Musical instruments for the iPad

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Abstract

Apple's iPad is today one of the most popular tablets using the touch interface. Innovative applications are created daily using the new features on these tablets enabled by technological advancements. Features like the big multi-touch screen, the 3-axis gyroscope, the accelerometer and even the camera have opened up new possibilities for software-developers to let users control and manipulate software in new and creative ways.

The purpose of this study is to explore the possibilities of using the iPad as a musical instrument for live performance. This will be done by first studying and analyzing some of the software currently available for making and manipulating sounds on the iPad and suggesting a design for a new application based on this study. The study does not include applications designed to simulate already existing instruments.

Sammanfattning

Apple's iPad är idag en av de mest populära handhållna enheter som använder sig av touch gränsnittet. Innovativa applikationer skapas dagligen genom att implementera de nya funktionerna på tabletterna som tagits fram genom senaste årens teknologiska framsteg. Med funktioner som den stora touch-skärmen, 3-axlat gyroskop, accelerometer och kamera så har nya möjligheter skapats för att låta användare kontrollera och manipulera ljudprogram på nya och kreativa sätt.

Målet med denna studie är att utforska möjligheterna att använda iPad som ett musikinstrument för live framträdanden. Detta kommer göras genom att först studera och analysera några av applikationerna som finns idag för att skapa och manipulera ljud på iPad och sedan skapa ett designförslag för en ny applikation baserat på denna studie. Studien inkluderar inte applikationer som är designade att efterlikna redan existerande applikationer.

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Authors Contributions

This table illustrates the distribution of workload during the study. The workload on parts which both authors worked with is considered to be equal among the two.

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Introduction

The purpose of this study is to get an insight in how the iPad can be used as a musical instrument used for performing live. With the technological functionality featured in the iPad and the growing number of sold devices, the potential and possibilities for creating software for manipulating sounds are steadily increasing.
One of the goals of this study will be to provide a starting point for software developers with a musical interest as to where the market is today and what is available on it. By studying and analyzing the software already available for the iPad and also coming up with design suggestion of a basic application, we will hopefully get a sense for what the iPad is capable of when it comes to musical creativity and performance and also where this might head in the future.
It can be pointed out that much of what is presented in this paper probably applies to other tablets than the iPad, however in this study only the iPad was used.

The study consists of two phases, a software research phase and a software design phase. Focus will mostly lie on the research phase since it seems like a very efficient way to get a wide picture of what has already been developed and what can possibly be developed in the future.

By investigating the software already available on App Store we get an insight of what is already done and how developers have used the available tools to make applications used for musical creation. The study also shows which functionalities and software concepts that have been successful in enhancing and enriching musical creativity with the iPad and the ones which have been less successful.

The goal with the second phase is to come up with a simple suggestion for a new musical instrument based on the knowledge collected during the research phase. The purpose is not to develop a full-fledged musical instrument, but to give the reader a suggestion for what we, the authors, think could and should be developed in the future.
The aim of the study is to obtain a broad overview of the use of iPad as a musical instrument, now and in the future. The specific questions are:

- What are the main concepts used in today's music-instrument applications for the iPad?
- How do these concepts use the different features of the iPad?
- Which of these concepts are successful in enhancing and enriching musical creativity with the iPad?
- What can be expected in the future?

Background

2.1 History

Historically instruments have always existed in different forms such as the flutes and drums to the more classical ones like the violin and piano. With every passing decade the world of music and instruments has developed and today technology is often combined with the term instruments. For example many of the classical instruments have been remade into digital versions such as the synth and electric guitar. Furthermore one could say that the past decade has been very focused with

computerized instruments. Today some of these applications such as Ableton Live[21] can be used to produce sounds and at the same time be operated as a live instrument.

2.2 Initial pros and cons

Since digital applications are essentially code and variables these “tools of music” can easily be modified and improved in order to add functionality and meet artist requirements versus the traditional instruments which are not as dynamic in that sense. But as with all programs they require both electricity and hardware to run them which means having to rely on these to work flawlessly in order to use properly in live situations such as concerts.

The musical world is not showing any signs of slowing down its evolvement and as more and more music producers turn to digital applications to compose their music this study will evaluate the instrumental side of this evolvement using the relatively new handheld device iPad.

Method

3.1 The iPad

During this study an iPad 2 was used for both the software research and prototype phase. The main features and advantages of iPad 2 were summarized below [2]:

- 9,7 inch display with back lit led, and a 178 degree viewing angle provides a very dependable main interface in all environments e.g live concert stages, dark rooms.
- Dual core A5 processor which is both strong and power-efficient. This enables low-latency in applications and features such as the camera, which can prove essential when making music live and maintain a smooth flow in the work process.
- Accelerometer
- Gyroscope which detects movement and angles that the iPad is put in.
- Two cameras, one in front one in back.
- Microphone

3.2 Evaluating existing software

In order to get a grasp of what is available on the market today, the first phase involved evaluating a selection of existing applications. Due to the vast difference between how each software was operated, they were tested function by function and then each was paired with a short description in Section 3. Because the purpose of this study is discovering new types of musical instruments based on the iPad, extra emphasis was put on functions and methods of interaction that was unique or innovative in some way between the user and application. All the applications were tested by us, the authors of this paper.

