# Game Design for Expressive Mobile Music

Ge Wang
Center for Computer Research in Music and Acoustics (CCRMA)
Stanford University
ge@ccrma.stanford.edu

## ABSTRACT
This article presents observations and strategies for designing game-like elements for expressive mobile musical interactions. The designs of several popular commercial mobile music instruments are discussed and compared, along with the different ways they integrate musical information and game-like elements. In particular, issues of designing goals, rules, and interactions are balanced with articulating expressiveness. These experiences aim to invite and engage users with game design while maintaining and encouraging open-ended musical expression and exploration. A set of observations is derived, leading to a broader design motivation and philosophy.

## Author Keywords
Game design, physical interaction design, mobile music, musical interface, gamification, game studies.

## ACM Classification
H.5.5 [Information Interfaces and Presentation] Sound and Music Computing–Methodologies and Techniques, H.5.2 [Information Interfaces and Presentation] User Interfaces–Theory and Methods, H.1.2 [Information Systems] User/Machine Systems–Software psychology.

## 1. INTRODUCTION
Game design is the art and emerging science of applying design and aesthetics to define a cohesive set of rules, goals, challenges, and rewards – to be experienced through interactions by its participant(s). Effective game design engages players to make creative use of game rules to overcome a set of challenges. Often this involves gradually developing specific skills (e.g., timing, coordination, reflex, memory, problem solving, strategic thinking, and more). From a practical perspective, game design can provide both motivation and the medium to learn and hone skills. It is therefore not surprising that games have been invented not only for pure entertainment but also for learning, in areas such as math, language, logic, and music.

Games are no stranger to music. For example, in the practice and mastery of traditional instruments such as the cello or piano, game-like strategies can be employed to instruct, overcome difficulties and undesirable habits, motivate, and provide long-term structure in mastering a particular aspect of an instrument. For example, a learner may practice a passage starting with a slow metronome click, and only when it is played perfectly, can she raise the metronome by 1 or 2 BPM. Teachers and learners may empathize with this technique, as it promotes long- and short-term engagement with a clear challenge to overcome.

This simple example of sustained music training facilitated by a simple set of rules and constraints is effective in engaging the player for a longer period of time than without the "game", and is often successful in developing skill. Game design for such ostensibly "serious" purposes date back several millennia, ranging from early military uses to applications in education and business in the 20th century [1].

A closely related—and more recent—notion of *gamefication* is provided by Deterding et al. as "the use of game design elements in non-game contexts" [5]. In their thorough and careful distillation, subtle differences are drawn between "gamefication" and such concepts as "productivity games" [15], "playful design" [7], "behaviorial games" [6], and "game layer" [19]. A deeper distinction is highlighted between the notions of *paidia* (or "playing") and *ludus* (or "gaming"). Whereas the former denotes more open-ended, expressive, free-form behaviors and meanings, *ludus* is characterized by rule-based systems designed with specific goals. It is interesting to consider these bipolar notions in the context of game design for musical expression—as designers we seem to value both the open-ended expressive possibilities as well as *gameful designs* that naturally motivate and facilitate such expressive engagements (in the short- and long-term).

Games possess the ability to motivate users to engage with peak intensity and duration, reaching a state some call "being in the zone" or "flow". The concepts of "flow" and "optimal experience" [4] provide frameworks to better understand how we achieve states of such heightened concentration while so engaged in an activity that all other concerns and distractions disappear – enabling one to experience a sense of unparalleled productivity and performance. According to Csikszentmihalyi, reaching flow is dependent on several conditions, which include 1) balance between inherent challenges and the present skill of the participant, 2) the potential for growth in the progression of continually expanding challenges, as well as the potential for immediate feedback on one's performance, and 3) setting forth of goals that are reachable within a clear, defined boundary of time and space.

