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Ocarina: Designing the iPhone's Magic Flute

Abstract: Ocarina, created in 2008 for the iPhone, is one of the first musical artifacts in the age of pervasive, app-based mobile computing. It presents a flute-like physical interaction using microphone input, multi-touch, and accelerometers—and a social dimension that allows users to listen in to each other around the world. This article chronicles Smule's Ocarina as a mobile musical experiment for the masses, examining in depth its design, aesthetics, physical interaction, and social interaction, as well as documenting its inextricable relationship with the rise of mobile computing as catalyzed by mobile devices such as the iPhone.

Ocarina for the iPhone was one of the earliest mobile-musical (and social-musical) apps in this modern era of personal mobile computing. Created and released in 2008, it re-envisions an ancient flute-like clay instrument—the four-hole "English-pendant" ocarina—and transforms it in the kiln of modern technology (see Figure 1). It features physical interaction, making use of breath input, multi-touch, and accelerometer, as well as social interaction that allows users to listen in to each other playing this instrument around the world, anonymously (in a sort of musical "voyeurism"), by taking advantage of the iPhone's Global Positioning System (GPS) location and its persistent network connection (see Figure 2). To date, the Smule Ocarina and its successor, Ocarina 2 (released in 2012), has more than ten million users worldwide, and was a first class inductee into Apple's App Store Hall of Fame. More than five years after its inception and the beginning of a new era of apps on powerful smartphones, we look in depth at Ocarina's design—both physical and social—as well as user case studies, and reflect on what we have learned so far.

When the Apple App Store launched in 2008—one year after the introduction of the first iPhone—few could have predicted the transformative effect app-mediated mobile computing would have on the world, ushering in a new era of personal computing and new waves of designers, developers, and even entire companies. In 2012 alone, 715 million new units of smartphones were sold worldwide. Meanwhile, in Apple's App Store, there are now over one million distinct apps spanning dozens of categories, including lifestyle, travel, games, productivity, and music. In the humble, early days of mobile apps, however, there were far fewer (on the order of a few thousand) apps. Ocarina was one of the very first musical apps. It was designed to be an expressive musical instrument, and represents perhaps the first mass-adopted, social-mobile musical instrument.

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Origins and Related Works

The ingredients in creating such an artifact can be traced to interactive computer music software such as the ChucK programming language (Wang 2008), which runs in every instance of Ocarina, laptop orchestras at Princeton University and Stanford University (Trueman 2007; Wang et al. 2008, 2009a), and the first mobile phone orchestra (Wang, Essl, and Penttinen 2008, 2014; Oh et al. 2010), utilizing research from 2003 until the present. These works helped lead to the founding of the mobile-music startup company Smule (Wang et al. 2009b; Wang 2014, 2015), which released its first apps in summer 2008 and, at the time of this writing (in 2013), has reached over 100 million users.

More broadly, much of this was inspired and informed by research on mobile music, which was taking place in computer music and related communities well before critical mass adoption of an app-driven mobile device like the iPhone.

Reports on an emerging community of mobile music and its potential can be traced back to

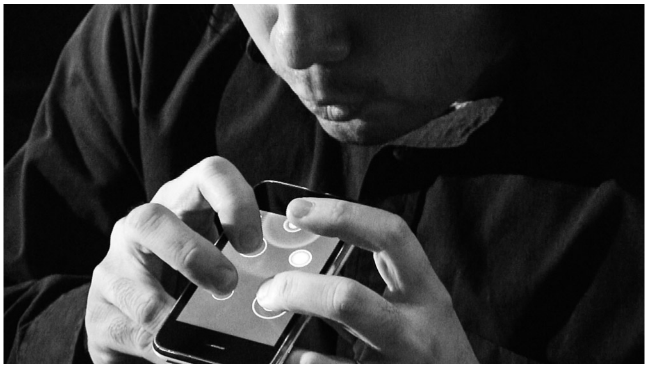


Figure 1

Figure 1. Ocarina for the iPhone. The user blows into the microphone to articulate the sound, multi-touch is used to control pitch, and accelerometers control vibrato.

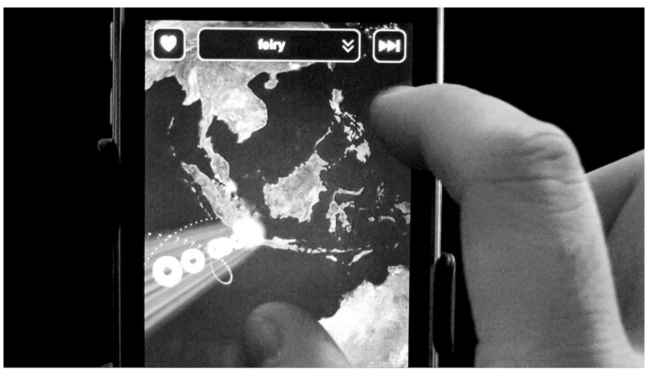


Figure 2

Figure 2. As counterpoint to the physical instrument, Ocarina also presents a social interaction that allows users to listen in, surreptitiously, to others playing Ocarina around the world, taking advantage of GPS location and cloud-based networking.

2004 and 2006 (Tanaka 2004; Gaye et al. 2006). The first sound synthesis on mobile phones was documented by projects such as PDa (Geiger 2003), Pocket Gamelan (Schiemer and Havryliv 2006), and Mobile STK (Essl and Rohs 2006). The last of these was a port of Perry Cook and Gary Scavone's Synthesis Toolkit to the Symbian OS platform, and was the first programmable framework for parametric sound synthesis on mobile devices. More recently, Georg Essl, the author, and Michael Rohs outlined a number of developments and challenges in considering mobile phones as musical performance platforms (Essl, Wang, and Rohs 2008).