3.2.1 Software evaluated

In order to ensure all the music applications were relevant to this study the following requirements were set and matched during the search for applications on the internet and the App Store.

- Can be used to produce and/or manipulate sounds in a way that it could be used in a live performance act.
- Is not dependent of other software (except iOS).
- Is not dependent of other hardware than the iPad.
- Does not try to replicate traditional instruments or other hardware used for sound manipulation.
- Does not cost more than 100 SEK (10 €) (due to the lack of economical budget for this study).

When choosing the apps, one goal was to try to have a great conceptual variety between them to better represent what is available on the App Store. Since testing every different application available on the market wasn't possible in this study, the reader should have in mind that this evaluation only covers a small sample of the actual market.

The applications evaluated were:

Soundprism
Sound Matrix Free
Seline Ultimate
A Noise Machine
Reactable Mobile
GyroSynth
Ocarina
PixelWave
GeoSynth
Fourier Touch
ImproVox

3.2.2 Types of software

The software tested was sorted into two different categories due to their differences in how they are designed to be used.

Live device
This category includes software designed to produce and manipulate sounds in real time during the actual interaction with the software - just like most traditional music instruments.

Sequencer
This category includes software designed to play looping sound-sequences recorded/designed by the user.

3.2.3 Evaluation form

In order to compare and analyze the differences and common functions of the applications in a consistent way, an evaluation form was used. The first four fields of the form (Name, Developer, Type and Description) are for the reader to get an idea of what kind of application that is tested. The fifth and sixth fields (Main functions implemented, Main iPad features used) are to present the results of the systematic part of the evaluation (see 3.2). These are to give the reader data that is comparable between the applications (eg. "How many of these applications use the

gyroscope of the iPad?"). The last field (Comment) is the testers comment about his impressions of the application. This is based entirely on what his opinion of the application when he tested it and should in no way be considered as fact.

Name: *The name of the application*
Developer: *The name of the developer*
Type: *The type of the application (see 3.2.2)*
Description: *A basic description of the application*
Main functions implemented: *The main functions implemented in the application*
Main iPad features used: *The main iPad features that the application makes use of*
Comment: *A comment from the tester about the "feel" of the application*

Results

4.1 Software evaluations

4.1.1 Soundprism

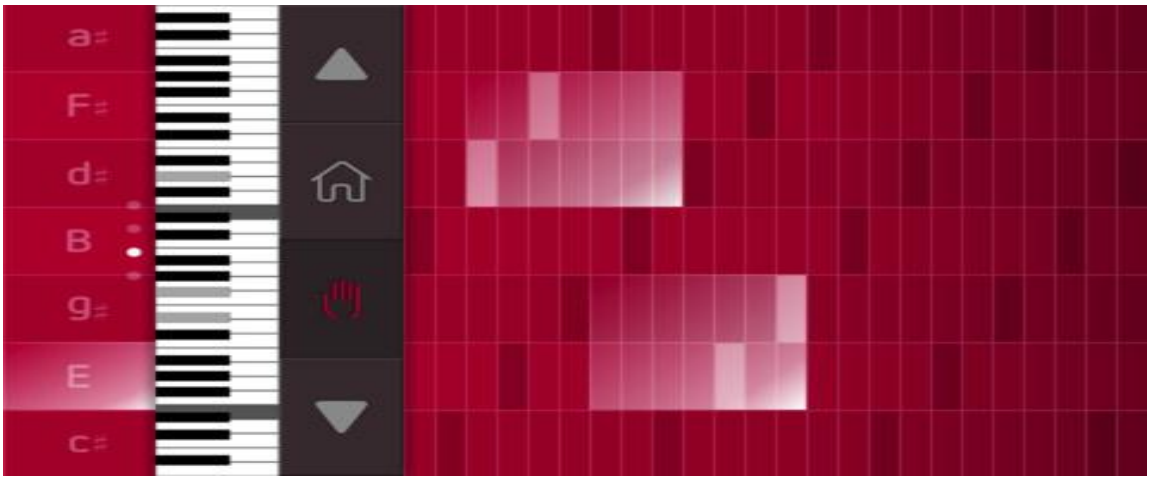
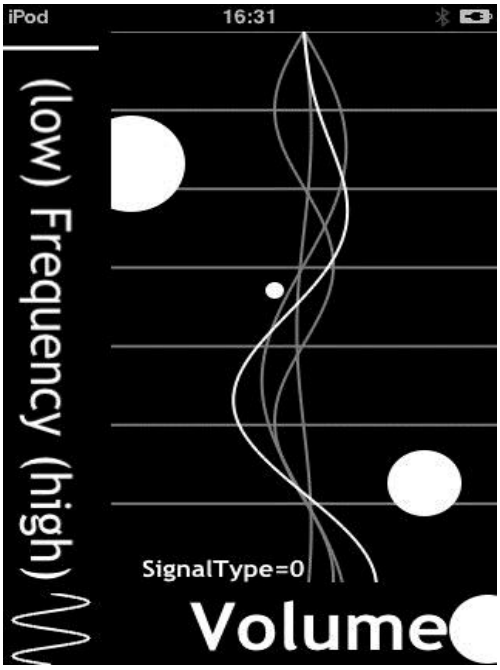


