WIJAM: A Mobile Collaborative Improvisation Platform under Master-players Paradigm

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ABSTRACT

Music jamming is an extremely difficult task for musical novices. Trying to extend this meaningful and highly enjoyable activity to a larger recipient group, we present WIJAM, a mobile application for an ad-hoc group of musical novices to perform improvisation along with a music master. In this “master-players” paradigm, the master offers a music backing, orchestrates the musical flow, and gives feedbacks to the players; the players improvise by tapping and sketching on their smartphones. We argue that this paradigm can be a significant contribution to the possibility of music playing by a group of novices with no instrumental training leading to decent musical results.

Keywords

social improvisation, music collaboration, mobile music making

1. INTRODUCTION

Music jamming is a kind of music improvisation performance usually given by a band of music virtuosos who feel natural and comfortable to express musical feelings using their instruments. Musical novices seldom touch this type of performance because their musical knowledge is insufficient to handle the complex musical context built up during the jamming. Trying to bridge this gap between the virtuosos and novices, so as to lowering the barrier of enjoying the pleasure of music jamming, we design WIJAM, an impromptu mobile application for a group of musical novices(friends or strangers) to jam along with a music master. The master provides backings, directs the musical flow and gives feedbacks to the players. The players improvise along freely while listening to the backing music. This is similar to any staged jam session, except that WIJAM has an explicit “bandleader” and the “band” is composed of an *ad-hoc* group of people.

WIJAM, according to Weinberg[1], is a “small-scale local system”, which can be characterized as “collaborative musical network ... that support three to ten players in close proximity, which allows for detailed and subtle interpersonal interactions”. Under the “theoretical framework of musical interconnectivity”[1], WIJAM can be considered structure-centered and process-centered, where “structure” is manifested in the absolute musical arrangement control of WIJAM master, and “process” is done when WIJAM players express intuitively their musical feelings within the bounds as defined by the WIJAM master. In terms of organization and architecture, WIJAM is a “synchronous centralized network” with a “flower topology”, where music is being generated in real-time with a central hub, and the degrees of freedom in terms of the nodes’ expression are limited to a level such that the musical outcomes are at least musically harmonious.

2. DESIGN AND IMPLEMENTATION

WIJAM’s design follows [2]:

> The underlying premise of most collaborative interface design is that with various design constraints, playing music can be made accessible to non-musicians ... at the expense of limiting the musical range and possible gestures associated with sound in a collective space.

But as pointed out in the same paper, such a guideline has its drawback:

> ... many of the simple-to-use computer interfaces proposed for musical control seem, after even a brief period of use, to have a toy-like character and do not invite continued musical evolution.

Although the authors go on to argue that this is only true for expert musicians, “balancing this trade-off is a key concern for designers”, as pointed out in [3]. This point is echoed in many other papers, such as [4], it mentions “provide novices with essential goals and experts with additional goals”. Trying to strike this very balance, WIJAM equips the players with an easy to learn and easy to play keyboard, while at the same time providing “a knowledgeable person to stand by and assist the players” [2]—the master. The players’ performance bound is imposed upon by the master, which should give a large enough space for the players to show off their virtuosity.

2.1 Big Picture - Entities and Flow Chart

Figure 1 shows the big picture of WIJAM. There are two kinds of active entities: the master, who initiates and orchestrates the jamming, and the players who participate in the jamming. There is also a passive entity: a loudspeaker system, which is connected to the master.

Figure 2 is the flowchart of the whole jam session process. At the beginning, the master hosts a MIDINetworkSession as a jam session service to be discovered and connected to.

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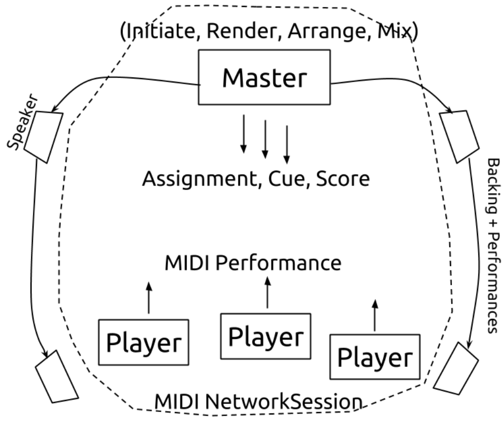

Figure 1: The big picture of WIJAM. The music collaboration is achieved under the "master-players" paradigm.

