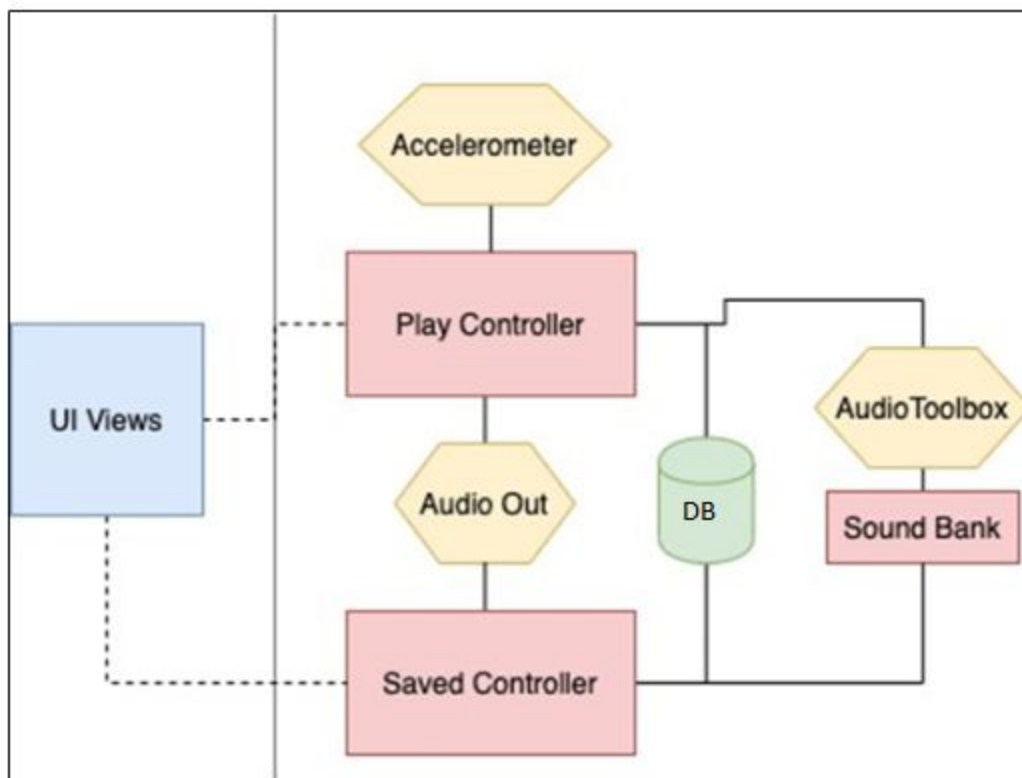

Figure 7 - Block Diagram of iBand

Everything on the right side of the diagram in figure 7 represents the core functionality of the application. The red boxes refer to the swift components in *iBand*:

1. **Play Controller**: The Play Controller is responsible for coordinating the data read from the accelerometer, producing sound data to the audio

output, retrieving the correct sound files to play from the Sound Bank and saving the recorded music to the database.

2. **Saved Controller**: When the user requests that their music be recorded, the play controller saves the MIDI notes played during that session. The Saved controller then recalls the saved music files from the database, and uses the Sound Bank to retrieve the correct audio files.

3. **Sound Bank**: This class will act as an adapter between the Audio Toolbox library and the Saved Controller.

The orange hexagons in the diagram represent the built in components of the iOS device:

1. **Accelerometer**: provides data about the device's acceleration in 3-axis. The accelerometer will be utilized to determine what gesture the user is applying, and in what direction.

2. **Audio Out**: This refers to the device's speakers, the audio will be played live as the user applies the gestures to play music.

3. **AudioToolbox**: represents an iOS library that provides *iBand* with audio files representing notes for various different instruments. From these audio files, we are able to construct chords in different keys.

Finally, in green, the iOS device's storage is represented and used for storage of the saved user sessions. This data includes the MIDI notes played, the instruments selected, and the timing of how the notes were played in the original session.