Figure 1 Soundprism[19]

Name: Soundprism
Developer: Audanika [3]
Type: Live device
Description: This is a simple synthesizer which is using the touch interface of the iPad to let the user control the tones of the sound played with an interface pretty different from the traditional musical keyboard. The interface consists mainly of two different sections of the screen, the chord section and the bass section. The chord section is a grid representing the 7 different tones of a certain major-scale which lets the user play chords in this scale by holding their fingertips on the grid. Each row represents a tone and each tone can be played in three different octaves depending on how far to the right the user places his fingertip. When placing the finger somewhere on the chord section, all the tones in an area around the finger are played. This lets the user play chords without having to place more than one finger on the chord section. The size of the area can be changed in the settings menu.
The bass section is a strip of seven buttons which each corresponds to one of the 7 tones in the scale. Every button is aligned to the rows of the chord section and plays the same tone as the

row corresponds to but in a lower octave.
The whole application supports multi-touch so chords can be played with multiple fingers.
Main functions implemented: Chords playable with only one finger, multi touch for chord play, all tones are kept in the major-scale chosen by the user, lets the user change the sound by offering a couple of sound presets.
Main iPad features used: Touchscreen, Network support, Memory storage
Comment: This app lets the user easily improvise without having to worry about playing out of harmony. The interface makes it really easy to both play chords and play bass tones at the same time.

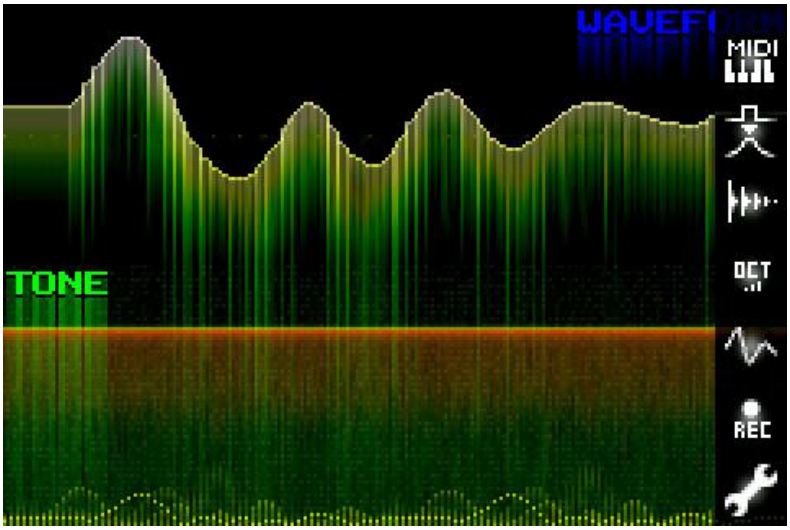
4.1.2 Fourier Touch



Figur 2 Fourier Touch[5]

Name: Fourier Touch
Developer: KonakaLab[5]
Type: Live device
This app is a synthesizer which uses both the touch interface and the gyroscope to let the user play and manipulate sound. The type of waveform played is chosen by a button in the corner of the screen and then the sound played is controlled by a x-y-control surface that is the section part of the interface. This x-axis of this section represents the pitch of the sound played ranging over one octave. The y-axis controls the volume of the sound according to how far from the center of the axis the finger is placed. This section of the interface supports multi-touch for playing chords. The pitch and volume of the tone can be altered further by tilting the iPad in different directions but also by using the pitch and volume sliders on the sides of the interface.
Main functions implemented: Using the gyroscope or the touchscreen to control the pitch and volume , controlling the note played and its volume with the touchscreen, multi-touch for chords, changing the shape of the sound wave with presets.
Main iPad features used: Gyroscope, touchscreen
Comment: Interesting use of the gyroscope which opens up possibilities for musical expression. Might be hard to master for live performance since the pitch range is stepless and doesn't snap to fixed notes.

4.1.3 Pixelwave



Figur 3 PixelWave [6]

