eGenjiko: Scent Matching Game using a Computer-Controlled Censer

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CHI PLAY EA '19, October 22–25, 2019, Barcelona, Spain
ACM 978-1-4503-6819-3/20/04.
https://doi.org/10.1145/3341215.3356259

Abstract

We propose "eGenjiko," a gaming system for *Genjiko* (Japanese traditional scent-matching game) utilizing a computer-controlled censer and a tablet device. *Genjiko* is a scent-matching game in which players smell five scents and guess which are identical. The game is so simple and attractive that even a beginner can enjoy. However, aromatic wood and utensils such as a censer used in traditional *Genjiko* are very costly [1] and they are definitely not affordable for beginners. In this study, we developed a gaming system named eGenjiko that conforms to real *Genjiko*'s rules. The system has a computer-controlled censer that selects randomly five scents and diffuses them. After smelling all the scents, a player answers the matching pattern of five scents using simple notation by drawing on a tablet device. Then the system returns the correct answer. Using our eGenjiko, a single player who is not familiar with *Genjiko* can enjoy the game casually, without inviting other players.

CCS Concepts

•Human-centered computing → Ubiquitous and mobile computing systems and tools; Human computer interaction (HCI); Interaction design; •Applied computing → Arts and humanities;

[1] Aromatic wood required for a single *Genjiko* play costs around 600 USD.

Author Keywords
Kodo; Smell; Olfaction; Scent Matching; Games; Computer-Controlled; Censer

Introduction
Genjiko is a scent matching game held in a traditional sent-smelling ceremony, *Kodo*. *Kodo* is counted as one of the three traditional Japanese art of refinement, along with *Kado* for the flower arrangement, and *Sado* for the tea ceremony. In *Sado*, the master of the ceremony invites guests and serves traditional green tea, while in *Kodo*, the master of the ceremony invites guests and serves scent of traditional aromatic wood. *Kodo* has been familiar to Japanese through the ages well as *Kado* and *Sado*. In fact, a few pictures in "*Ukiyo-e*" (Japanese pictures) contain the image of *Kodo*[10] (see Figure 1). Enjoying *Kodo* requires some utensils such as a censer, aromatic wood, stoking utensils, etc. However, the acknowledgment of *Kodo* is still low among ordinary people comparing to *Kado* and *Sado*. One of the possible reason is that some utensils for *Kodo* is very expensive. Most people do not have knowledge about *Kodo* ceremony and "*Genjiko*," rules.

In this paper, we present the implementation of "eGenjiko," a single player gaming system for beginners of *Kodo*, using a computer-controlled censer and a tablet device. The eGenjiko provides simplified and inexpensive *Genjiko*-like gaming experience that ordinary people can enjoy casually.

Related works
Digital Extension of the Traditional Cultures
Recently, the number of young people practicing Japanese traditional cultures such as *Sado*, *Kado*, and *Kodo* has been decreasing, due to the influence of severe declining birth rate in Japan. This makes difficult to pass knowledge and skills of traditional cultures to the next generation. As

Figure 1: *Kodo* appeared in various *Ukiyo-e* in the Edo period (1603 to 1868 A.D.), which implies that it was widely enjoyed by people.

one of the measures to solve the problem, several studies have been conducted on resolution and succession of the traditional skills by digitization. Among researches focusing on *Kado*, Yokokubo et al. [11] proposed a system that recommends flower arrangements using pictures of actual flowers and related materials prepared by a user. Sithu et al. [8] introduced a training system for flower arrangement using haptic devices. Among researches focusing on *Sado*, Levy et al. [4] created 3D-printed utensils for *Sado* that were interactively designed for the ceremony and evaluated interviewing masters. Based on the research presented, we can provide the necessary means to combine computer technology with traditional knowledge and skills effectively. However, to our knowledge, no research has been conducted on the digitization of *Kodo*.

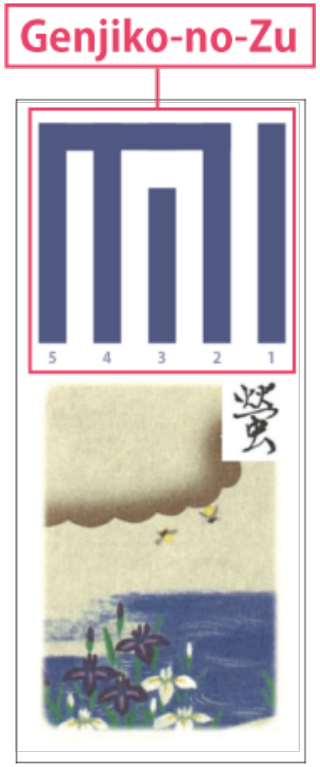

Figure 2: *Genjiko-no-Zu* symbol and illustration shown in a game booklet.

