ChinAR: Facilitating Chinese Guqin Learning through Interactive Projected Augmentation

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ABSTRACT
The Guqin, a seven-stringed fretless zither, is the most representative traditional musical instrument in China. However, the complexity of its unique notation and theory has severely limited its popularity in the modern world. With the goal of providing an easy and effective way of learning Guqin, we have created an interactive learning system called ChinAR which employs augmented reality. We have made three main contributions in this paper: (1) a systematic method to design for instrumental learning combing eastern and western musical concepts; (2) a primary validation of the effect of augmented reality in facilitating learning of the Chinese Guqin (3) a natural user interface for the learning system applying gesture detection. The result of user study shows our design is helpful in providing better learning experience and enhancing performance and memorization with markedly less time spent learning. This work shows how a new interface helps promote the use of heritage instruments and culture.

Author Keywords
Augmented Reality; Interactive Design; Guqin; Instrument Learning Interface

ACM Classification Keywords
H.5.1 [Information Interfaces and Presentation]: Multimedia Information Systems; K.3.1 [Computers and Education]: Computer Uses in Education—Computer-assisted instruction (CAI).

INTRODUCTION
The Guqin is a typical heritage instrument in China. While the cultural and aesthetical value makes it especially charming, its arcane notation, costly learning way and abstruse theory keep it difficult to master, and then hard to promote. However, existing endeavors related to the digital preservation of the Guqin, e.g. [2, 14, 21], fail to consider reducing the learning difficulties through interaction design. To make it easy for general beginners to experience the charm of Guqin, we introduce ChinAR (Figure 1), an interactive learning system based on Augmented Reality (AR), which can enhance Guqin beginners' learning efficiency by expressing instructions in an intuitive way.

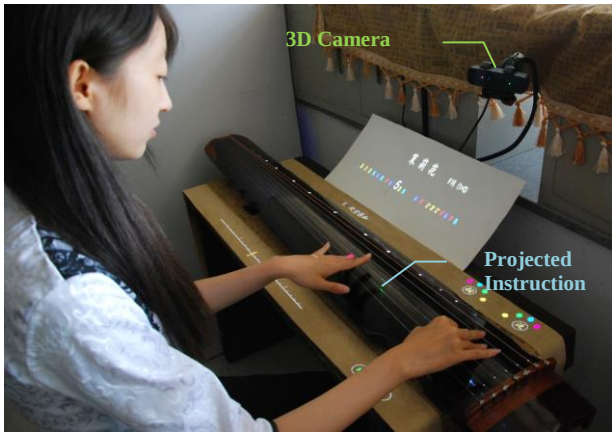

Figure 1: Guqin Learning with ChinAR

Considering Guqin playing context in Chinese cultural, it will be intrusive to add any device directly to the instrument or the body of the player. So we choose augmented reality to reach our goal, applying the interactive projection, audio processing and gesture detection. Our system is able to create a perceptual and cognitive overlap between physical instrument, visual instructions and acoustic perception, so that the learners can relieve themselves from the pressure to plough through the self-learning process and concentrate more on being engaged and playing well.

By experiencing Guqin courses with other learners and consulting the experts, we use autographical design method [11] to summarize a systematic structure in design for the instrument learning. We also used a depth camera to design

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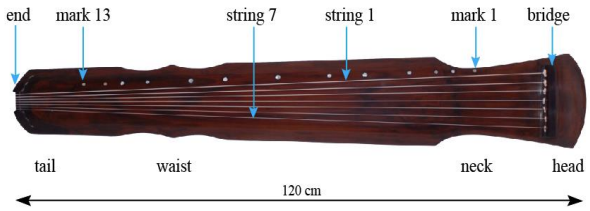

Figure 2: The construction of the Guqin

a natural user interface that allows the user to control with their hands in the air. Then we conducted a user study on selected beginners to evaluate their learning efficiency, memorization, and user experience when learning with ChinAR compared to traditional method. The results of our within-subject study show that ChinAR can bring better performance and memorization while saving about 30% learning time and providing enjoyable experience.

We will review some related works before describing the concept and design of ChinAR in detail, followed by a user study and additional case study. Then we will discuss the findings, limitations and future work, and finally conclude with an overview of the contributions.

BACKGROUND

The Guqin, originally called Ch'in, is the oldest stringed instrument regarded as a symbol of Chinese high culture. As shown in Figure 2, the Guqin has a long, narrow body made of two wooden boards with seven steel-nylon strings to produce sounds and thirteen marks called "Hui" to indicate positions for proper pitch. Typically, the Guqin is able to produce three types of timbre: "San Yin" (open sounds), "Fan Yin" (floating sounds), and "An Yin" (stopped sounds) [5]. "San Yin" is a deep and vigorous sound produced by plucking certain string with the right hand. "Fan Yin" is a crisp and clear sound produced by lightly touching the strings with the left hand as soon as the right hand plucks. "An Yin" is a mellow and varied sound produced by pressing against the string with the left hand while or after the right hand plucks, often modified by sliding the left hand up and down.