Researchers have explored various sensors on mobile phones for physical interaction design. It is important to note that, although Ocarina explored a number of new elements (physical elements and social interaction on a mass scale), the concept of blowing into a phone (or laptop) has been documented in prior work. In the Princeton Laptop Orchestra classroom of 2007, Matt Hoffman created an instrument and piece for "unplugged" (i.e., without external amplification) laptops, called Breathalyzer, which required performers to blow into the microphone to expressively control audio synthesis (Hoffman 2007). Ananya Misra, with Essl and Rohs, conducted a series of experiments that used the microphone for mobile music performance (including breath input, combined with camera input; see Misra, Essl, and Rohs 2008). As far as we know, theirs was the first attempt to make a breath-mediated, flute-like mobile phone interface. Furthermore, Essl and Rohs (2007) documented significant exploration in combining audio synthesis, accelerometer, compass, and camera in creating purely on-device (i.e., no laptop) musical interfaces, collectively called ShaMus.

Location and global positioning play a significant role in Ocarina. This notion of "locative media," a term used by Atau Tanaka and Lalya Gaye (Tanaka and Gemeinboeck 2006) has been explored in various installations, performances, and other projects. These include Johan Wagenaar's Kadoum, in which GPS sensors reported heart-rate information from 24 participants in Australia to an art installation on a different continent. Gaye, Mazé, and Holmquist (2003) explored locative media in Sonic City with location-aware body sensors. Tanaka et al. have pioneered a number of projects on this topic, including Malleable Mobile Music and *Net_Dérive*, the latter making use of a centralized installation that tracked and interacted with geographically diverse participants (Tanaka and Gemeinboeck 2008).

Lastly, the notion of using mobile phones for musical expression in performance can be traced back to Golan Levin's *Dialtones* (Levin 2001), perhaps the earliest concert concept that used the audience's mobile phones as the centerpiece of a sustained live performance. More recently, the aforementioned Stanford Mobile Phone Orchestra was formed in 2007 as the first ensemble of its kind. The Stanford Mobile Phone Orchestra explored a more mobile, locative notion of "electronic chamber music" as pioneered by the Princeton Laptop Orchestra (Trueman 2007; Smallwood et al. 2008;

Wang et al. 2008) and the Stanford Laptop Orchestra (Wang et al. 2009a), and also focused on various forms of audience participation in performance (Oh and Wang 2011). Since 2008, mobile music has entered into the curriculum at institutions such as Stanford University, University of Michigan, Princeton University, and the California Institute of the Arts, exploring various combinations of live performance, instrument design, social interaction, and mobile software design.

Physical Interaction Design Process

The design of Ocarina took place in the very early days of mobile apps, and was, by necessity, an experiment, which explored an intersection of aesthetics, physical interaction design, and multiple modalities in sound, graphics, and gesture.

"Inside-Out Design"

Why an ocarina?

If one were to create a musical instrument on a powerful mobile device such as the iPhone, why not a harpsichord, violin, piano, drums, or something else—anything else?

The choice to create an ocarina started with the iPhone itself—by considering its very form factor while embracing its inherent capabilities and limitations. The design aimed to use only the existing features without hardware add-ons—and to use these capabilities to their maximum potential. For one, the iPhone was about the physical size of a four-hole ocarina. Additionally, the hardware and software capabilities of the iPhone naturally seemed to support certain physical interactions that an ocarina would require: microphone for breath input, up to 5-point multi-touch (quite enough for a four-hole instrument), and accelerometers to map to additional expressive dimensions (e.g., vibrato rate and depth). Furthermore, additional features on the device, including GPS location and persistent data connectivity, beckoned for the exploration of a new social interaction. Working backwards or "inside-out" from these features and constraints, the design suggested the ocarina, which fit the profile in terms of physical interaction and as a promising candidate for social experimentation.

Physical Aesthetics

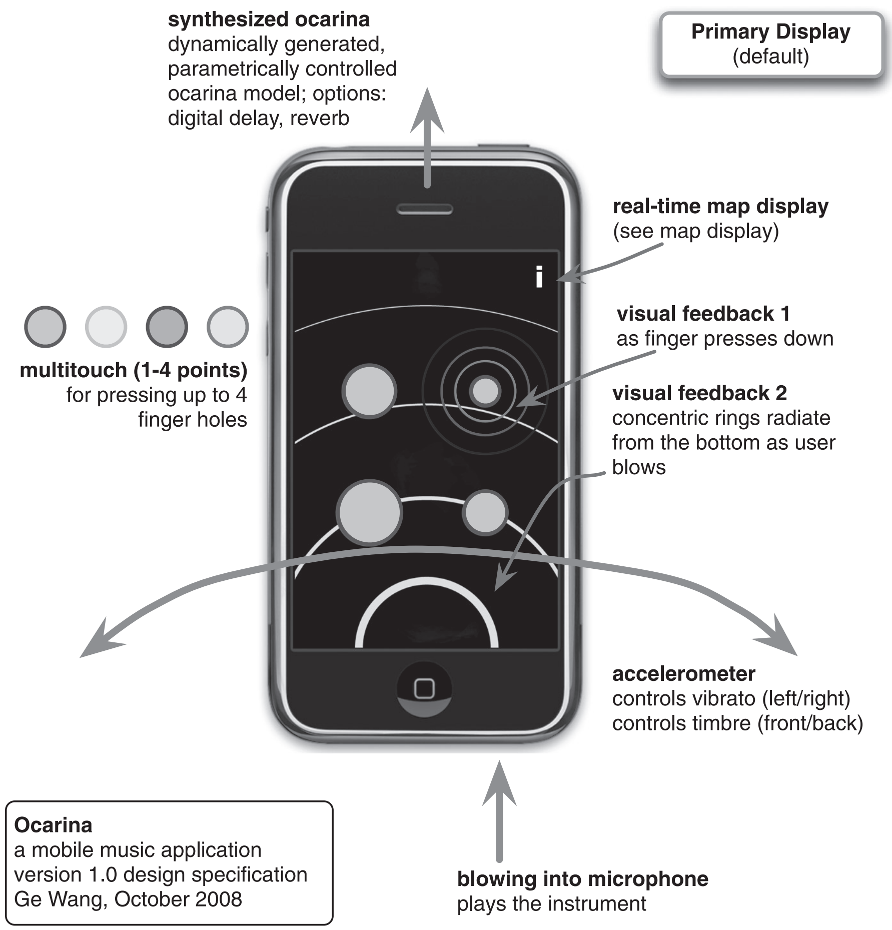
From an aesthetic point of view, the instrument aspect of Ocarina was rigorously designed as a physical artifact. The visual presentation consists only of functional elements (such as animated finger holes, and breath gauge in Ocarina 2) and visualization elements (animated waves or ripples in response to breath). In so doing, the statement was not "this simulates an ocarina," but rather "this is an ocarina." There are no attempts to adorn or "skin" the instrument, beyond allowing users to customize colors, further underscoring that the physical device is the enclosure for the instrument. Even the naming of the app reflects this design thinking, deliberately avoiding the common early naming convention of prepending app names with the lowercase letter "i" (e.g., iOcarina). Once again, it was a statement of what this app is, rather than what it is trying to emulate.