Scent Display

A lot of smell-based interaction have been proposed. For instance, Nakaizumi et al. [6] proposed a projection-based olfactory display method using a scent projector. Matsukura et al. [5] proposed an olfactory display system that can generate an odor distribution on a two-dimensional display screen. These scent releasing devices are significantly large and consume excess electric power. Brewster et al. [2], Braun et al. [1], and Herrera et al. [3] proposed a small scent device and applications that enable a user who undergoes an experience to remember emotions and memories. Similarly, Uriu et al. [9] developed a small scent device for the reminiscence of the deceased. Vaqso VR[2] is a device that add smell to the virtual reality (VR) experience. The user can smell scents in conjunction with the scenes and actions on VR. Similarly, Ranasinghe et al. [7] proposed a traditional horror folklore game using visual-auditory-olfactory interactions. These approaches are intended for use in VR and augmented reality environments, so the user cannot handle tangible utensils, which are essential in the practice of *Kodo*. The system we propose tackles this issue by combining digital contents and tangible utensils. Besides, it uses small and low-cost utensils to play *Kodo*.

What is Genjiko?

Genjiko is one of the traditional way of enjoying *Kodo* ceremony. It is a scent matching game using aromatic wood burned in a censer. The rule is so simple that even beginners can easily enjoy. The procedure for *Genjiko* is as follows:

1. The master picks up a censer then burns aromatic wood.

[2]Vaqso Inc., Vaqso VR(2019) , https://vaqso.com/

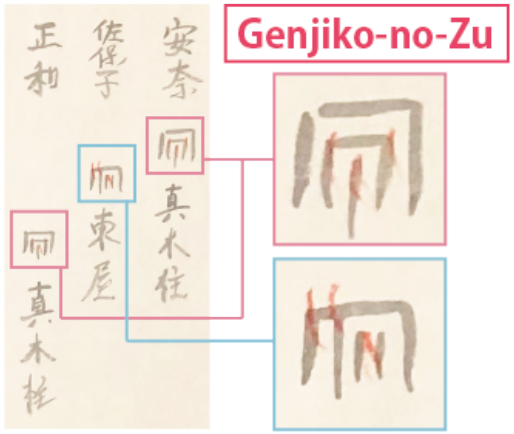

Figure 3: Example of a game record using *Genjiko-no-Zu* symbols.

2. The participants sit down near each other. They each take turns smelling the scent rising from the censer.
3. Repeat processes 1 and 2 five times.
4. After all participants have finished smelling the five scents, each participant writes down on an answer sheet which scents were the same.
5. The master checks all participants answers with correct answers.

When answering, participants draw five vertical lines on an answer sheet of paper, each of which indicates the scent in the five turns. The vertical line in the most right side indicates the scent in the 1st turn, and the most left one is that in the 5th turn. Then the participants draw horizontal lines to link the scents of the turns they think are the same. Figure 3 indicates an example of a recording paper of Genjiko game that shows answers of three participants. Both of the

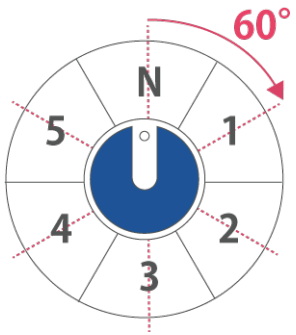

Figure 5: Assignment of one neutral and five scents to each 60 degree of the Aromastic dials.

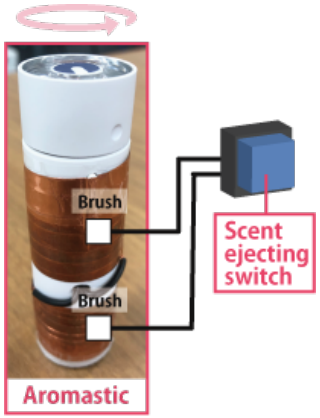

Figure 6: Slip ring mechanism attached to the Aromastic to extend sent ejecting switch.

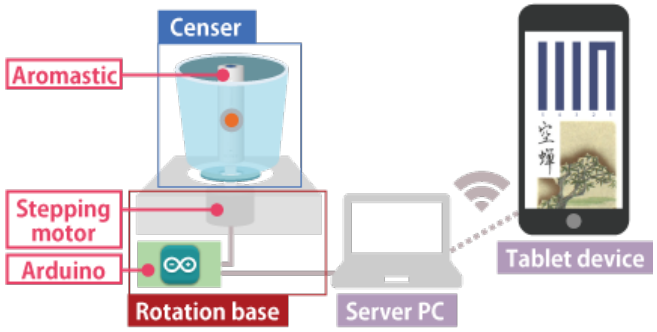

Figure 4: Overview of eGenjiko.

first (right) and the third (left) participants answered that the 1st and 5th, and 2nd and 4th scents are the same, while the second (middle) participant answered that the 1st, 4th, and 5th are the same.