Then the players join the session. After that the master sends an "assignment" package to each player. The package contains an instrument ID, a musical key (or "root" to be precise) and a musical scale. The master signals the start of the jam by switching on the backing music. When the players start to jam, they send MIDI performance contents to the master via coreMIDI. The master monitors all the performance, renders the notes in the chosen instrument sounds and mixes them with the backing into one output stream. While jamming, the master orchestrates everything to fit to the backing music by instantly changing the assignment or providing performance cue feedbacks to the players such as "good", "solo", "fast", "calm", etc. When they finished jamming a song, the master gives an overall score as well as an individual score to the players to indicate how well they have done.

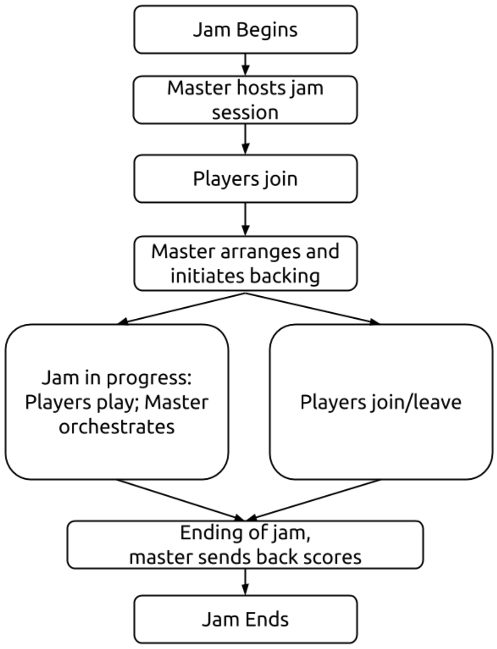
Jam Begins
Master hosts jam session
Players join
Master arranges and initiates backing
Jam in progress: Players play; Master orchestrates
Players join/leave
Ending of jam, master sends back scores
Jam Ends

Figure 2: The flowchart of WIJAM.

2.2 Details - Master Machine

The internal structure and layering of the master machine is shown in the middle part of Figure 4. The core modules are detailed below:

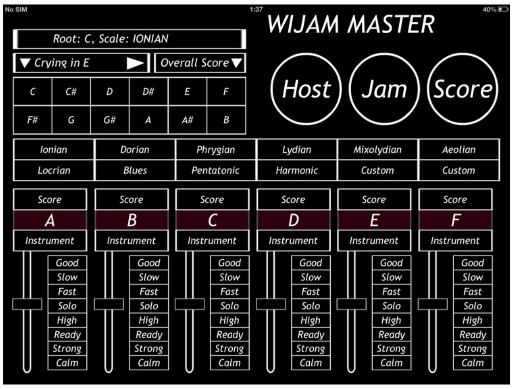

Figure 3: Master Interface

Master Interface — The master interface is shown in Figure 3. In the top left corner there is a backing selector which allows the "user" to initiate the backing music. Moving downwards one finds the chord and the scale panels. They are particularly important for orchestrating the musical flow. At the bottom we can see six consoles, from A to F, each for an individual player. They are needed for providing performance feedback to the players as well as music output level balancing.

Arranger — This allows the master to manipulate chords, scales, instruments, and provide performance cues and scores as feedbacks. These messages are sent via MIDI sysEx messages.

Virtual Instruments — It stores a library of digital musical instruments in the form of samplers. The audio samples are managed using AUPreset and AUSampler technologies[5]. The AUPreset files are used to map audio samples directly to MIDI numbers and velocity ranges.

Jam Session Host — It hosts a service which can be easily discovered and connected to by the player machines. We use MIDINetworkSession within the CoreMIDI framework to enable a Bonjour service. It is to be discovered by the player machines' Bonjour service browsers, and to be connected to by the player machines' MIDINetworkSessions.

2.3 Details - Player Machine

The player machine's layering is described on the right hand side of Figure 4, and its interface on Figure 5 with the jam console on the left and the keyboard on the right.[1]The jam console is designed to discover and connect to the master machine, while the keyboard is dedicated to musical expression. The keyboard appears after the jam session has been established. The following items summarize the working mechanism of the keyboard:

- The y position determines the pitch, where higher position yields higher pitch. A screen has 22 pitches.

- At any time the keyboard is filled with the assigned chord-scale given by the master machine. The chord-scale consists of a root and a scale, such as A-Ionian, which is played under the presence of a chord like A major, or a chord progression with a common scale, such as A-F#m-D-E and their substitutions.