This design approach also echoed that of a certain class of laptop orchestra instruments, where the very form factor of the laptop is used to create physical instruments, embracing its natural benefits and limitations (Fiebrink, Wang, and Cook 2007). This shifted the typical screen-based interaction to a physical interaction, in our corporeal world, where the user engages the experience with palpable dimensions of breath, touch, and tilt.

Physical Interaction

The physical interaction design of Ocarina takes advantage of three onboard input sensors: microphone for breath, multi-touch for pitch control, and accelerometers for vibrato. Additionally, Ocarina uses two output modalities: audio and real-time graphical visualization. The original design schematics that incorporated these elements can be seen in Figure 3. The intended playing method of Ocarina asks the user to "hold the iPhone as one might a

Figure 3. Initial physical interaction design schematic.



sandwich," supporting the device with thumbs and ring fingers, putting the user in position to blow into the microphone at the bottom of the device, while also freeing up both index fingers and both middle fingers to hold down different combinations of the four onscreen finger-holes.

Breath

The user articulates Ocarina literally by blowing into the phone, specifically into the onboard microphone. Inside the app, a ChucK program tracks the amplitude of the incoming microphone signal in real time, and an initial amplitude envelope is calculated using a leaky integrator, implemented as a one-pole feedback filter (the actual filter parameter was determined empirically; later versions of Ocarina actually contained a table of device-specific gains to further compensate for variation across device generations). The initial breath signal is conditioned through additional filters tuned to balance between responsiveness and smoothness, and is then fed into the Ocarina's articulator (including a second envelope generator), which controls the amplitude of the synthesized Ocarina signal. The signal resulting from air molecules blown into the microphone diaphragm has significantly higher energy than speech and ambient sounds, and naturally distinguishes between blowing interactions and other sounds (e.g., typical speech).

Real-Time Graphics

There are two real-time graphical elements that respond to breath input. Softly glowing ripples smoothly "wash over" the screen when significant breath input is being detected, serving both as a visual feedback to breath interaction, but also as an aesthetic element of the visual presentation. In the more recent Ocarina 2, an additional graphical element visualizes the intensity of the breath input: Below an internal breath threshold, the visualization points out the general region to apply breath; above the threshold, an aurora-like light gauge rises and falls with the intensity of the breath input.

Multi-Touch Interaction and Animation

Multi-touch is used to detect different combinations of tone holes held by the user's fingers. Modeled after a four-hole English-pendant acoustic ocarina, the mobile phone instrument provides four independent, virtual finger holes, resulting in a total of 16 different fingerings. Four real-time graphical finger holes are visualized onscreen. They respond to touch gestures in four quadrants of the screen, maximizing the effective real estate for touch interaction. The finger holes respond graphically to touch: They grow and shrink to reinforce the interaction, and to help compensate for lack of tactility. Although the touch screen provides a solid physical object to press against, there is no additional tactile information regarding where the four finger holes are. The real-time visualization aims to mitigate this missing element by subtly informing the user of the current fingering. This design also helps first-time users to learn the basic interaction of the instrument by simply playing around with it—Ocarina actually includes a built-in tutorial, but providing more "on-the-fly" cues to novices seemed useful nonetheless. A nominal pitch mapping for Ocarina can be see in Figure 4, including extended pitch mappings beyond those found on an acoustic four-hole ocarina.

Accelerometers

Accelerometers are mapped to two parameters of synthesized vibrato. This mapping offers an additional, independent channel of expressive control, and further encourages physical movement with Ocarina. For example, the user can lean forward to apply vibrato, perhaps inspired by the visual, performative gestures of brass and woodwind players when expressing certain passages. The front-to-back axis of the accelerometer is mapped to vibrato depth, ranging from no vibrato—when the device is flat—to significant vibrato when the device is tilted forward (e.g., the screen is facing away from the player). A secondary left-to-right mapping allows the more seasoned player to control vibrato rate, varying linearly between 2 Hz from one side to 10 Hz on the opposite side (the vibrato is at 6 Hz in its non-tilted center position). Such interaction offers "one-order higher" expressive parameters, akin to expression control found on MIDI keyboards. In practice, it is straightforward to apply vibrato in Ocarina to adorn passages, and the mechanics also allows subtle variation of vibrato for longer notes.