Games seem to naturally excel at satisfying the above conditions for flow. They can be balanced to provide goals (long- and short-term) while continually be tuned to provide just the right amount of challenge to motivate the player satisfyingly onwards – to provide a sense of being "in the zone". It can be argued that games are created, above all else, to induce a sense of flow, and the potential benefits – such as entertainment, pleasure, productivity, improvement in skill – are "by-products" of flow. Nonetheless, we are often interested in these very "by-products" as results, including using games to fundamentally enhance expressive musical experiences and skills. In this paper, we specifically explore how game-like elements can be designed and incorporated into expressive interactive music experiences, in the form of mobile music instruments designed to reach a wide audience. In particular, this work is concerned with designing music-making interactions that are "expressive" – that is, they have potential to convey feeling and nuance through open-ended creativity.

## 2. VIDEO GAMES AND MUSIC
As direct predecessors of mobile music games, music video games include the works of Toshio Iwai [13], *Mario Paint*'s musical arrangements [18], *Rez* [25] where in-game actions and music occur with strong mapping, and musical timing and rhythm games such as *PaRappa the Rapper* [17]. Custom computer music interfaces have


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been inspired by and created with game-like elements. *ChucK ChucK Rocket* [21] for laptop orchestra by Scott Smallwood and Ge Wang is a "music-fied" version of the Sega Dreamcast game *ChuChu Rocket!* [23]. Games and game engines have also directly been used as platforms for research into environments for composition and other music-based experiences [10,8].

*Guitar Hero* [11] and *Rock Band* [12] represent a more physical class of musical timing games that have achieved mainstream appeal. They are imitative in nature, from the plastic guitar- and drum-like controllers to the core experience where timing and dexterity are rewarded with the feeling/illusion of playing complex rock music, in front of simulated in-game audiences. The experience hinges on reasonable and satisfying reductive mappings of musical score to button presses in time with the music. The player is not so much making the music, but rather causing recorded musical tracks and stems to play back without mistakes. In this sense, Guitar Hero and Rock Band are fundamentally more games than music instruments; they are not intended for open expression, and instead are designed, quite effectively, to provide a form of active engagement with familiar (and nostalgic) recorded music.

Another relevant class of games is GWAP, or "games with a purpose" [26]. These computer games are specifically designed to leverage human intelligence to solve interesting or useful problems that are inherently difficult for computers but easy for humans (e.g., image labeling, music classification and analysis, crowdsourced music-making). These games place humans into problem-solving loops driven by game-like goals, while their broader "ulterior" purposes (e.g., labeling objects in a photograph, transcribing audio or musical recording, etc.) are not necessarily apparent to the players (nor is it necessary to carry out the game). By playing the game, players help contribute, sometimes unwittingly, to more "practical" and "useful" tasks.

All of the above have influenced the design and incorporating game-like elements into mobile music instruments examined in this work, designed by the author and as part of the startup Smule [30]. These mobile musical games are products and experiments to bring expressive music making for a wide, "casual", and mass audience.

# 3. OBSERVATIONS AND ASSUMPTIONS

The works described in this paper follow a set of general observations and assumptions about games and game design for musical expression. We list them below and draw upon them in the case studies.

1) Whereas musical instruments are generally viewed to be "*specialized"*, games are viewed as playable by potentially anyone. There is a lower perceived barrier of entry with games (or more relevantly, with things that are *perceived* as games).
2) Games can be designed to provide clear, attractive, and attainable goals (short- and long-term) for engagement with an activity; reaching these goals can provide a sense of satisfaction and reward, which in turn reinforces the desire to experience elements with increasing difficulty. Similarly, game-like elements can help balance challenge and difficulty (and perhaps adapt to the skill level of the player) to provide a sustained sense of progress. It also can give rise to the possibility of flow.
3) Games do not need to come at the expense of expressiveness. Game-like elements can be added while also leaving open space for expression. The most engaging games offer a balance of well-designed constraints and open creativity. For example, the game Minecraft [16] encourages users to explore and create at various scales. In fact, appropriate constraints can – and are arguably necessary to – encourage creativity.