[1] The source code of WIJAM is now available at github: `https://github.com/tangkk/MasterMachine.git` and `https://github.com/tangkk/PlayerMachine.git`

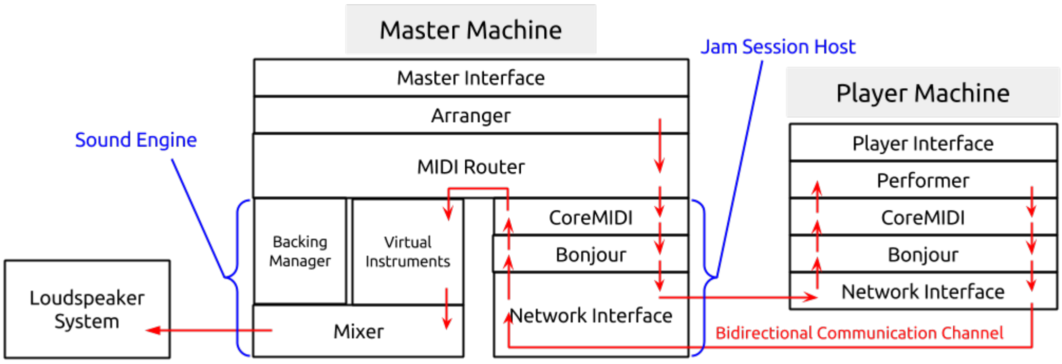

Figure 4: The internal layering and structure of WIJAM. The data flows from the master machine (middle) to the player machine (right) through the bidirectional communication channel, and vice versa.

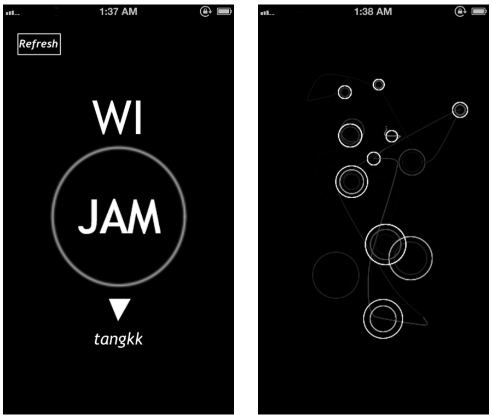

Figure 5: Player Interface

- The x position determines the note velocity. A larger x position value gives higher velocity.
- When sketching, a note is generated when the it starts or when the curve comes to a stationary point.

This keyboard is intuitive for the novice players since it abstracts away much of the complicated musical context. It also frees the players' imagination since it offers a space as large as the entire screen without any grid. This allows the players to do a relatively high-level melody improvisation.

3. DEMO

There are two demos of WIJAM available[2]. The WIJAM demo shows how WIJAM works, and provides tips for using the master machine and the player machine. The audio track is an unmodified recording of the original playback. Before the jam starts, the players are told to follow their "musical feelings" based on the backing. As can be heard in the video, the music outcome is quite pleasing, even at the critical "key modulation" points: 2:30 and 2:43. Note that as the jam goes on, because the players have little idea about what the exact notes they are playing, the "avoid note", the most dissonant note within the chord-scale, may be played on downbeat. This may happen, but with a very small chance.

The "trombone" player and the two "guitar" players are with zero training in musical instruments. The "piano" player has some limited experience with piano before. Even so, the piano player is able to inject a very beautiful solo during the jam. The "piano" player apparently plays the best music in this jam session. This somewhat justifies the "balance" problem in the "Introduction" section of this paper, in that WIJAM actually allows advanced players to show off their virtuosity while also enabling an acceptable level of performance for the novice players.

The WIJAM advanced demo is a bonus track featuring the designer of WIJAM playing and overdubbing a whole jam session. It shows some advanced features of the PlayerMachine. The audio track is an overdubbing of each instrument track plus the backing track.

4. BACKGROUND REVIEW

Apple GarageBand's "Jam session"[6] probably has the most similarity to WIJAM. It allows real-time jamming and multitrack recording at the same time. The players choose instruments from Garageband's instrument library, and then one of them creates a jam session that everyone else can join in and jam. However, it is obviously not a "master-players" paradigm, even though the jam session has a "bandleader"[7]. The "bandleader" does not seem to have much control over the jam compared with WIJAM master who can dominate the key, scale, backing, performance feedback, output volume, etc. in real-time. Therefore Garageband requires its players to be relatively musically talented in order to complete a successful and comfortable jam session. Also its player interfaces are replicas of real instruments' layouts, which are relatively difficult for a musical novice to handle. One should be able to easily tell the essential differences between the two applications, which lie in their target scenarios. Garageband is suitable for a group of musical talented peers to intentionally record their jam, while WIJAM targets at an ad-hoc group of people who happen to come together in a common place and want to have fun.