Sound Synthesis

Audio output in Ocarina is synthesized in real time in a ChucK program that includes the aforementioned amplitude tracker and articulator. The synthesis itself is straightforward (the acoustic ocarina sound is not complex). The synthesis elements include a triangle wave, modulated by a second oscillator (for vibrato), and multiplied against the amplitude envelope generated by the articulator situated between Ocarina's analysis and synthesis modules. The resulting signal is fed into a reverberator. (A general schematic of the synthesis can be seen in Figure 5.)

The acoustic ocarina produces sound as a Helmholtz resonator, and the size of the finger holes are carefully chosen to affect the amount of total uncovered area as a ratio to the enclosed volume and thickness of the ocarina—this relationship directly affects the resulting frequency. The pitch range of an acoustic four-hole English-pendant ocarina is typically one octave, the lowest note played by covering all four finger holes, and the highest played by uncovering all finger holes. Some chromatic pitches are played by partially covering

Figure 4. Pitch mappings for C Ionian. Five additional pitch mappings not possible in traditional four-hole ocarinas are denoted with dotted outline.

Figure 5. Ocarina's general sound synthesis scheme as implemented in ChucK.

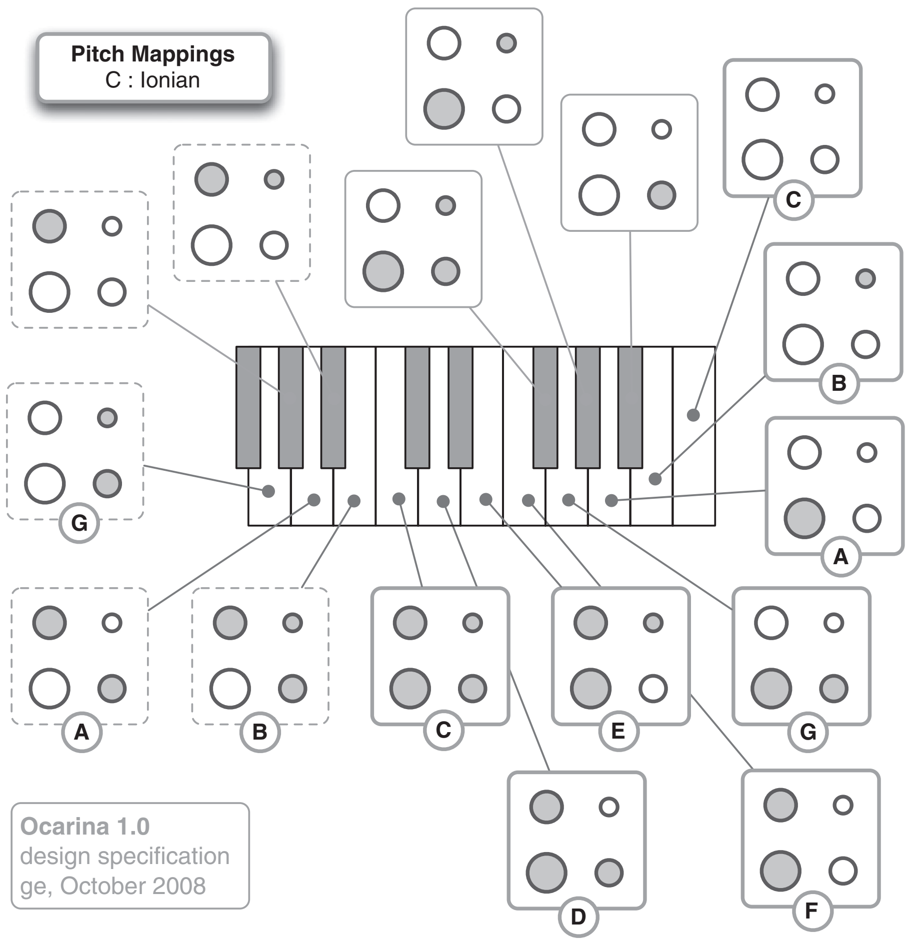


Figure 4

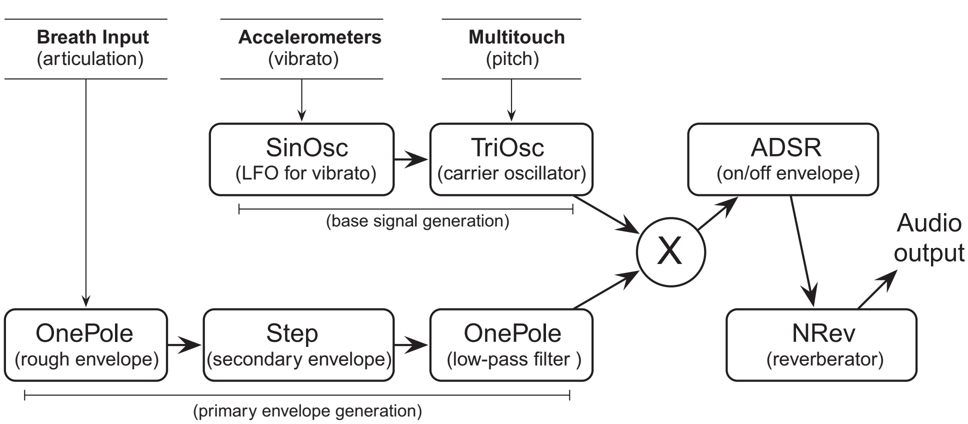
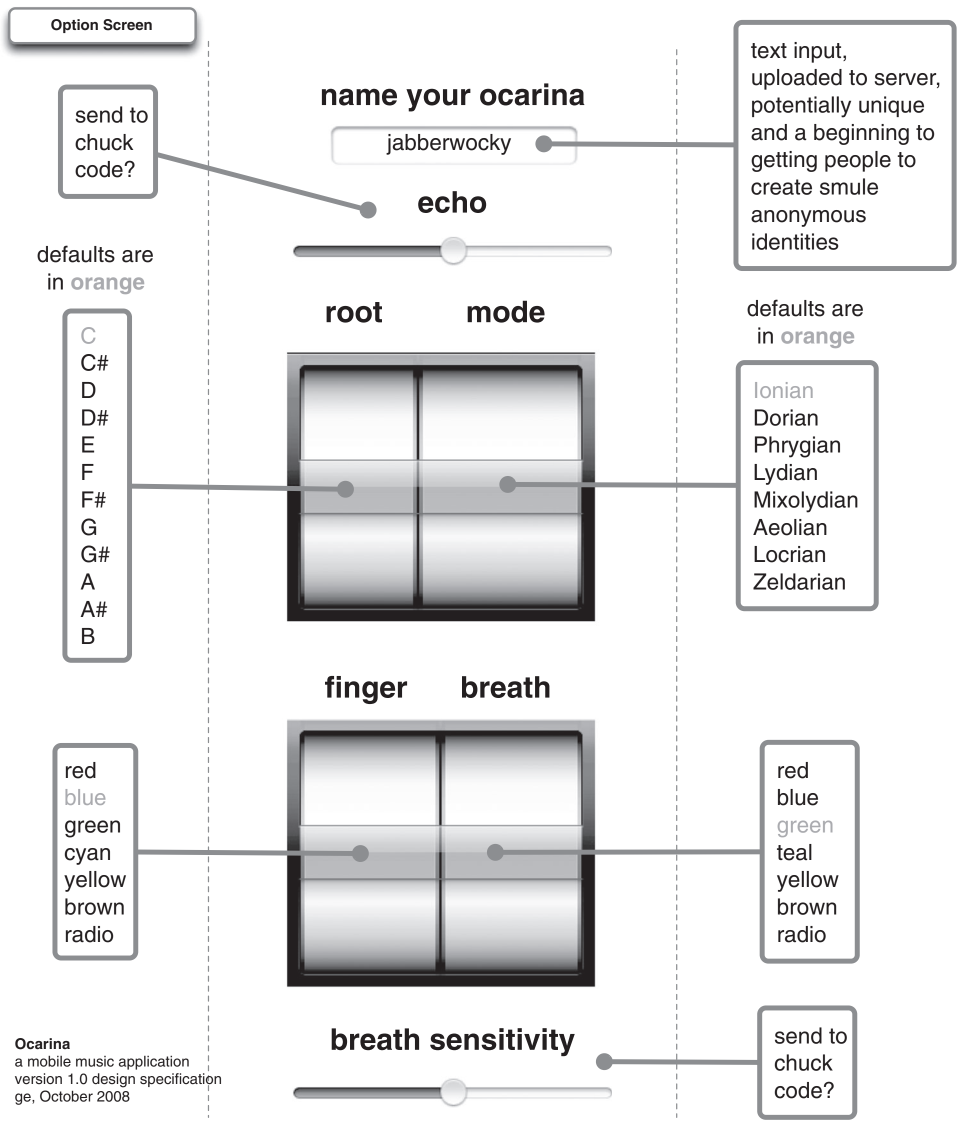


Figure 5

Figure 6. Initial option screen design, allowing users to name their instrument (for social interaction), change key and mode, as well as simple customizations for the instrument's appearance.



certain holes. No longer coupled to the physical parameters, the digital Ocarina offers precise intonation for all pitches, extended pitch mapping, and additional expressive elements, such as vibrato and even portamento in Ocarina 2. The tuning is not fixed; the player can choose different root keys and diatonic modes (Ionian, Dorian, Phrygian, etc.), offering multiple pitch mappings (see Figure 6).

