Traditional Thai Musical Instrument
for Tablet Computer– Ranaad EK

Kasikrit Damkliang, Athiwat Thongnuan, Suppakit Chanlert

Abstract—This paper proposes an architectural and graphical user interface (GUI) design of a traditional Thai musical instrument application for tablet computers for practicing "Ranaad Ek" which is a trough-resonated keyboard percussion instrument. The application provides percussion methods for a player as real as a physical instrument. The application consists of two playing modes. The first mode is free playing, a player can freely multi touches on wooden bar to produce instrument sounds. The second mode is practicing mode that guilds the player to follow percussions and rhythms of practice songs. The application has achieved requirements and specifications.

Keywords—Architectural software design, GUI; traditional Thai musical instrument, percussion instrument

I. INTRODUCTION

THAI classical music is an integral part of the lives of Thais. It is the focal point of their way of life, tradition, culture, arts, education, religion and philosophy. Throughout Thai history, a valuable and impressive musical foundation was set up with a variety of instruments, compositions and playing techniques, that could clearly express a range of emotions and feelings. This inestimable inheritance of Thai music, handed down through the ages by craftsmen and accomplished musicians, continues to be lovingly maintained and developed by today's generations of music teacher and musicians [1][2].

Thai society has rich cultures. The Kingdom of Thailand has several types of traditional Thai systems of organology they which are classified into four categories, by the playing action: Plucking for plucked string instruments, Bowing for bowed string instrument, Striking for percussion instruments and Blowing for wind instruments. However, nowadays, studying and practicing in Thai classical music is not as interesting or popular to our Thai youth as much as that of western or contemporary music. There are only some interested groups that still conserve and study it.

This paper proposes an architectural software and GUI design of a traditional Thai musical instrument application for tablet computers. In this paper, we implement "Ranaad Ek", alto xylophone in percussion instrument. The application will support iOS, Apple operation system and iPad, Apple trademark tablet computer.

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We adore and appreciate Thai classical music. Therefore, we desire for a seemliness combination of traditional Thai musical instrument and state of the art technology. We hope that our research project will encourage inspiration, motivation and good attitude of Thai people and boot more opportunity to reveal Thai classical music on the international level.

In addition, there are many musical instrument applications on the tablet computer platform such as guitar, violin, drums, piano, keyboard and so no [3]. These producer companies distribute them for free and commercially via online places and market in both Apple and Android platforms but there are no traditional Thai musical instrument available.

II. RANAAD EK

A. Ranaad Ek and Its Significance

Ranaad is a traditional Thai musical trough-resonated keyboard percussion instrument generally played with two mallets in Thai classical music and performance [4]

The traditional Thai system of organology classifies Ranaad into five categories such as "Ranaad Ek", higher-tone xylophone with bars usually made of hardwood, "Ranaad Ek lek", higher-tone metallophone, "Ranaad thum", lower-tone xylophone with bamboo or hardwood bars, "Ranaad thum lek", lower-tone metallophone and "Ranaad kaeo", crystallophone which is very rare.

Ranaad Ek (Thai: ระนาดเอก) is the generic name for keyboard percussion instrument or Thai xylophone used in the Thai classical music (Fig. 1). It is an important instrument as a leading instrument in piphat ensemble [2] and also called an iconic instrument. In addition, the Ranaad Ek is also a symbolic representative of Thai classical music.

Fig. 1 Ranaad Ek[1]

B. Ranaad Ek's Composition

Ranaad Ek has evidently occurred since The Kingdom of Ayutthaya, 1350 - 1767. The Ranaad Ek composes of three parts [1][2].

First part, it is boat-shaped resonated trough for amplifying reverberation and bright sounds, as shown in Fig. 2. The center

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of trough is a base or foot, sloped like pyramid. Then, the next important component is "Khon ranaad" (Thai: โขนระนาด) which is made of wooden plate funnel (Thai: พุ่มข้าวบิณฑ์; like float filled with rice used as offerings in traditional Thai cultures) that is closed adjacent to heading and ending of the trough and is for hanging wooden bars, the important part for producing cords [1][5].
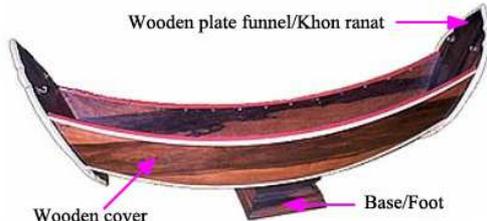

Fig. 2 Resonated trough of Ranaad Ek [5]

Ranaad Ek consists of 21 or 22 wooden bars, as shown in Figure 3. The wooden bars are typically made of rosewood or hardwood which is rare to find. A bar is located at the far most left called the beginning bar which produces the lowest sound tone and the far most right one called ending bar produces the highest sound tone.