ZOOZbeat[8] is also a music jamming application focusing on musical novice's experience. It supports multiple notes input gestures, such as shaking, tilting, tapping and tossing. It provides individual play mode or group play mode. We notice however that in its group play mode, there is neither a centralized control nor a common goal among the players; it is designed more for the situation where the players are actually a group of friends following a pre-composed work or with a clear objective, and less for group ad-lib. In comparison to ZOOZbeat, the most significant advantage of WIJAM is the "master-players" paradigm, where the players can follow someone's musical arrangement and performance cues in real-time. Most importantly, they

[2] WIJAM demo: `http://www.youtube.com/watch?v=YOPnKBrgzgw` and WIJAM advanced demo: `http://www.youtube.com/watch?v=16dWj5G9UKw`

have a shared goal which is to try to achieve a good score by the master at the end of the jam.

Ocarina [9] is a famous application that can offer a great user experience by emulating perfectly a real ocarina. Although this is not a music jamming application, it includes a "world-stage" [10] engine to let users perform or compose for other people, or to observe and judge the performance by anyone else in the world. WIJAM borrows some of this idea, but limits the performance to a "common-area-stage", and every participant in the jam, including the master, is a performer, a composer, a listener and a judger at the same time. WIJAM is different from Ocarina in the composing process and performing process, as they can happen at the same time. That means every player is actually an improviser under the assistance of the master. This is interesting because in WIJAM the master does not compose everything for the players, he/she just applies some very relaxed constraints on what the players' playing, whereas in Ocarina, the players are only playing what they see on the screen in order to get their score.

Some academic literature have also suggested various approaches and paradigms for network collaborated performance. Reference [11], one of the seminal papers in the field of mobile music making, describes a system targeting collaborative performance over wireless ad-hoc network. The collaboration paradigm is based on a social metaphor of friendship. Thus it's basically a "playing together" peer-to-peer approach. It stresses on real-time music creation, collaborative composing and proactive listening. WIJAM differs from this in that it is based on the "master-players" paradigm; hence it aims at a relatively serious kind of jamming rather than simply "playing together". Reference [12] suggests an audience-participation music making approach, by using a master server to collect the audience generated materials, reprocess them and present them back to the audience. This is similar to the master-players approach, but its final output can be expected to be somewhat experimental, since, unlike WIJAM, it does not take much of traditionally "musical" materials into consideration. Reference [13] also suggests a master-players performance approach. Master controls the tempo and time signature of the performance via sending players MIDI-clock signal, while the players contribute to the performance by sending audio contents to the master who performs real-time post processing before the final output. This kind of collaboration is quite similar to WIJAM's except that WIJAM master puts more stress on the arrangement and orchestration rather than simply the tempo.

5. CONCLUSIONS

Our discussion stresses repeatedly on the "master-players" collaborative performance paradigm, by which the powerful master machine and intuitive player machines together can achieve some meaningful collaboration. We describe two demos of WIJAM, showing that the musical outcomes of WIJAM can be quite acceptable. Finally, we contrast the uniqueness and novelty of WIJAM with existing applications or ideas from the academia. Based on discussions, we can safely draw a conclusion that WIJAM, with its "master-players" paradigm, provides a brand new perspective on how social music collaboration could be done.

There is ongoing work following the current WIJAM implementation. For example, in order to have social music making independent of the existence of a real musician, i.e. the WIJAM master, an auto-assignment module is being developed to "look ahead" or "pre-analyse" the backing and assign the correct chord-scale to the players at the appropriate time. Besides auto-assignment, an auto-arrangement and auto-mixing module will be needed if the real musician is to be eliminated eventually. This means that the musical burden, from arrangement to mixing, will be migrated to the computer. Furthermore, there are some other related topics such as crowd-sourcing composition and algorithmic composition. Crowd-sourcing composition involves automating the music outcome evaluation process, while algorithmic composition is about automating low-level musical processes on players' side in order to let them improvise at a much higher level. We hope WIJAM will eventually become a "musical-automated" social improvisation platform that can involve anyone interested in playing music.

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