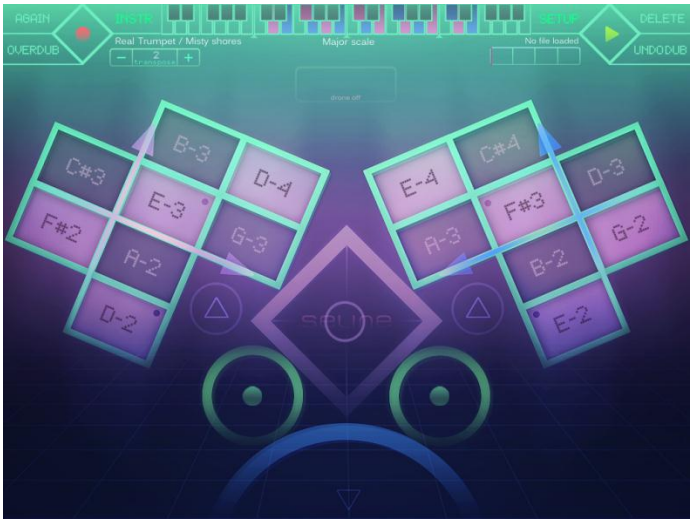
Name: PixelWave
Developer: Alexander Zolotov[6]
Type: Live device
This app lets the user draw a soundwave and the play sounds with it. The sound is played and manipulated by pressing the screen and moving the finger(s) over the screen. The pitch of the sound is by the x-axis position of the finger and the volume is determined by the y-axis position. The range of the pitch over the x-axis of the screen can be set from 2 octaves up to 6 octaves. The app supports multi-touch so that chords can be played with multiple fingers.
The app also lets the user choose to add basic effects like an echo to the sound.
Main functions implemented: Draw the shape of the sound wave completely free, controlling pitch and volume of the sound with the x-y-touch interface, multi-touch for chords, possibility to add some basic effects.
Main iPad features used: Touchscreen, network Support, memory storage
Comment: Easy to use and the possibility to draw sound waves freely gives big possibilities to shape the sound. Might be hard to play live since the user might feel restricted by the size of the screen when controlling the pitch of the sound.

4.1.4 GyroSynth

Figur 4 GyroSynth [11]

Name: GyroSynth
Developer: BeepStreet [11]
Type: Live device
Description: This app lets the user control the pitch, volume and modulation by holding the device in different positions. The graphical interface consist of a settings menu which lets the user change type of the sound wave played, choose the scale which the application should play in, the base octave of the sound, the octave range of the pitch (1-3) and the possibility to add some basic effects to the sound. The app is developed for the iPhone but works with the iPad aswell.
Main functions implemented: Using the gyroscope to control pitch, volume and modulation, possibility to choose scale for the notes played, possibility to change the shape of the sound wave with presets, possibility to add simple effects.
Main iPad features used: Gyroscope, memory Storage
Comment: A very interesting app because of the way it uses the gyroscope. Opens up possibilities for great musical expression.

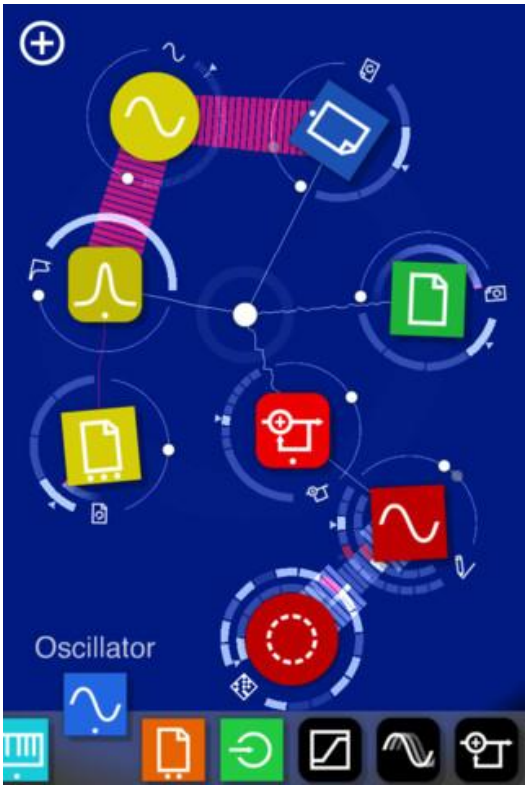
4.1.5 Seline Ultimate



Figur 5 Seline Ultimate[7]

Name: Seline Ultimate
Developer: Amidio Inc [7]
Type: Live device
Description: Seline Ultimate uses solely the touchscreen as an interface for making music. At the first glance composing music on Seline might not be completely intuitive. However the user will quickly discover that the keys are all on the same scale and the creators have made many presets for different scales and instrument in order for everything to sound in harmony. With that said it is also possible for the user to customize its own scale if wanted. In addition to the user input the application also has an automated feature which can be turned on to play the underlying keys as a complement to the composed song. Seline Ultimate also offers recording features, change of octaves on the fly.
Main functions implemented: Pad-like interface on the touchpad which produces different preset tones when played. The presets can be redefined by the user or chosen from the library of Seline. There are also a number of ways to adjust the tone played by half a note aswell as activate the automatic drone function.
Main iPad features used: Touchscreen, memory storage
Comment: Short learning curve, Easy to play due to the fact that all presets are on scale. Although it is possible for the user to define their own custom preset.

4.1.6 Reactable Mobile



Figur 6 Reactable Mobile [10]

Name: Reactable Mobile
Developer: Reactable Systems [10]
Type: Live device
Description: Reactable Mobile uses the touchpad as an interface and the user here gets the ability to make allot of different sound effects by combining sound generators with effects. At first the application itself is more of a sound synthesizer but after some time as the user masters more of the interface it is possible to create projects which could resemble an electronic song. Besides the extremely customizable sound synthesis Reactable also introduces a unique way of making sounds due to the layout of the application where the user can connect the different effects with sound generators based on distance. Unique features of Reactable also offers the possibility to share and discuss their ideas with other users online which both creates an online community for the application and also helps fuel the creativity when users need new inspiration to move on with a project.
Main functions implemented: A simple board like layout where the user can input different sound generators and effects and can change them by moving them closer and further away from eachother.
Recording feature and Online community for uploading and downloading projects created in Reactable Mobile.
Main iPad Features used: Touchscreen, accelerometer, microphone, memory storage
Comment: Reactable Mobile is definitely one of the more complex applications tested and it takes a while to master the basics. Once this is done however one can produce real tracks in Reactable. The Online community also floats smoothly and already seems to have a few well-established artists