Tone adjustment is achievable using a combination between lead (malleable metal) and paraffin to attach under each wooden bar in both leading ends. Moreover, the tones of some wooden bars are used as reference tones for other instrument in the ensemble.

Fig. 3 Wooden bars of Ranaad Ek [5]

The last important part is mallets. We play Ranaad Ek with two mallets. There are two types of mallets. The soft mallets provide relaxed, silky and softer tones for playing slow songs. Meanwhile, the hard mallets provide sharp bright sounds when wooden bars are being percussed for faster playing. Both of mallets types are shown in Fig. 4.

a. Soft Mallets   b. Hard Mallets
Fig. 4 (a) Soft mallets   Fig. 4 (b) hard mallets [5]

C. Ranaad Ek Percussions

Basic Ranaad Ek percussion is a beating methods. When the player holds mallets and strikes double wooden bars concurrently, as shown in Fig. 5, therefore both sound tones are generated concurrently.

Fig. 5 Percussion of Ranaad Ek [5]

There are many ways to play Ranaad Ek. Main and basic percussions are classified into four methods: Gep (Thai: ตีเก็บ), Graw (Thai: ตีกรอ), Seaw (Thai: ตีเสี้ยวมือ) and Gwaad (Thai: ตีกวาด) [1][5].

Gep in Thai means 'to keep or clean up' and it is the most important basic percussion when a player holds mallets and hits double wooden bars concurrently. Each bar refers to the note sound name but they have different tones, such as low Sal and high Sal sound tones, as shown in Fig. 6. In order to position the couple notes we count the bars from one to eight. Therefore, this percussion method is called 8-double percussion.
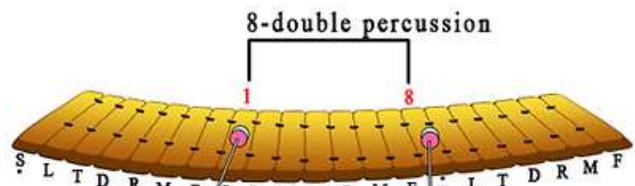

Fig. 6 Basic or 8-double percussion [5]

When speaking of music, the minor instruments of an ensemble fill in the pauses and stronger, more outstanding notes of the major instruments. This adds more details to the music.

The second percussion, 'graw' or repeat, is for playing long notes when the player frequently swaps hitting double wooden bars with equals weight of left and right hand, as shown in Fig. 7. In the another way, the term 'graw', the player strikes the keys on the Ranaad Ek on the rows in a quick, staccato pattern, causing the tones to run together into a single long running phrase. In addition, a musician can also percuss 2-double, 3-double, 4-double, 5-double, 6-double or 8-double percussions.
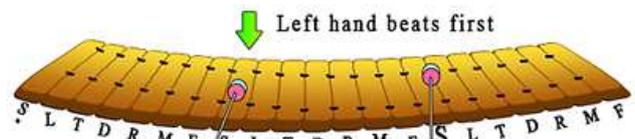

Fig. 7 Repeat percussion [5]

The third percussion, 'seaw' or portion, is a way to percuss wooden bars when a hand is repeatedly hitting the same bar while another hand synchronizing hits through wooden bars

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producing resonated sound tones and harmony melodies, as shown in Fig. 8.

Fig. 8 Portion percussion [5]

The last one is 'gwaad' or sweep percussion, as shown in Fig. 9. In music, it refers to the player running the mallets along the entire wooden bars keyboard in one long draw, slow or fast, same or different directions, generating charming sounds.
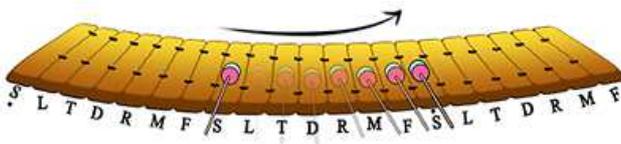

Fig. 9 Sweep percussion [5]

These basic percussions are fundamental practice for the player improve players for later applying in adaptive and advanced percussion styles or more interesting rhythms. Therefore, our application will support and focus on these main and basic percussions.