Additionally, we make a distinction between two levels of incorporating game-like elements (or gamification): peripheral vs. core. "Peripheral" gamification is built around the main experience or interaction – for example, achievements, points, leveling-up, in-game reputation. These can be designed somewhat independently from the central game experience. By contrast, we define "core" gamification as deep integration of game elements into the core mechanic, such that these elements are inseparable from the experience – in fact, they help to define it. While we address both types of gamification in the next section, this work mostly examines the latter – core musical gamification, since it is more directly relevant to the experience of musical expression we are after.

# 4. DESIGN: CASE STUDIES

In this section, we present the design of several popular commercial mobile music apps. These apps make us of game-like elements in core interactions that intentionally leave room for open expressiveness. They were designed "for the masses", intended to lower barrier of entry for novices, non-musicians, and casual players, but have high skill ceilings to leverage more seasoned skill and musicianship. To date (since 2008), these apps have collectively reached more than 125 million users. We examine each of these through the lens of games and game-design, and discuss their roles in expressive music-making.

Three fundamental design considerations recur in these case studies: 1) whether pitch is hard-coded or provided as guides or indicators (users can deviate from the latter), 2) whether timing is open-ended or proceeds at predetermined tempo, and 3) the complexity of interaction (minimal/reduced vs. fully involved multiple simultaneous actions, such as blowing into microphone and multitouch). How these design considerations are managed help define the core experience in each app.

## 4.1 Magic Piano

Magic Piano's primary game mechanic is simple, perhaps even minimal (Figure 1). Glowing points of light ("fireflies") encode a musical score with up to four voices of polyphony (expressed via multitouch). These "fireflies" fall from the top of the screen (their vertical spacing hint at the relative note durations), while each new touch gesture triggers the next unplayed note. There are no tempo constraints – this is a game built around expressive musical timing. In other words, the player is completely free to express each note in time – at any tempo, with variation, rubato, swing, rolling chords, and trills. The fireflies fall only as more notes are played, otherwise they patiently wait, twinkling onscreen. The design specifically avoids the notion of a "correct" tempo.

**Figure 1. Magic Piano's core game interface: dots encode pitch, while player maintains control over musical timing.**

The pitch in Magic Piano has been abstracted away (i.e., "put on rails" and to be rigidly followed), partly because of the small screen size and lack of tactile feedback of physical keys and key boundaries. This design concession allows users to focus on music timing (musical dynamics are encoded into the score, with additional subtle dynamic variation mapped to touch position along the Y-axis: the closer a user taps to the bottom of the screen, the louder). Somewhat whimsically, notes can sound "out of tune" if the tap gesture strikes sufficiently far away from the firefly along the horizontal axis. This design intends to add an additional game-like challenge while still keeping intact a direct and satisfying gesture-to-sound interaction.

There are four levels of difficulty for each song in Magic Piano (to date there are more than 1,000 songs in its Song Library). They differ in timing and polyphonic complexity (the easiest mode,

"practice", collapses each chord down to only one dot; whereas the hardest mode will require multitouch gestures for up to four voices).

In a way, the Magic Piano is designed to rarely sound horrible – largely due to the score being hard-coded and therefore easy and quickly satisfying to play – even for players with no prior musical experience, and with reasonably convincing piano sound. This may explain the app's appeal to novice users. Yet, with familiarity and practice, a player can become quite skilled (app analytics suggests that songs are commonly replayed, and often in succession, suggesting a natural motivation and challenge). Furthermore, a song can be potentially played in many different styles. No two performances of a given song are quite the same.

If the intrinsic instrument/game mechanic may be classified as "core" gamification, a more "peripheral" gamification provides game levels and rewards (such as new instrument sounds) for progress and mastery of songs. Overall, the presentation of Magic Piano as a game is designed to lower inhibition about actively making music. This has proven effective, as evident by its more than 80 million users. As Magic Piano's designer, the extent to which it is perceived as an expressive instrument is not important – so long as expressiveness is afforded when people experience the game.