The app even contains a newly invented (i.e., rather apocryphal) "Zeldarian" mode, where the pitches are mapped to facilitate the playing of a single melody: *The Legend of Zelda* theme song. In popular culture, the Nintendo 64 video game *The Legend of Zelda: Ocarina of Time* (1998) may be the most prominent and enduring reference to the acoustic ocarina. In this action-adventure game, the protagonist, Link, must learn to play songs on an in-game ocarina with magical powers to teleport through time. The game is widely considered to be in the pantheon of greatest video games (Wikipedia

Figure 7. A typical tablature on Ocarina's online songbook database populated with content from the user community.

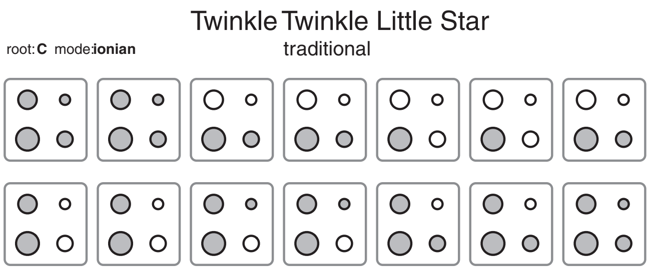


Figure 8. Ocarina 2 provides a teaching mode that shows the next three fingerings for any particular song (from center and up). This mode also provides basic harmony accompaniment that follows the user's melody playing.

2013), and for that reason continues to endure and delight—and continues to introduce the ocarina to new generations of gamers (so effectively that apparently a portion of the population mistakenly believe ocarina is a purely fictional instrument that exists only in the mythical in-game realm of Hyrule). In any case, there is a sense of magic associated with the ocarina, something that the design of Ocarina aimed to capture. After all, isn't hinting at magic a powerful way to hide technology, while encouraging users to focus on the experience?

Incorporating Expressive Game-Like Elements

In Ocarina, users learn to play various melodies via a Web site specially crafted for users to share tablatures for the iPhone-based instrument (Hamilton, Smith, and Wang 2011). Each tablature shows a suggested root key, mode, and sequence of fingerings (see Figure 7). An editor interface on the Web site allows users to input and share new tablatures. Through this site, users are able to search and access over 5,000 user-generated Ocarina tablatures; during peak usage the site had more than a million hits per month. Users would often display the tablature on a second computer (e.g., their laptop), while using their iPhone to play the music. This is reminiscent of someone learning to play a recorder while reading music from a music stand—only here, the physical instrument is embodied by the mobile phone, and the computer has become both score and music stand.