4.1.7 Ocarina

Figur 7 Ocarina [8]

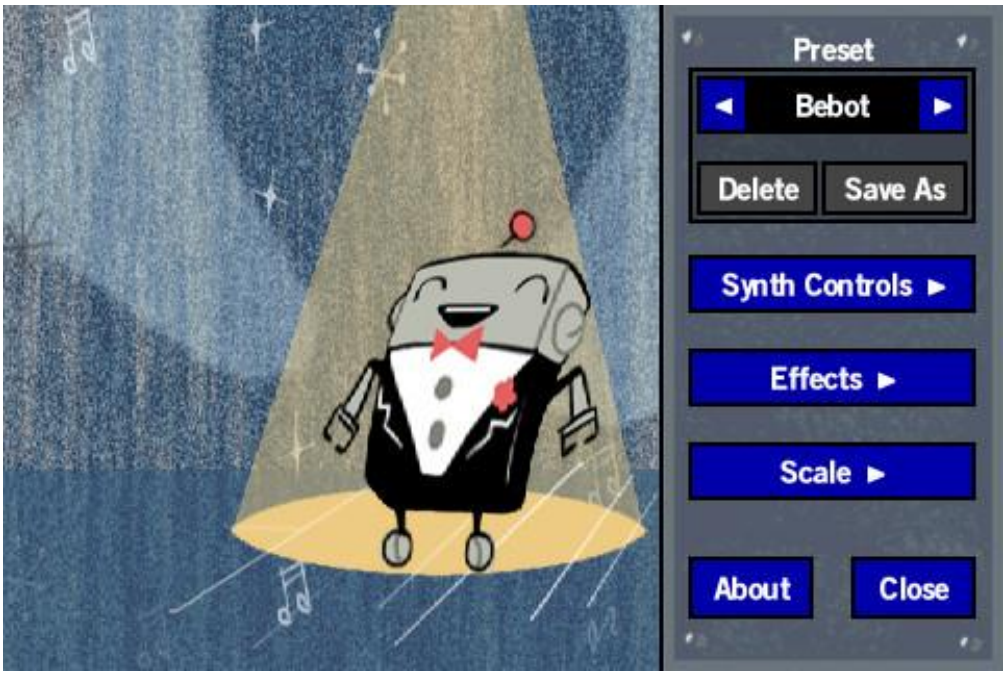
Name: Ocarina
Developer: Smule, Inc
Type: Live device
Description: By blowing into the microphone this application produces sound with loudness based on amount of noise it gets through the microphone. It can also change the tunes that are played by laying fingers on the touchscreen like a regular flute. This app is designed for the iPhone but can be used on the iPad as well.
Main functions implemented: Uses the microphone to control the loudness of the sound played, lets the user choose what scale the notes should be in.
Main iPad features used: Microphone, touchscreen
Comment: The design of the application itself is quite simple and leaves room for improvement since the developers still doesn't make use of most of the screen. The interesting innovative part for this application is that it's the first one tested that implements the use of the microphone.

4.1.8 ImproVox

Figur 8 ImproVox [20]

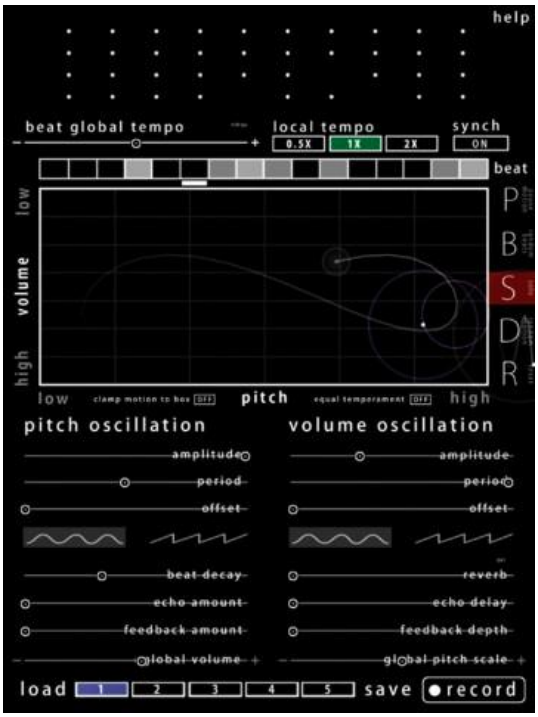
Name: ImproVox
Developer: MuseAmi Inc.
Type: Live device
Description: This application utilizes the microphone as the main input form and lets the user manipulate all the sound that the iPad hears. Most of the effects are standard issue such as the echo and reverb which are quite useful when manipulating sound in this fashion. A more extraordinary effect is however the harmony effect which can transform sounds such as vocals into different keys and therefore effectfully make for example a singer sound in key even if false.
Main functions implemented: Ability to manipulate sounds through the microphone also has extra features such as uploading recordings to soundcloud.
Main iPad features used: Microphone, touchscreen, memory storage, network Support
Comment: Fairly easy to use, and all the functions seem useful and relevant Interesting that it connects with soundcloud.