The graphical symbols to describe the answer in *Genjiko* game is called *Genjiko-no-Zu*. *Genjiko-no-Zu* expresses the correct answer by linking the heads of the longitudinal lines of the same scents with horizontal lines. As there are 54 possible answers mathematically, there exist 54 types of *Genjiko-no-Zu*. Each of them is named after a chapter of the Tale of Genji (a novel written from 1001 to 1005 A. D.) that happen to have 54 chapters. Figure 2 is a page of the game booklet that shows one of *Genjiko-no-Zu* symbols and the assigned chapter name with an explaining picture.

eGenjiKo

We developed eGenjiko, a gaming system based on *Genjiko* using a computer-controlled censer, a server PC, and a tablet device as shown in Figure 4. The computer-controlled censer consists of a removable censer unit and a rotation

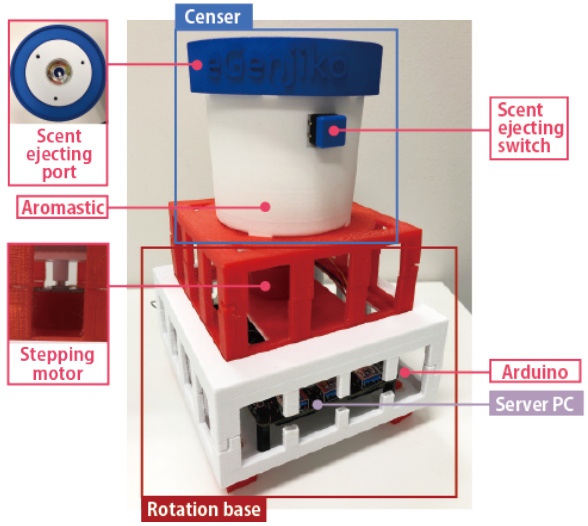

Figure 7: The censer and the base.

base, hereafter referred to as the censer and the base, respectively. We designed these consists of aiming to imitate real utensils for *Genjiko*. The similarity of these consists of the actual utensils provides a user experience closer to that of enjoying an actual *Genjiko*. For example, a computer-controlled censer resembles a real censer, and a tablet device resembles an answer sheet.

Implementation

Figure 7 shows the censor and the base fabricated by a 3D printer. The censer consists of a censer-shaped case, a commercial electric scent diffuser (Aromastic [3]) at the center, and a scent ejecting button outside. The base consists

[3] Sony Co., Aromastic (2017), https://scentents.jp/aromastic/

of an Arduino [4] microcomputer and a stepping motor. The base shown in the Figure 7 also has an extra space for a one-board server PC for the future plan.

Aromastic used in the censer is a cylindrical hand-held device of 8.6 cm in length and 2.5 cm in diameter. It contains five scent containers, a scent diffuser head, a battery, and a scent ejecting button. In ordinary Aromastic usage, a user selects one of the five scents by rotating the upper part of the device and press the button to enjoy the scent. We have automated the scent selection by designing the censer to fix the upper part of the Aromastic, while the lower part of the Aromastic is attached to the rotor of the stepping motor embedded in the base. When the stepping motor rotates by multiples of 60 degrees , the lower part of the Aromastic also rotates, and one of the five scents assigned to each container can be selected (Figure 5) . The Arduino microcomputer generates five random combinations of scent patterns for eGenjiko's answers, by sending commands to the stepping motor.

We also extended the scent ejecting switch to the outside of the censor by using a slip ring mechanism made of conductive tapes and electric brushes, as shown in the Figure 6. Each of the switch electrodes inside the Aromastic is connected to one of the conductive tape of the slip ring mechanism. A user can smell the selected scent by pressing the push switch attached on the outside of the censer.

The tablet device [5] provides interactions to a user, who starts the *Genjiko* game, tries a combination of five scents, and answers by drawing a *Genjiko-no-Zu* symbol. The server PC [6] hosts a web application for eGenjiko using

[4] Arduino Foundation, Arduino Uno (2010), https://www.arduino.cc/
[5] ASUS ZenPad 8.0 8inch; AsusTek Computer Inc., Taipei, Taiwan.
[6] Microsoft's Windows Surface Pro, with Windows 10. We are planning to migrate to a one-board computer LattePanda to embed in the base.