A sequel to Ocarina was created and released in 2012, called Ocarina 2 (abbreviated as O2—alluding to the oxygen molecule and the breath interaction needed for the app). Inspired by the success of the Web-based tablatures, Ocarina 2's most significant new core features are (1) a game-like "songbook mode" that teaches players how to play songs note by note and (2) a dynamic harmony-rendering engine that automatically accompanies the player. In addition, every color, animation, spacing, sound, and graphical effect was further optimized in Ocarina 2.

For a given song in Ocarina 2, an onscreen queue of ocarina fingerings shows the next note to play, as well as two more fingerings beyond that (see Figure 8). The player is to hold the right combination of finger holes onscreen, and articulate the note by blowing—the Ocarina 2 songbook engine detects these conditions, and advances to the next note. It is important to emphasize there are no time or tempo restrictions in this mode—players are generally free to hold each note as long as they wish (and apply dynamics and vibrato as desired), and furthermore they are encouraged to play at their own pace. In essence this songbook mode follows the player, not the other way around. The design aims to both provide a more natural and less stressful experience to learn, and also to leave as much space as possible for open expression. The player is responsible for tempo and tempo variations, articulation (and co-articulation of multi-note passages), dynamics, and vibrato. The player is also responsible for the pitch by holding the correct fingerings as shown, but is free to embellish by adding notes and even trills.

There is no game-score reward system in Ocarina 2, though game-like achievements can be earned. Progress is accumulated per song, via "breath points" as a general measurement of how much a user has blown into his or her phone. Achievements like "Every Breath You Take" (accumulate 300 breath points) can be earned over time. Probably the most hard-core achievement in Ocarina 2 is one called "Lungevity," which challenges the user to accumulate 1,000,000 breath points. By rough estimation, to get this achievement, one would need to play 500 songs each 200 times!

Ocarina 2 was an exploration to strike a balance between an expressive musical artifact (i.e., an instrument) and a game or toy. The goal is to retain genuine expressive possibilities while offering game-like qualities that can drastically reduce barrier of entry into the experience. The theory was that people are much less inhibited and intimidated by trying something they perceive as a game, in contrast to a perceived musical instrument—yet, perhaps the two are not mutually exclusive. It should be possible to have game-like elements that draw people in, and even benignly "trick" the user into being expressive—and, for some, possibly getting a first-time taste for the joy of making music.

Social Interaction Design

Ocarina is possibly the first-ever massively adopted instrument that allows its users to hear one another around the world, accompanied by a visualization of the world that shows where each musical snippet originated. After considering the physical interaction, the design underwent an exercise to use the additional hardware and software capabilities of the iPhone to maximum advantage, aimed to enable a social-musical experience—something that one could not do with a traditional acoustic ocarina (or perhaps any instrument). The exercise sought to limit the design to exactly one social feature, but then to make that feature as compelling as possible. (If nothing else, this was to be an interesting and fun experiment!)

From there, it made sense to consider the device's location capabilities—because the phone is, by definition, mobile and travels in daily life with its user, and it is always connected to the Internet. The result was the globe in Ocarina, which allows any user to anonymously (and surreptitiously) listen in on potentially any other Ocarina user around the world (see Figure 9). Users would only be identified by their location (if they agreed to provide it to the app), a moniker they could choose for themselves (e.g., Link123 or ZeldaInRome), and their music (see Figure 10).

If listeners like what they hear, they can "love" the snippet by tapping a heart icon. The snippet being heard is chosen via an algorithm at a central Ocarina server, and takes into account recency, popularity (as determined by users via "love" count), geographic diversity of the snippets, as well as filter selections by the user. Listeners can choose to listen to (1) the world, (2) a specific region, (3) snippets that they have loved, and (4) snippets they have played. To the author's knowledge, this type of social–musical interaction is the first of its kind and scale, as users have listened to each other over 40 million times on the globe. A map showing the rough distribution of Ocarina users can be seen in Figure 11.

How is this social interaction accomplished, technically? As a user plays Ocarina, an algorithm in the analysis module decides when to record snippets as candidates for uploading to a central Ocarina server, filtering out periods of inactivity, limiting maximum snippet lengths (this server-controlled parameter is usually set to 30 seconds), and even taking into account central server load. When snippet recording is enabled, the Ocarina engine rapidly takes snapshots of gestural data, including current breath-envelope value, finger-hole state, and tilt from two accelerometers. Through this process a compact network packet is created, time-stamped, and geotagged with GPS information, and uploaded to the central Ocarina server and database.

During playback in Ocarina's globe visualization, the app requests new snippets from the server according to listener preference (region, popularity, and other filters). A server-side algorithm identifies a set of snippets that most closely matches the desired criteria, and sends back a snippet selected

Figure 9. Social interaction design for Ocarina. The goal was to utilize GPS location and data connectivity into a single social feature.

Figure 10. Listening to the world in Ocarina.