## 4.2 Magic Fiddle

Despite the reappearance of "Magic" in the name, Magic Fiddle is a drastically different experience and game from Magic Piano, beyond the obvious instrument difference. For one, the Magic Fiddle game mechanic is based on a virtual iPad-based three-string fiddle-like interface [29] with continuous pitch mappings, and the ability to "bow" (via a circular interface) and "pluck" (running finger across or tapping the string near the bridge).

The game mode animates colored lines moving towards positions on one of three fiddle strings, colliding gently at the intended point of articulation (Figure 2). Longer lines represent longer note durations. Unlike Magic Piano, there is a specific tempo at which the music is intended to proceed – an automated piano accompaniment helps to keep time. Part of the game in Magic Fiddle is to play at the intended tempo and in concert with the accompaniment. The color line indicators are merely helpful suggestions, leaving the player to express pitch freely (often to the detriment of intonation, but allowing glissandi, vibrato, and various embellishments) along with dynamics via the circular bowing interface (closer to the center, the louder), which also provides some limited control over articulation.

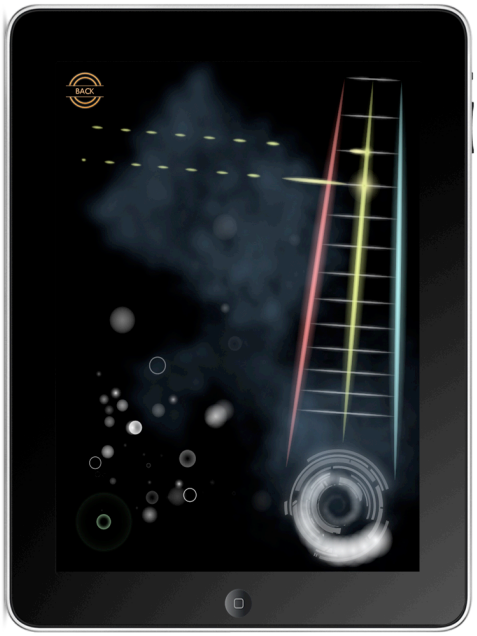


**Figure 2. Magic Fiddle's core game mode.**

It is useful to note that the sound is synthesized in real-time, in order to support a strong and direct action-to-sound mapping. The player is aware at all times (and sometimes painfully so) that he is directly making the sound. The far-from-perfect bowed string physical model (a difficult class of instruments to model!) and the open freedom of the game often lead to less-than-spectacular or even comical renderings of well-loved songs such as *Pomp and Circumstance*, *Super Mario Bros. Theme*, *Bach's Air for G String*, and many others. From a design perspective, this is not wholly undesirable – Magic Fiddle is as much designed to capture the nostalgia of learning a difficult instrument (or having neighbors learning the violin), as it is to play the instrument.

### *4.2.1 Gamifying Music Lessons*

To help users learn to play a virtual, physically-modeled, three-string violin on an iPad, a "Storybook" game mode provides a macro-level arc to the game progression (as a form of elaborate "peripheral" gamification). Each of the 16 chapters features content to teach a player techniques such as "how to hold Magic Fiddle", "bowing", "posture", "pizzacato" as well as tips on expressing particular passages and pieces. Even more whimsically, all lessons are given from the first-person perspective (and personality) of the fiddle itself (The Fiddle's first words: "Hello. I am your fiddle."). As the lessons unfold, so does the personality of the fiddle, adding another dimension of interaction and educational engagement.