4.1.9 Bebot - Robot Synth



Name: Bebot - Robot Synth
Developer: Russell Black [14]
Type: Live device
Description: This is a synthesizer which lets the user control the sound played by using the the touchscreen as an x-y-control surface. The x-axis represents the pitch of the sound and the y-axis represents both the modulation and the volume. This app supports multi-touch for chord play with multiple fingers. By using two buttons at the left side of the screen, it is possible to change the octave of the notes on the screen.
The application lets the user change the sound by using two oscillators that the user can combine. The first is based around a couple of presets which includes a wave shape together with some options customizing the modulation of the sound. The second one works like a sub bass to the first one and is based around presets of wave shapes. The user can choose how much to mix these two oscillators. Further the application offers some basic effects (echo, overdrive and chorus) and the possibility to lock the range of the pitch to certain scales.
Main functions implemented: Controlling the pitch, volume and modulation with the touchscreen, multi-touch for chords, possibility to lock pitch into different scales, uses more than one oscillator for customization of sound, the possibility to add effects to the sound.
Main iPad features used: Touchscreen
Comment: The app offers a lot when it comes to giving the user tools for customizing the sound. The way the pitch can be locked to a certain scale makes it possible to easily improvise even without the need for much knowledge about harmonies.

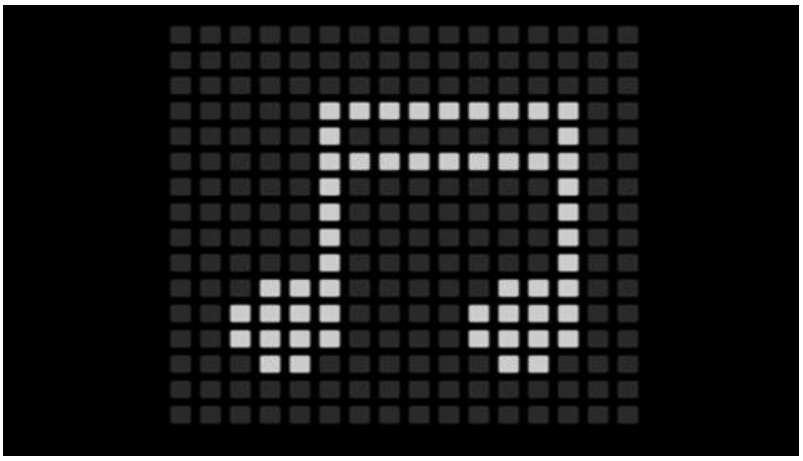
4.1.10 A Noise Machine



Figur 9 A Noise Machine[9]

Name: A Noise Machine
Developer: JellyBiscuits[9]
Type: Sequencer
Description: A Noise Machine offers the user 40 dots to place freely on a grid in order to combine different sounds. Each dot produces a sound which can also be modified by amplitude, period and different offsets as well as sound curves. The Noise Machine has a short learning curve but due to the design and simplicity of the application it is hard to create standalone music.
Main functions implemented: 40 dots which can be customized to produce different sounds in a sequencer. Live pitch oscillation with options of changing amplitude, period and offset. Also offers the ability to change tempo of which the sequencer plays the different dots.
Main iPad features used: Touchscreen
Comment: The application itself is pretty simple to use. However, the sounds produced and possibilities to create a real song are limited in comparison to other applications

4.1.11 Sound Matrix Free



Figur 10 Sound Matrix[4]