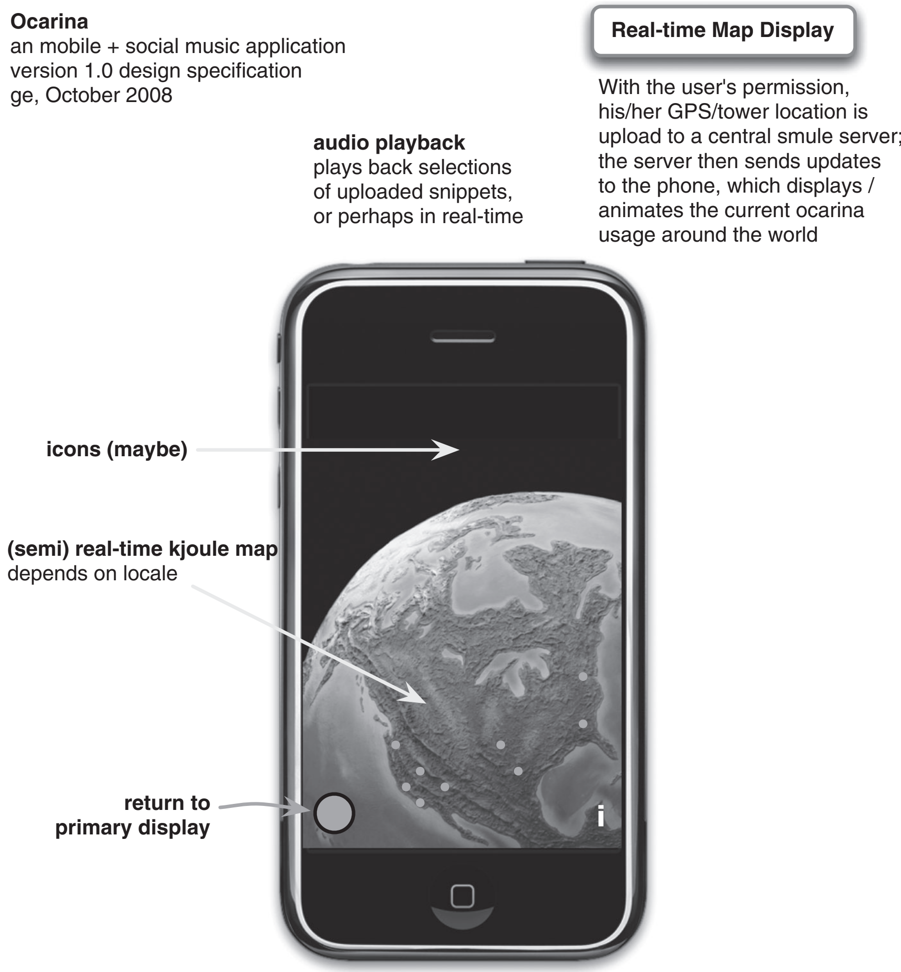


Figure 9

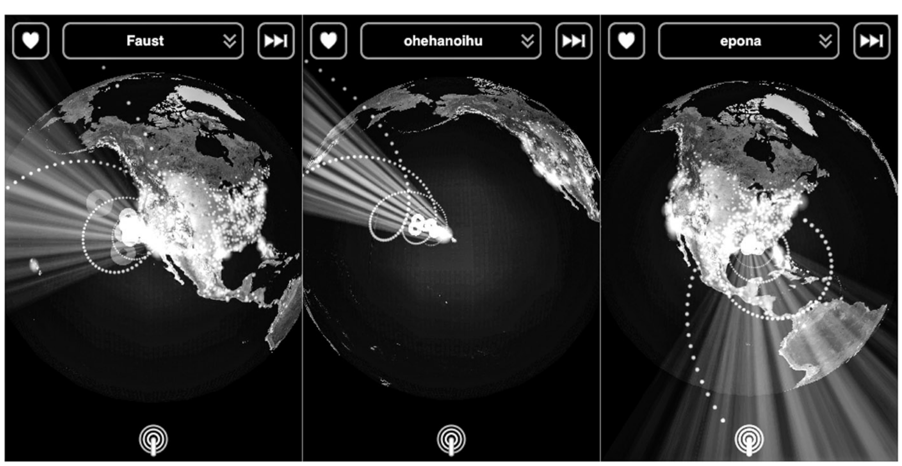


Figure 10

Figure 11. Distribution of the first 2 billion breath blows around the world.

Figure 12. Ocarina system design, from physical interaction to social interaction.