Several of the lessons end with a "social homework assignment", which break up the normal format by asking the user to perform tasks that require interacting with people and places in the physical world (for example, "play a song on Magic Fiddle for a friend or loved one"). These encourage users to share the experience as performative and social acts. After each social homework assignment, the app asks the user about the experience as part of the game. For example, one early homework assignment asks the user to play *Mary Had a Little Lamb* while standing up to practice correct posture, followed by a "mission" to play it "in front of a live audience". This activity elicited user responses (via the in-game, end-of-lesson surveys), ranging from the brief ("fun", "awesome", "cool"), to the experiential ("It was fun, my audience (mom and dad) clapped"; "The fiddle told me what to do. Awesome"; "It was so much fun. It was like playing my own violin!"), to the whimsical ("I was epic, the crowd cheered and lifted me up after I stage dived off my bed. Money and roses were thrown at me. It was pretty cool"; "Almost got a standing ovation from 2 dogs"). Later in the Storybook, more demanding missions vary from inviting a friend (or potential lover) to a public play and playing *L'amour est un oiseau rebelled*, to busking outside a coffee shop while playing *Johnny Has Gone for a Soldier*. Perhaps due to Magic Fiddle's game-like whimsical nature, users seem willing to participate. As two more brief examples, Twitter user **timmmmyboy** tweeted (on 11/18/2010): "Ok the whole office is cracking up at my attempts playing the magic fiddle now", while **Intenso** pledged that "this year's Christmas Eve I'll play *Silent Night* for my family on my #Magic Fiddle" (11/26/2010).

## 4.3 Magic Guitar

Magic Piano and Magic Fiddle represent two different, nearly opposite approaches with respect to our three recurring design considerations. For example, Magic Piano embraces 1) hard-coded "on-rails" pitches (users have no open pitch control) 2) on-demand and open timing 3) minimal interaction (multitouch taps). On the other hand, Magic Fiddle was designed with nearly opposite characteristics: 1) pitch is not hard-coded (only suggested by the lines) – the instrument gives user free control over pitch, 2) tempo and intended timing are predetermined, though users can deviate locally for expressive purposes, 3) sophisticated interaction, involving three virtual strings with continuous pitch mapping, and independent articulation control via bowing and plucking interfaces. Magic Guitar embodies some elements of each.

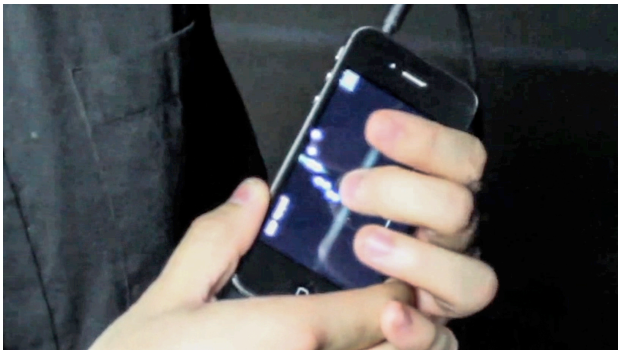

**Figure 3. Magic Guitar interaction includes tap-and-hold to playing incoming pitches, shaking the device for vibrato, and possibility for bending any note.**

In Magic Guitar (Figure 3), the pitches are hard-coded in onscreen animations (like Magic Piano), but the timing proceeds at a predetermined rate (the user can choose a tempo before playing a song, but not during). The complexity of interaction is more involved than Magic Piano, but less than Magic Fiddle. In Magic Guitar there is no picking interaction: a note starts on tap and is held until the touch is lifted. Vibrato can be expressively applied to held notes by gently shaking the phone up and down, tracked by accelerometers. Lastly, a pitch-bend gesture can be initiated by starting a tap in a special screen region (which will begin a note two semitones lower in pitch), and then pushing across the screen towards the target pitch. The design focuses the core interaction on the fret hand to provide a satisfying, if reduced experience. The sound is rendered in real-time through soundfont- and wavetable-based synthesis of acoustic, clean electric, and distortion guitar.

## 4.4 Ocarina & Ocarina 2

Released in 2008, Ocarina [28] is one of the very first expressive mobile music instruments, featuring the physicality of breath for articulation and multitouch to control pitch on a 4-hole iPhone-based ocarina. It also incorporates a game-like element whereby users can learn to play the Ocarina via tablatures provided on the Ocarina website (users can also create and share scores to the forum). The tablatures are easy to learn and required no musical training, but provided a satisfying experience to play familiar melodies on a whimsical instrument that requires blowing into a phone.