Reflection

While working on developing *iBand*, our team has been able to reflect on things that we've done that have worked well for us, and things that we could improve.

First and foremost, it's important to point out that keeping our code quality at the highest level helped us save time in the long run. The team members peer reviewed each other's code through GitHub's branches. This ensured that we were all on the same page about how the code was implemented, and it made it easier for developers to go in and make additional changes when needed.

Our team met biweekly to plan the remaining work. We broke down the work planned for the next week into smaller manageable tasks, and then used our whatsapp group to document which team member agreed to do which set of tasks. This has worked exceptionally well for us and we found ourselves always done and ready ahead of schedule.

One thing we could have done to save ourselves some time is to have invested more time in setting up the initial repository. We had some issues with setting up the developer license on the application, which is required to be configured properly in order to run the application through a simulator on XCode. Struggling with fixing the licensing issue every time someone cloned the code to their local machine was a bit rough, and it cost us a lot of time. We were able to fix it eventually, however, I think fixing it at an earlier stage in the project would have saved us some time.

Contribution by group members

Our team worked well together. We tried our best to distribute the work equally, and we helped each other out when it was needed. We agreed at the start of the term to commit to the tasks at hand, and to reach out if we are struggling in completing a task for whatever reason. This has worked well for us and allowed us to tackle any issues we faced early on with no finger pointing.

That being said, while developing the application, there have been three main areas of focus taken on by each developer:

1. **Rami**: worked on the initial UI views and launch screen, the setup of the application and the navigation between its views. Selecting keys, chords, metronome and error handling in the application.
2. **Yifan**: worked on reading and interpreting the data from the accelerometer, translating that information into the chords based on the selection provided by the user, saving the data to midi file, and playing the audio to the user.
3. **Zhuqi**: worked on improving UI design, recording the audio played by the user, as well as adding functionality to modify the recorded music (edit name, delete, change instrument.)

Future work

1) Mixing tracks

In our current app, users can play one instrument at a time and record it in a file. This new feature will allow users to mix tracks and instruments together. Users will still play one instrument at a time. Played tracks will loop themselves in the background and users can play new instruments on top of that. For example, the user plays a drum beat riff, and based on that riff looping, the user can play a chord progression using the guitar. Eventually, all tracks of different instruments can be added together to create a full song and be recorded in a file. This kind of performance is popular these days and it would be cool to be able to do this performance with only an iPhone.

2) Audio metronome

The current metronome is a visual metronome, which is helpful and less annoying when users are performing songs in front of an audience. However a common metronome is audible and is more user-friendly for beginners practicing. Therefore, in the future we would like to add a switch to provide both audible and visual metronomes, and users can switch between the two for different scenarios.

3) Additional keys and instruments

For now, *iBand* supports three instruments and two keys. We can add support for more keys and instruments based on the sound bank we have. Users will have more options in keys and instruments when playing music.

4) Options for recording

The first version of *iBand* used the iPhone's microphone to record, which records the users' voice and surrounding background noise. We changed it to midi recording in later versions so no noise will be recorded anymore. However, some

users may want their singing recorded. So it would be nice if we can bring microphone recording back and let users choose the method of recording.

5) Share and export

We can add options for users to share recordings to social media and export recordings to mp3 files or midi files in the saved page.

Statement

The table below (table 1) reflects the team members' statements to share the video of the final presentation of *iBand*, this report, and the source code of the *iBand* application. Based on this table, the *iBand* team members consent to sharing the video of the final presentation, as well as this report. However, the *iBand* team is not okay with sharing the *iBand* source code.

Table 1 - Group members' statements to share

Team Member	Video of Final Presentation	Report	Source Code
Rami Ashtar	Yes	Yes	No
Zhuqi Jin	Yes	Yes	No
Yifan Zhang	Yes	Yes	No

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