III. APPLICATION ARCHITECTURE AND DESIGN

A. Framework

Application development for tablet computers under trademark 'iPad' of Apple has classified into four frameworks: Native, Web Based, Embedded WB and Cross Platforms. Each framework has both advantages and disadvantages depending on several factors such as device hardware utilization or fast network connection requirement, etc. [6]

In feasibility study, we chose Native framework development. The advantages of this framework are latest API, fast software development and management and device hardware utilization. On the other hand, the developer has to engage with the framework specification requirements, for example, programming language must be Objective-C on only Xcode IDE. These conditions are disadvantages for platform specific development. Apple iOS SDK consists of Foundation Framework and UIKit library already bundled with iOS.

Cocos2D framework is an Object-oriented APIs, as shown in Fig. 10. Cocos2D is an open source under MIT (Massachusetts Institute of Technology) license agreement that the developer can independently distributes the source code [7].

Cocos2D is easy to implement and extend the development and has an effective memory management. Cocos2D supports both 2D and 3D (2 and 3 Dimensions). Our application supports only 2D and is implement following the OpenGL ES
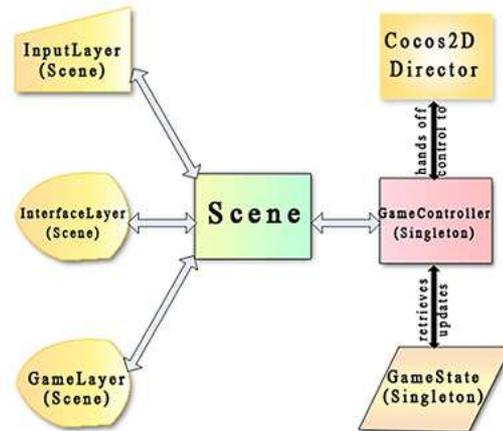
standard.

Fig. 10 Cocos2D Framework [7]

B. Application Architecture

We design the application architecture and divide it into 6 modules, as shown in Fig. 11. The most important part is Playing Manager Engine (PME) which is responsible for application controlling and orchestrating all modules to drive for the application goal.

The first module, Multitouch Detecting Engine (MDE), is a module for detecting all concurrent touches from the user which will support both free and practice playing modes [8]. In order to do Ranaad Ek percussions, the application will allow the user's touches on touchable areas and directions, as shown in Fig. 12 indicated by dash arrow lines meanwhile solid arrow lines indicate the opposite. The player is able to touch the areas outside the wooden bars but the application will not have any response.
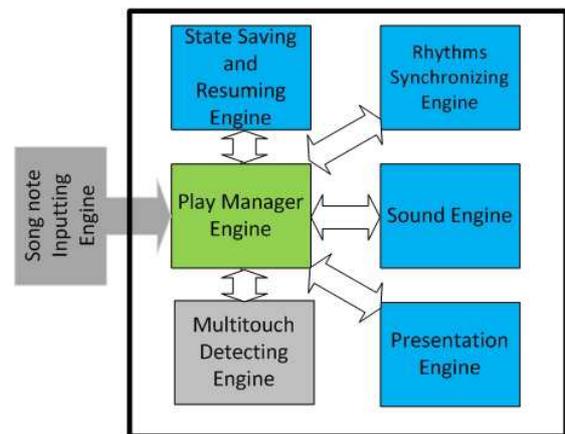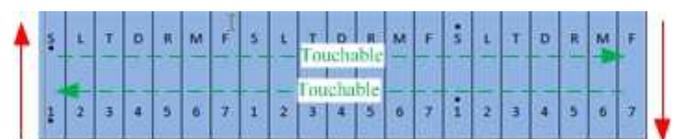

Fig. 11 Application architecture

Fig. 12 Touchable areas and directions

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There are wooden bars in our application starting from the far left to the far right. Each produces an identical sound tone in traditional Thai system of organology from the lowest Sal to the highest Far tone. Therefore, there are 21 mono tones and 14 8-double percussion tones.