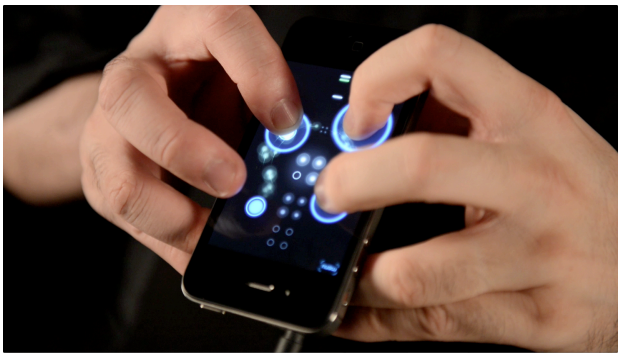

**Figure 4. Ocarina 2's game mode displays the next several fingerings to play. A real-time accompaniment engine follows the score and the player with chord swells.**

The 2012 sequel, Ocarina 2, introduced a new in-app game mode that features animated tablature along with an accompaniment engine that follows the player (Figure 4). An onscreen queue of ocarina fingerings is displayed as hints for the notes to be played. This display advances as the player holds the correct fingering while blowing into the phone. Like Magic Piano, there is no indication of time or tempo; players are generally free to hold each note as long as they wish, apply musical rest, and are generally encouraged to play at their own pace. Articulation and dynamics are controlled via breath, while vibrato rate and amount can be added by tilting the device. Embellishments and ornaments (such as trills and appoggiatura) can be added (or at least attempted). The design aimed to provide a less stressful experience to learn the instrument and to leave as much space as possible for open expression. This was another exploration to strike the balance between an expressive musical artifact and a game / toy. Ocarina 2's game mode mixes 1) pitch indicators (not hard-coded), 2) free timing, and 3) moderately complex physical interaction (breath, multitouch, and tilt).

## 4.5 Leaf Trombone: World Stage

Released in 2009, Leaf Trombone: World Stage [27] is a game-like instrument that embodies many elements discussed above, with the addition of a large-scale crowdsourced social game in which users can publish their Leaf Trombone performances to the World Stage, where ad hoc juries comprised of anonymous users provide feedback and ratings (Figure 6). The instrumental game aspect of Leaf Trombone most resembles Magic Fiddle, where animated indicators preview upcoming pitches. The interaction involves articulation via blowing into the device, while multitouch controls an onscreen trombone "slide" and pitch registers. Performers can embellish melodies with grand musical gestures, which can come across as both skillful and comical. The whimsical instrument similarly imbues poor performances with a sense of humor – missing a note somehow seems funnier when a performer then glides to the correct pitch.

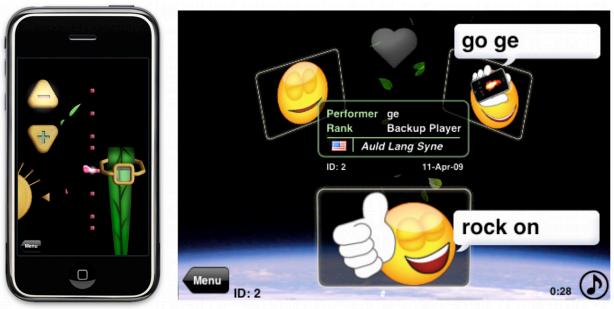


**Figure 5. Leaf Trombone: World Stage. Left: the instrument and game. Right: World Stage social game, where users give feedback and rate performances.**

Leaf Trombone: World Stage leverages game design on three levels: core interaction (the leaf trombone), a social dimension (World Stage), as well as peripheral gamification where users are encouraged to participate in the social game with rewards of getting anonymous feedback, as well as achievements and public status as both a performer or as jury. Users in the ecosystem of the World Stage can take on multiple roles, including performer, judge, spectator, and composer (users can composer content and publish it to the game). In game "performance tokens" regulate the balance of users between the activities of performing and judging for the World Stage – users earn the privilege (with tokens) to perform on the World Stage by serving jury duty in giving feedback to other users. The World Stage is inspired by Games With A Purpose – the design leverages natural human intelligence (e.g., serving as casual jurors and giving feedback) to complete a social interaction loop. Both performing and judging, in turn, allow users to progress through large game arcs by gaining experience and renown. As a testament to the World Stage's game-driven engagement, users have repeated served as jurors in over 800,000 judged performances (in fact, one extremely industrious individual judged more than 10,000 performances!).