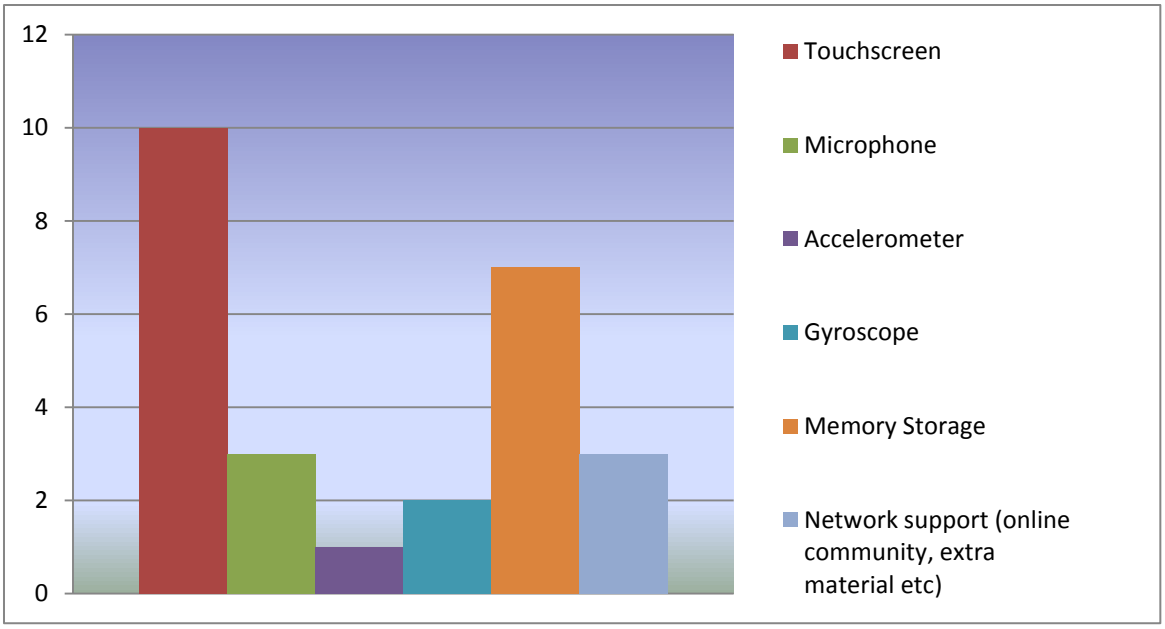
Name: Sound Matrix Free
Developers: SugarOnTop [4]
Type: Sequencer
This apps interface consist solely of a 16x16 matrix of small boxes. Each box can be activated or deactivated and represents a note in a 16 step looping sound sequence. Each column in the matrix represents one step in the looping sequence and each row represents a tone.
Main functions implemented: Looping sound sequence that can be changed through the 16 x 16 matrix interface.
Main iPad features used: Touchscreen
Comment: This app is a really simple but still has potential for some really creative use. Since it's loop-based it can easily be used together with other instruments during a live performance.

4.2 Summary of evaluations

4.2.1 Summary

After evaluating the applications the following summary over the most important applications was discussed (see section 4.2.2). Many of the applications tested were well-developed and seemingly stable thus making them more or less ready for live play. However in our opinion, not all of these offered enough depth concerning sound manipulation for professional use. It was also suggested that the artist must be able to create a song and also be able to reproduce it somewhat accurately with the application for it to be considered professionally useful. Several applications such as Ocarina offered too limited functionality for this or were just too inaccurate on this requirement. There was however a few applications such as the Seline Ultimate and Reactable Mobile which in our opinion could be used for real live applications as an instrument.

To summarize it all most of the instruments could potentially be improved to make them ready for professional use. Some are already at that stage whilst most are not.



Figur 11 Functions of iPad which was used most by the applications during the evaluation.

4.2.2 Functions we think are good

Locking playable notes to a scale chosen by the user

This function could be found in most of the applications evaluated and is a great way to make the instrument easier to handle. By guaranteeing that notes played will always be in harmony, the user won't have to worry about accidentally playing a note out of harmony during a live performance. This also makes it easier for users to improvise when playing a song.

Simple chords

This function could be found in SoundPrism and the ImproVox application. It lets users without knowledge about musical harmony easily play many of the basic chords with simplicity. This makes the application more beginners friendly and makes it easier for users to discover harmonies that they enjoy. However, if implemented wrong, this function could harm the user's creativity since it might make them use certain chords and combinations of chords more than other.

Multi-touch for chords

This function could be found in most applications tested which used the touchscreen for pitch control. This is a good feature for the more experienced users who want to freely play chords and more advanced melodies.

Controlling parameters such as pitch, volume and modulation with gyroscope

Beside using the touch screen for manipulating the sound, also giving the opportunity to let the user control pitch, volume and modulation by moving the device in different ways opens possibilities for great musical expression. If an application could react to the movements similar to the movements of a conductor of an orchestra, this would really let the user express his/her feelings through the device.

Customization of the sound
This function could be found in different forms in the applications evaluated. The ones we liked most where the way PixelWave lets the user freely draw the shape of the sound wave and the way Bebot - Robot Synth lets the user combine different oscillators to customize the sound. A combination of these would give the user great freedom when it comes to forming the sound of their liking.

Letting the user add basic effects to the sound
This is a very basic function that could be found in many of the different applications evaluated. This function lets the user customize the sound of the instrument to give it a more unique sound. Different effects can totally change the feel and atmosphere that an instrument provides.

Saving and loading sound presets
This function lets the user store and later load a sound that they have customized to their liking. This makes it possible for users to design their own unique sound but still have access to them whenever they like. This is great for artists who perform live and want to access that unique sound preset every time they perform.

4.3 The design suggestion

This phase of the study basically consisted of taking the knowledge earned during the first phase and using that to come up with a design suggestion for a new music application for the iPad. It should be noted that during this phase, no actual software developing were done. The phase mainly consisted of deciding which functions and concepts that we, during the research phase, found good for enhancing musical creativity and expression with the iPad and brainstorming ideas of how to use these together in one application.

Our design suggestion is based mostly on the results of the research phase but since we both have our personal opinion about what is “good” for enhancing the musical experience with the iPad, this affects the final design suggestion. The reader should take this in consideration while reading this and in no way think of the following section as fact or “the optimal design of a musical instrument for iPad”.