The second module, Sound Engine (SE), is a module for playing each sound of each wooden bar of Ranaad Ek in order to precisely produce sound from the message or parameter sent by MDE. We design the application that will support both tones of sounds produced by using soft and hard mallets. This module will be activated in both free and practice playing modes.

The third module, Rhythms Synchronizing Engine (RSE), is for managing the song rhythm that is classified according to the speed of playing into one-class, two-class and three-class in the traditional Thai system of organology. In this work, our application will produce the sounds of Ching, a traditional Thai musical instrument for controlling rhythm.

The forth module, State Saving and Resuming Engine (SSRE), is a module for collecting states in practice playing mode in case that a player pauses. The system will keep necessary states and when the player resumes to play, the system can restore these saved states to continue running the application.

The fifth module, Song note Inputting Engine (SIE), is a module for inputting song notes used in the practice playing mode only. Therefore, it transforms of song notes into PME (Playing Manager Engine). The application supports song notes in 8-double and portion percussion as a minimum requirement [9].
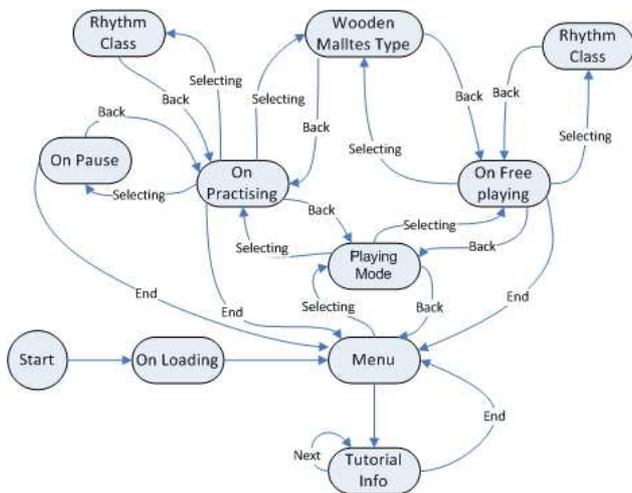

Fig. 13 Application main state diagram

The last module is Presentation Engine (PE). Our application will run in user-event-driven orientation such that the interaction between the application and the player will achieve by PE module. The application main state diagram is shown in Figure 13. On Free Playing and On Practicing are states which support free playing mode and practicing mode respectively.

In order to end the application established by the iPad hardware mechanism, the user need to push Home button. Nevertheless, the application may not be destroyed or deallocated from the main memory depending on the iOS multitasking [6]. However, its resuming mechanism allows the player to jump from On Loading state to each playing mode which was suspended before swapping the application into the background.

C. Playing Mode

We design the Ranaad Ek application to have two playing modes. The first mode is free playing. The player can freely multi touches. Even though they play wrong percussions, the application still generates note sounds located on the touched wooden bars. The state diagram is shown in Fig. 14.
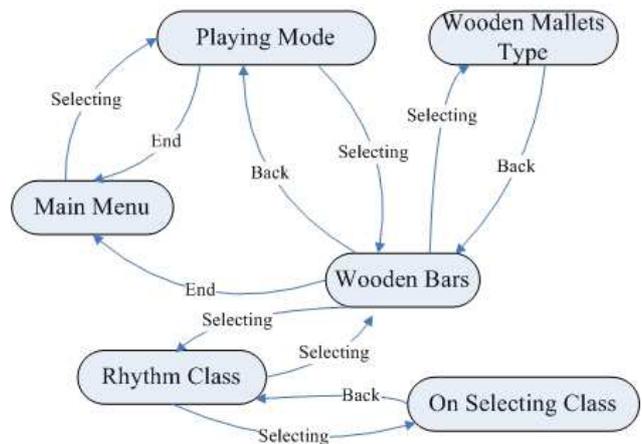