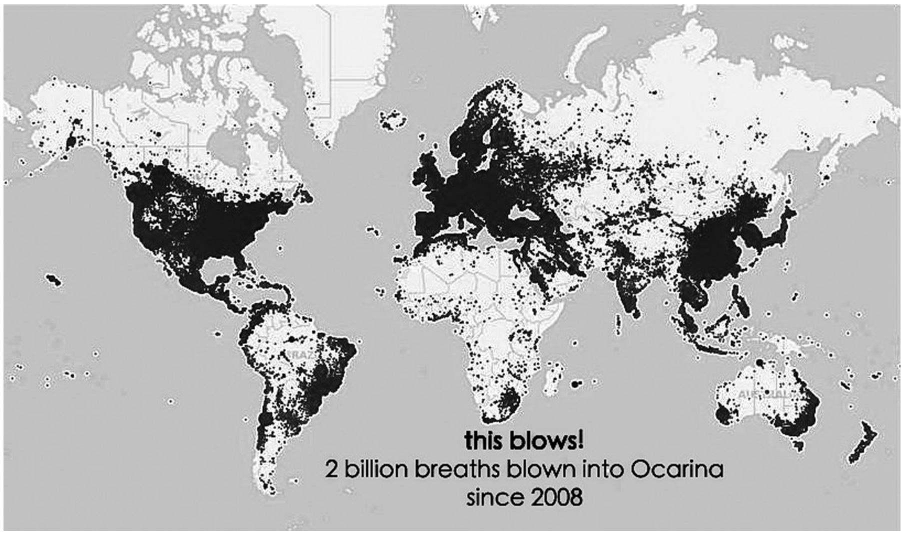


Figure 11

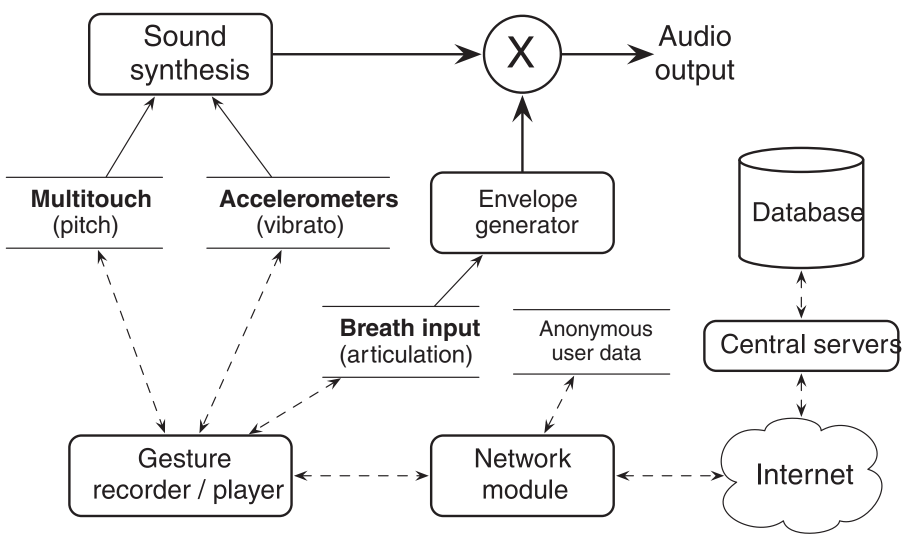


Figure 12

at random from this matching set. Note that no audio recording is ever stored on the server—only gesture information (which is more compact and potentially richer). The returned snippet is rendered by the Ocarina app client, feeding the gesture data recording into the same synthesis engine used for the instrument, and rendering it into sound in the visualized globe. The system design of Ocarina, from physical interaction to cloud-mediated social interaction, can be seen in Figure 12.

User Case Studies

Ocarina users have listened in on each other over 40 million times, and somehow created an

Figure 13. Ocarina users share their performances via Internet video.

unexpected flood of self-expression in their everyday life. Within a few days of the release of Ocarina (in November 2008), user-created videos began surfacing on the Internet in channels such as YouTube (see Figure 13). Thousands of videos showcased everyday users performing on their iPhone Ocarinas, in living rooms, dorm rooms, kitchens, holiday parties, on the streets, and many other settings. Performers vary in age from young children to adults, and seem to come from all over the globe. They play many types of music, from *Ode to Joy*, video game music (e.g., *Legend of Zelda*, *Super Mario Bros.*, *Tetris*), themes from movies and television shows (e.g., *The X-Files*, *Star Wars*, *Star Trek*), to pop and rock music, show tunes, and folk melodies (e.g., *Amazing Grace*, *Kumbaya*, *Shenandoah*). Many are solo performances; others are accompanied by acoustic guitars, piano, and even other iPhone-based musical instruments.

As an example, one user created a series of videos in which she plays Ocarina by blowing into the iPhone with her nose (top left in Figure 12). Apparently, she has a long history of playing nose flutes, and Ocarina was her latest nasal-musical experiment. She began with a nose-mediated rendition of *Music of the Night* and, after this video gained renown on YouTube, followed up with performances of *The Blue Danube* (this one played upside-down to further increase the difficulty), the *Jurassic Park* theme, *The Imperial March* from *Star Wars*, and Rick Astley's *Never Gonna Give You Up*.

One user braved snowy streets to busk for money with his iPhone Ocarina and filmed the experience. Another group of users created a video promoting tourism in Hungary. Some have crafted video tutorials to teach Ocarina; others have scripted and produced original music videos. All of these represent creative uses of the instrument, some that even we, its creators, had not anticipated. There is something about playing Ocarina on one's iPhone that seems to overcome the inhibition of performing, especially in people who are not normally performers and who don't typically call themselves musicians.

It was surprising to see such mass adoption of Ocarina, in spite of the app's unique demand on physically using the iPhone in unconventional ways. Over the years, one could reasonably surmise that much of its popularity may be that the sheer novelty and curiosity of playing a flute-like instrument on a mobile phone effectively overcame barriers to try a new musical instrument. And if the physical interaction of Ocarina provoked curiosity through novelty, the social globe interaction provided something—perhaps a small sense of wonder—that was not possible without a mobile, location-aware, networked computer.

Discussion

Is the app a new form of interactive art? Can an app be considered art? What might the role of technology be in inspiring or ushering a large population into exploring musical expression? Although the mobile app world has evolved with remarkable speed since 2008, the medium is perhaps still too young to fully answer these questions. We can ponder, nonetheless.

There are definite limitations to the mobile phone as a platform for crafting musical expression, especially in creating an app designed to reach a wide audience. In a sense, we have to work with what is available on the device, and nothing more. We might do our best to embrace the capabilities and limitations, but is that enough? Traditional instruments are designed and crafted over decades or even centuries, whereas something like Ocarina was created in six weeks. Does it even make sense to compare the two?

On the other hand, alongside limitations lie possibilities for new interactions—both physical and social—and new ways to inspire a large population to be musical. Ocarina affords a sense of expressiveness. There are moments in Ocarina's globe interaction where one might easily forget the technology, and feel a small, yet nonetheless visceral, connection with strangers on the other side of the world. Is that not a worthwhile human experience, one that was not possible before? The tendrils of possibility seem to reach out and plant the seeds for some yet-unknown global community. Is that not worth exploring?

As a final anecdote, here is a review for Ocarina (Apple App Store 2008):

> This is my peace on earth. I am currently deployed in Iraq, and hell on earth is an every day occurrence. The few nights I may have off I am deeply engaged in this app. The globe feature that lets you hear everybody else in the world playing is the most calming art I have ever been introduced to. It brings the entire world together without politics or war. It is the EXACT opposite of my life—Deployed U.S. Soldier.

Is Ocarina itself a new form of art? Or is it a toy? Or maybe a bit of both? These are questions for each person to decide.

Acknowledgments

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