4.3.1 What kind of application we would like to have

We believe in applications that are simple to use for the beginners but still leaves room for advanced use. We think a good application should have a simple, clean main interface but also offer a lot of customization. We believe that letting the user use a combination of the touchscreen, the gyroscope and the accelerometer would offer possibilities for great musical expression.

4.2. Suggestion for a design

The main section of the interface would be similar to the chord section of the SoundPrism application, letting the users use the “simple chords function” if they wanted but still supporting multi-touch for custom chord play. There would be buttons for enabling gyroscope/accelerometer interaction that would include manipulation of sound volume, pitch bend and modulation.
The notes playable would be locked to a certain scale chosen by the user in the options menu.

The settings section of the interface would include options for customizing the sound played. Presets for all options would be available but the user would also be able to store own presets with their own options. The settings section would have options for the scale-lock function, the sound customization and the gyroscope control.
The scale-lock function would have presets for the traditional scales but also let the user fully customize what notes that should be playable.
The sound customization would consist of letting the user form the shape of the sound wave by combining at least two or more oscillators in a way similar to what can be done in the Bebot - Robot Synth application. The shape of each individual oscillator’s sound wave would be either chosen through a set of presets or drawn by freehand in the same way as in the PixelWave application. There would also be options to add basic effects to the generated sound such as reverb, delay, overdrive and chorus.
The gyroscope/accelerometer options would be sensitivity for the gyroscope/accelerometer interaction, what every each of the axis of the gyroscope would control (volume, pitch, modulation), pitch bend range and options for the modulation. The modulation would be able to control different settings such as the dry/wet of the effects, a filter with low/high/band-pass and LFO options.

Discussion

5.1 Results from evaluation

The evaluation of applications showed that the touchscreen was the most used feature whilst the more nontraditional functions such as the gyroscope and accelerometer were not utilized nearly as much. This is probably because people in general are more used to using touchscreens for interaction than the other features of the iPad. This fact most likely stimulates many developers think that in order to make their applications as intuitive as possible, they have to use the touchscreen as the main way to control the sound played by the application. Many of the applications also seemed to have elements inspired by traditional instruments and already existing hardware such as interfaces similar to the traditional musical keyboard and the x-y-control surface, probably so that the user would find the interface more intuitive as well. On the other hand, some of the applications had interfaces and ways to interact with the application that wasn’t at all traditional. These applications were harder to get used to and learn but let the user interact with sound in a totally new way.

Based on this we can draw a few theories as to what drives the developers. Some developers seem to focus on to make the musical instrument as easy to use for the user as possible, defined by a short learning curve and number of presets which have been previously fine-tuned. The other end developers strive to “push the boundaries” by creating applications using unique methods of interaction and features of the iPad such as the microphone and accelerometer. Which one of these approaches that is better for the sake of evolution of the iPad as a musical instrument is hard to say, a combination is probably the way to go.

One of the prominent details discovered when evaluating the applications was the importance of having a lot of customizable options so that the user could, through the application, change and manipulate whatever sounds needed to create a song or a beat. Lack of options could make the software itself easier to operate but render the instrumental side of it less dynamic.

5.2 Today and the future (examples of how apps are used today)

Some of the more developed applications today are already being used as musical instruments live and every day more artists put up digital media of their productions. A great example of this is the group “iPad Orchestra” who created a song and recorded it by using Seline[16]. Another good example of the developing music community for iPad instruments is the integration of online music communities. For example applications like Reactable have developed their own community [17] while others, like ImproVox, connect with Soundcloud[18]. We believe that this is a positive development for instruments on mobile devices such as iPad since sharing musical creations online will lead to greater exposure and hopefully trigger a larger number of users of iPad and other mobile devices to try out the applications and push the development further. More artists will also increase the amount of feedback given back to the developers as to what areas need improvement and what holes in the market need to be filled.

No one can tell by certainty what the future holds but one thing that is sure is that hardware will improve which will allow developers to create more advanced applications. This will mean more depth and more potential for musical creativity in musical applications. The evolution of iPads sensor-technology will open up for more and more possibilities when it comes to developing musical applications. We believe that, for example, a touchscreen with tactile feedback could be a huge leap forward for musical applications since it would make the touchscreen much more useful for controlling applications when performing live.

With today’s potential for growth of musical applications for the iPad the opinion of the authors is that the digital instruments for iPad may one day enable more artists to live off them in a professional sense.

5.3 Conclusion

We conclude that the majority of the applications out on the market today still try to stay intuitive and easy to learn by using mainly the touchscreen of the iPad, and to use elements similar to what can be found on traditional instruments and hardware. This might be good for letting many users enjoy the application but might not be best for the evolution of the iPad as a musical instrument. Few of the applications out on the market utilize iPad features such as the gyroscope, accelerometer, microphone and camera. This might be because of the big learning curve of these applications. In our view, the goal for developers should be to design applications which has a low learning curve and is simple for the beginner, but also offers a depth and more untraditional ways of manipulating the sound. Such applications would have the musical depth and complexity of traditional musical instruments but would be easier to learn to use, more adaptive and could reach out to more people than traditional instruments do.

There is still a lot of room for improvement and evolution of the iPad as a musical instrument and we will most likely see more advanced and innovative applications out on the market in the future.

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