# 5. DISCUSSION & TAKEAWAYS

The mobile music games discussed here embrace multiple facets of game design while aiming to provide an expressive dimension to the core experience. The high-level design decisions for the case studies in this work are summarizes in Table 1. No two apps are identical in their design approach to controlling pitch and timing; there seems to

| | Pitch Control | Timing | Core Interaction | Peripheral Gamification |
|---|---|---|---|---|
| **Magic Piano** | Hard-coded | Free | Minimal, direct (tap) | Play more to gain experience to level up; levels of difficulty; earn achievements and rewards |
| **Magic Fiddle** | Free | Tempo Enforced | Multi-faceted (pitch, bow, pluck) | Storybook Magic Fiddle lessons. |
| **Magic Guitar** | Hard-coded | Tempo Enforced | Reduced (tap-and-hold, vibrato, bend) | Levels of difficulty and ability to earn achievements |
| **Ocarina 2** | Free | Free | Multi-faceted (breath, pitch, vibrato) | Notion of progress per song, and overall progression via experience points and achievements |
| **Leaf Trombone: World Stage** | Free | Tempo Enforced | Multi-faceted (breath, pitch) | Massive Crowdsourcing ("World Stage") to judge and give feedback to other users; performers and judges can gain experience and level-up, earn achievements. |

**Table 1. Summary of Recurring Game Design Considerations**

be no "golden rule" – each design necessarily considers its particular set of characteristics and design goals, which includes mass-audience game appeal and some central notion of expressiveness.

These apps have collectively reached over 125 million users, which in and of itself suggests they have reach beyond even casual musicians, and well into the realm of general everyday users. Of these, Magic Piano has, by far, the largest number of users, estimated at more than 80 million users, followed by Ocarina 2 (more than 10 million). Magic Fiddle and Leaf Trombone: World Stage each had significant following in their time (each reaching approximately one million users), with Magic Guitar having reached hundreds of thousands. Beyond the scale and reach of the apps as a rough measure of appeal, there have been attempts to evaluate how people are engaging with these expressive mobile music games. Notably, Magic Piano user performance data have been studied and analyzed, raising an array of fascinating observations, questions, and conjectures about musicianship fostered in such a medium, along with cultural and socio-geographical influences [22].

What roles do these mobile music games serve? The inherent possibility for expression makes them instrument-like, while their playful nature resembles toys, and the goal-oriented appeal-to-the-masses design is characteristic of everyday games. We think of them as a hybrid, one that we call expressive musical games. While their respective designs differ from one another, they share common goals, which can be distilled as the following:

*Lower inhibition for music-making by presenting expressive musical experiences as games*. The goal is to retain genuine expressive possibilities while offering elements and perception of game-play that can drastically reduce barriers of entry into the music-making experience. The hypothesis is that people are much less intimidated and inhibited to try something if they perceive it as a game. In doing so, the experience might benignly "trick" the player into being musical and, for some, possibly taking a first taste for the joy of making music.

*Create satisfying core music-making mechanics aimed to induce a sense of flow*, balancing between challenges, learning, experience, and rewards. There should be an inherent attraction (or "fun") early, with continued "payoff" and sense of accomplishment, while providing challenges as to provide attainable game goals. Compelling mobile music games must engage almost immediately (due to the casual nature of the audience) but should make it possible (and fun) to acquire and hone the skills needed to improve in the instrument / game. In contrast to Guitar Hero and Rock Band, the games in this work were designed specifically to be musically expressive. The players generate the sounds directly through their actions, and hence have a greater degree of expressive control over each note, passage, and overall experience. Yet, even if the goals differ, these mobile apps share characteristics with Guitar Hero and Rock Band: they all attempt to provide satisfying interactive experiences through game design.