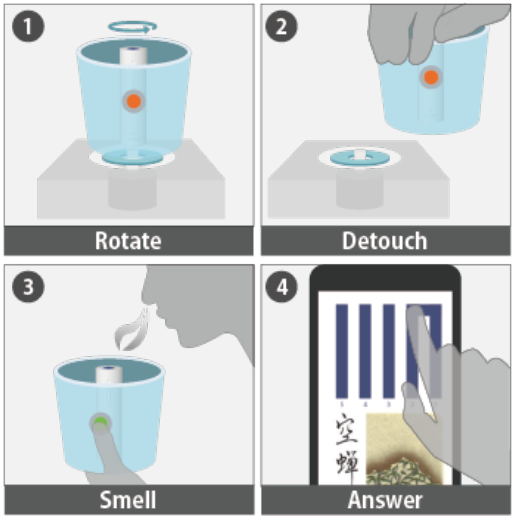

Figure 8: Steps to play eGenjiko.

HTML, CSS, and JavaScript. The web application shows the progress dialog pages, an answer page, and results on the client tablet device that connects through Wi-Fi.

Operation
Figure 8 shows steps 1 to 4 of the scent matching game provided by our system. **Step 1**: a player puts the censer on the base and taps the start button on the tablet device. The base rotates the lower part of the Aromastic in the censer to select one of five scents randomly. **Step 2**: the player takes the censer off the base in his/her hand and puts the other hand to the bottom of the censer. **Step 3**: the player smells the selected scent by pressing the scent ejecting button on the censer. After repeating the steps 1 to 3 for five times, the player is ready to answer the matching

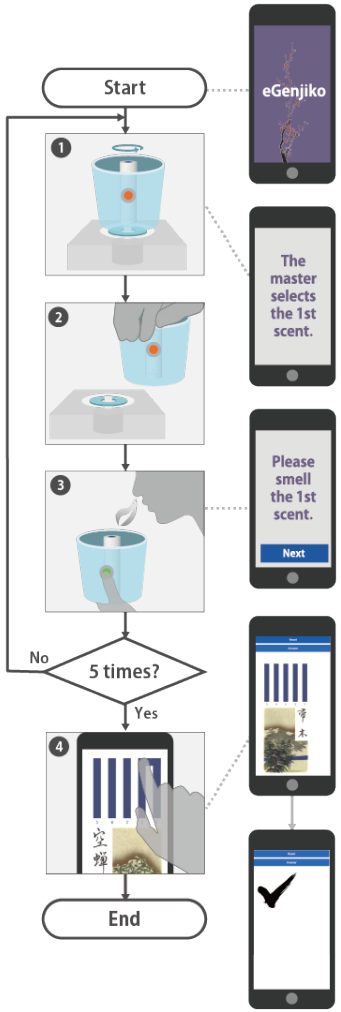

Figure 9: Flowchart of eGenjiko.

pairs of the five scents. **Step 4**: the tablet device displays an answer page of *Genjiko-no-Zu*, that represents five released scents by using five vertical lines. The player inputs his/her answer of matching scents by drawing horizontal lines between corresponding vertical lines. In case that the player misses or re-considers the answer, the reset button on the display can be used to initialize the input.

The flowchart of the eGenjiko system is as follows (see Figure 9):

1. The tablet device shows the title page of "eGenjiko." When the player taps the start button, the server PC generates a scent pattern of five scents that will be presented to the player.
2. The tablet device shows a message saying "The master selects the 1st scent." The server PC sends a command to the base to rotates the Aromastic to the 1st scent position. To prevent a player from guessing the scent by the stepping motor movement, the base proceeds dummy movements followed by movements to the target scent. The censer is ready to release the scent.
3. The tablet device shows "Please smell the 1st scent." The player picks up the censer, and smells the scent rising from the censer by pressing the ejecting switch on the censer. After finished smelling, the player puts the censer on the base and presses the "next" button on the tablet.
4. Repeat steps 1 to 3 for five times.
5. The tablet device shows the answer page with digital *Genjiko-no-Zu*. The player responds by drawing horizontal lines on the touch input display.
6. The server PC program checks the answer of the user, then the tablet device shows the result by correct or incorrect symbols.

Conclusions and Future Work

We have proposed eGenjiko, a digital gaming system based on traditional scent matching game *Genjiko*, using a computer-controlled censer and a tablet device. The system provides *Genjiko* experiences to casual players, because eGenjiko does not require expensive utensils and aromatic wood that are necessary to the actual *Genjiko* play.

In the future, we plan to evaluate the usability of eGenjiko through user experiments. Besides, we intend to improve the censer by equipping some air ejecting part to clear its surrounding atmosphere and avoid consecutive scents' mixing.

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