Fig. 14 On Free Playing mode state diagram

The second mode is practice playing. The state diagram is shown in Fig. 15. The mode is for letting the player to follow percussions and rhythms of practice songs which recommended by The Arts Cultural Center of Prince of Songkla University. The song named one-class rhythm Khae-Bor-Ra-Ted (Thai: แขกบรเทศชั้นเดียว) is the first practice song for the first beta version of the application. The song is classified into all three rhythm classes [4] which are used to play and sing in the performance. In these states, the player can choose soft or hard mallets and rhythm classes respectively.
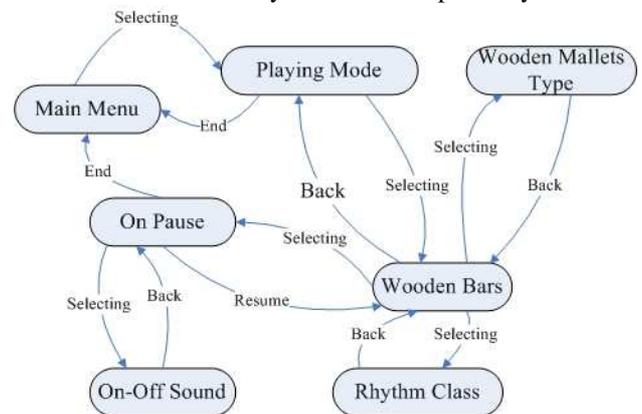

Fig. 15 On Practicing mode state diagram

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D. Graphical User Interface

Initially, traditional Thai musical instruments were created only for making music. Then musicians and craftsmen earned a lot of experiences and achievements. Therefore, the instruments were extended with decorative motifs or patterns. The instruments brought forward to more luxurious, refined carved and decorated with mother-of-pearl and golden designs [1]. Our application idea and design are conceptualized into golden motif theme. We design GUI in only Thai language for the first version. Our application supports landscape orientation displaying only in order to manage layout design of Ranaad Ek wooden bars which consists of 21 bars. The Landscape orientation gives us a flexible design area and it is easy for the player to touch these wooden bars. Fig. 16 shows Ranaad Ek application on loading screen. It is light flash animation while the application is initialized into the main memory.
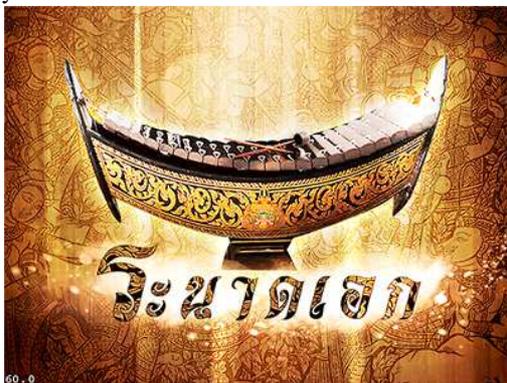

Fig. 16 Ranaad Ek application on loading screen

Fig. 17 shows Ranaad Ek application main menu. It consists of two choices. The higher item is playing mode and the lower item is tutorial information. Fig. 18 shows Ranaad Ek application wooden bars which are used in both free playing and practicing modes.

Fig. 17 Ranaad Ek application main menu

Fig. 19 shows the tutorial mode design screen for the practicing mode. When flash lights occur on the wooden bars for the user to practice the song notes, the player has to touch them, and then next song notes will flash lights on the next wooden bars again and again until the song ends.

Fig. 18 Ranaad Ek application wooden bars

Fig. 19 Tutorial design screen for practicing mode

IV. IMPLEMENTATION AND DISTRIBUTION PLATFORM

A. Implementation Environment

We implement Ranaad Ek application using Cocos2D version 1.0.1 framework on Mac OS X 10.6.8 with Objective-C on Xcode IDE version 3.2.6 (1761). We record the sounds from real instruments in a studio. Then, we improve the sound frequency of each wooden bar into same amplitude.

B. Multitouch Detecting

We manipulate multitouch detecting by overriding three Cocos2D methods; ccTouchesBegan, ccTouchesMoved and ccTouchesEnded.

For example, a fragment of ccTouchesBegan method implementation for free playing mode is shown in Fig. 20. We have to calculate touchable area which is wooden bars. Meanwhile, we have to detect moving touch gesture for marking flag 'senderMove' to ccTouchesMoved method. Finally we extract touchable area by sending message bounding box and touched location in OpenGL of each wooden bar Sprite to 'CGRectContainsPoint' method as shown in Fig. 21.