*Motivate longer-term engagements through social and peripheral gamification*. This comes in the forms of the World Stage, Storybook music lessons in Magic Fiddle, and various game levels, achievements, and rankings. Overall, the extent to which these mechanics are effective can be gleaned in the sheer number of users and the amount they engage with the experience. World Stage, as a more specific example, has shown it is possible to achieve equilibrium between performance and judging by tuning the rewards, enabling long-term engagement with the overall Leaf Trombone ecosystem [27].

In practice (and relating back to the gamefication literature), the expressive musical gamification in this work give arise to both *paidia* (playing) as well as *ludus* (gaming), embodying the free expression of the former as well as the latter's rule-based structure to motive short- and long-term engagement. As with many game-like experiences, the boundary here is not always clear – the experience addresses (or possibly "flickers" between) that of a playful artifact and gamefulness. For this work, such fusion seems reasonable (perhaps even inevitable) given our stated design aims of both expressiveness and game-like elements.

## 5.1 A Broader Context

In a broader sense, these apps are also a response to technology development, which has drastically reshaped the role of music and music making since the advent of recording and broadcast. For example, before the advent of modern recording and transmission technology (e.g., radio, phonograph; and eventually magnetic tape, digital storage, internet), in order to hear music, it had to be made live in the same place [14]. There was a time, prior to early 20th century, when families commonly played music as a form of participatory entertainment, and amateur music making was prevalent. Extraordinary technological progress in the 20th century has fundamentally altered music's role—on one hand rendering music supremely accessible like never before, while concurrently yielding a model where passive "music taking" consumption (as Landy calls it) has grown to dominate "music making" participation.

Nicholas Cook has written along similar veins [3]:

> Music has become part of an aesthetic economy defined by the passive and increasingly private consumption of commodified products rather than through the active, social processes of participatory performance. In short, we seem to have forgotten that music is a performance art at all, and more than that, we seem to have conceptualized it in such a way that we could hardly think of it that way even if we wanted to.

In a sense, these expressive musical games are attempts to use everyday technology to encourage people to participate in music making (and even if "participation" means "by one's self"). For a general mass audience, the disarming game-like qualities are arguably essential to lowering inhibition while providing the natural appeal to participate in the first place. These games are designed not for traditional musical performance but more for private music-

making. It is akin to the notion of music-making as entertainment, harking back to the idea of the amateur musician. If technology killed amateur music making (e.g., by nullifying a key motivation for its existence: access to music), then designing expressive games into casual, personal technologies such as app-based smartphones may be an opportunity to bring music-making back.

Christopher Small [20] put forth the idea of *musicking*, which embraces many roles beyond that of the ostensible "musician" or "performer" – roles that are nonetheless meaningful parts of a musical endeavor in progress (e.g., in a concert context, the audience, the ushers, ticket sellers, bootleggers are all musicking). Perhaps expressive mobile musical games articulate a new role in the realm of musicking – as a vehicle for casual, private, but nonetheless active creation of music. This form of engaging with music, we argue, can be meaningful as is, without the need to go beyond the casual settings (e.g., at home) in which they are experienced.

In conclusion, there are many reasons and approaches in incorporating game design into expressive mobile music. As ongoing and future work, game designers for mobile music might take inspiration from a number of ideas beyond game design that range from psychological and social considerations such as musicking and *participatory music* [24] – ideas from the latter might facilitate new group-based musical interactions, where social participation is the overriding goal. Potential future studies might also examine how expressive music games might be useful to the realms of musical learning and health [2], and skill acquisition in (more specialized) interactive music systems [9].

While any design must specifically adapt to its experiential goals, medium, and audience, we have presented a number of general design considerations and motivations as reference for expressive musical games. As with game design more broadly, expressive musical game design is still more art than science. Nonetheless, the opportunity is present and compelling – to bring new forms of interactive, expressive experiences to many would-be music makers around the world.

## 6. ACKNOWLEDGMENTS

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## 8. Video Appendix

Video demos: http://www.gewang.com/appendix/nime-2016/