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```
    UITouch *touch = [touches anyObject];
    CGPoint location = [touch locationInView: [touch view]];
    SpriteRanand *OBTouchBG = [[[SpriteRanand alloc] init]
autorelease];
    [OBTouchBG initBackground];
    CCSprite* Touchbg = OBTouchBG.bgRang;
        if (CGRectContainsPoint([Touchbg boundingBox] , location)) {
            NSLog(@"Test Touch BG");
            senderMove=YES;
        }
```

Fig. 20 A fragment of ccTouchesBegan for calculating touchable area

```
    for (UITouch* touch in touches ) {
        CGPoint location = [touch locationInView:[touch view]];
        location = [[CCDirector sharedDirector] convertToGL:location];
        if (CGRectContainsPoint([spriteButtonP1 boundingBox] ,
location)){
            touchedPads = touchedPads | (1<<0);
            spriteButtonP1.visible=TRUE;
        }
```

Fig. 21 A fragment of ccTouchesBegan for extracting each wooden bar area

C. Memory Management

iOS does not have a memory management. Therefore, it is necessary for developers to manipulate memory allocation and deallocation of many objects in the application by themself. We implement data property of object to "@property (nonatomic, retain)" for monitoring references and "release" for releasing unusable references in main memory.

D. Distribution Platform

The application supports iOS version 4.3 or later. Application distribution platform is a trademark apple tablet computer, iPad2. It has 9.7 inch widescreen with IPS touching technology bundled and 1024x768 resolutions [10]. User inputs are established via multitouch in order to do Ranaad Ek percussions that the user concurrently touches double wooden bars with two fingers.

V. CONCLUSION

This paper proposes an architectural software and GUI design of a traditional Thai musical instrument application for tablet computers. We implement Ranaad Ek, trough-resonated keyboard percussion instrument. The application will be distributed on iPad2 with iOS 4.3 or later.

The application consists of two playing modes. The first mode is free playing, a player can freely multi touches on wooden bar to produce instrument sounds. The second mode is practicing mode that guilds the player to follow percussions and rhythms of practice songs. In Fig. 22, the Ranaad Ek application provides percussion methods for a player as real as a physical instrument in the free playing mode. The application has achieved requirements and specifications.

Fig. 22 The application in free playing mode

REFERENCES

[1] "Divine Music", First English Edition, 1st Printed, Bangkok: Bangkok Printing (1984) Co., Ltd., 2003. ISBN 974-91812-6-3.
[2] The Royal Institute, "Thai Classical Music Encyclopedia: Kred Song And Sing Plays History Section", 1st Printed, Bangkok: The Royal Institute, 2007. ISBN 9789749588819.
[3] Yuksel, K.A.; Ketabdar, H.; Roshandel, M.; , "Towards digital music performance for mobile devices based on magnetic interaction," Haptic Audio-Visual Environments and Games (HAVE), 2010 IEEE International Symposium on , vol., no., pp.1-6, 16-17 Oct. 2010 doi: 10.1109/HAVE.2010.5623990.
[4] Suraporn Suwan, "Thai Classical Music in Thai Culture", 1st Printed, Bangkok: Chulalongkorn University Press, 2006. ISBN 974-9941-57-8.
[5] Physical and development of of Ranaad Ekm, Office of the National Culture Commission, online: October 2011, http://www.culture.go.th/knowledge/story/ranad/direct5.htm.
[6] Steven F.Daniel., Xcode 4 iOS Development, Beginner's Guide, First published: August 2011, Production Reference: 1160811, Published by Packt Publishing Ltd. Birmingham, UK. ISBN 978-1-849691-30-7.
[7] Cocos2D for iPhone, Available online: October 2011, http://www.cocos2d-iphone.org/.
[8] Costantini, G.; Todisco, M.; Perfetti, R.; , "A novel sensor interface for detecting musical notes of percussive pitched instruments," Advances in sensors and Interfaces, 2009. IWASI 2009. 3rd International Workshop, vol., no., pp.121-126, 25-26 June 2009. doi: 10.1109/IWASI.2009.5184781.
[9] GiHoon Go; TaeHoon Song; SoonMook Jung; HyunUk Jeong; MyungJin Kim; MinKyung Kim; HyungMin Kim; MiYoung Kang; KeyHo Kwon; JaeWook Jeon; , "Generating music using a picture and a transform system," Control Automation and Systems (ICCAS), 2010 International Conference on , vol., no., pp.2285-2289, 27-30 Oct. 2010.
[10] iPad2 Techinal Specifications, Apple, Available online: October 2011, http://www.apple.com/asia/ipad/specs/