Undoubtedly, the Guqin is an vitally important heritage, but unfortunately, it is only mastered by fewer than two thousand people, mainly because of the three following challenges in its learning.

Understanding the Unique Notation

The Guqin has its own notation called "Jianzipu" (Figure 3), a distinctive type of tablature composed of reduced characters indicating the appropriate fingerings in detail instead of the pitch and rhythm. Figure 4 shows an example of a reduced character, which can be interpreted as using the left thumb at the location of the ninth "Hui" while plucking the seventh string with the gesture "Tiao" (right index finger moving outward).

The special tablature looks very alien even for most educated Chinese people, let alone foreigners and children.

Figure 3: A part of the shorthand tablature "Jianzipu"

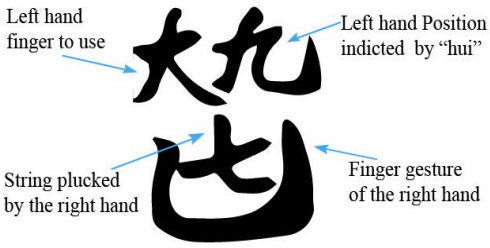

Figure 4: An example of a reduced character

The complex structure and meanings of the reduced character, as well as lack of melody information, make it hard to learn and easy to forget. Although the tablature is generally paired with number notation or staff notation as a supplement since the 20th century, many Guqin learners still have difficulty combing the different notation systems.

Building Effective Learning Habits

Since the performing techniques of Guqin are more complicated and put more stress on the coordination of both hands than most modern instruments, it is harder for learners to practice by themselves.

Traditional Guqin education is based on oral impartment and exemplary teaching over time, which is costly and inflexible for modern learners. But, without supervision, difficulties in forming proper practicing habits often incur a source of frustration for both teachers and students. According to an investigation, more than half of the amateur learners stop Guqin learning during the first year because of the inefficient practice.

Mapping the Fingering with Sound

Due to the complex musical temperament determined by the physical features and principles of the Guqin, the relationship between finger and sound, neither linear nor one-to-one mapping, is hard to understand and remember. Consequently, it is hard to find certain pitches on the instrument or translate other kinds of notation into tablature for the Guqin. Thus most players can only mechanically express what the tablature tells them, which limits not only their musical expression, but also their initiative and freedom.

RELATED WORK

As we are not aware of a similar system for the Guqin or other zither-style instruments, we reviewed related projects in the field of computer-assisted musical instrumental tutoring (CAMIT) focusing on augment reality applications for some popular western instruments, and analyzed what could be analogous and different with Guqin.

Augmented Piano

A recent project presented by Jonathan Chow [3] built an immersive learning environment with head-mounted projector. It exemplified many useful cases of performance instruction, evaluation and feedback, but the necessity to wear the display device limited its flexibility.

MirrorFugue [19] directly projected the video of players on the keyboard and in front of the piano, enabling observation in detail of practical music expression. In some scenarios this system is amazing, but its use in education is less promising due to the difficulty to correct reference model and offer feedback.

The P.I.A.N.O. [18] system used pictorial roll instead of symbols or images to represent notes. The design of different learning modes and the interface using piano keys are especially enlightening, and the evaluation is relatively comprehensive. But too much information and game elements might make players feel overwhelmed.

For keyboard instruments, MIDI (musical instrument digital interface) is the common means to connect with computer and provide rich, accurate digital performance information. However, MIDI is not available for most string musical instrument, especially traditional ones like the Guqin. Furthermore, their waterfall representation and game-like feedback do not apply to Guqin. For the Guqin, it is important to make the system unobtrusive and emphasize the relationship between the fingering, and the visual and aural elements.

Augmented Instruction on String Instrument

For string instruments, techniques like audio analysis will play an important role. The Digital Violin Tutor [20] can serve as an epitome to convert analogue audio to individual notes, compare the transcribed performance of students and teacher and show animation on the screen to provide visual instruction.

There are also some projects using augmented reality to indicate the music note directly on the instrument. The guitAR [9] projects the fingering suggestions and thereby offers an alternative note representation on the guitar fretboard. But the projector mounted on the headstock is relatively cumbersome and incapable of covering the full playing range; still it has not made any connection between the music and fingering indication.

In design for the Guqin, we are faced with the common problems in instrument learning, thus some visualization and audio processing techniques as well as some general design modes are deserved to be absorbed. But more important, we should infuse them with eastern musical theory, integrate them into the Guqin learning context, and make the interface elegant and natural.

CONCEPT AND DESIGN OF THE SYSTEM

In the eastern aesthetics, harmony is the basis of all tone. In term of the Guqin, there are three levels of ideal state in regard to harmony [22]. Here we are mainly concerned with the intermediate level of harmony, to which we can provide more facilities with AR to help learners overcome the learning challenges. This level of harmony, to harmonize the fingers with music, means to express the music smoothly with appropriate finger movements and actions, so that the intonation and rhythm will be dulcet.

Combining the eastern musical concept of laying particular emphasis on the variation of fingering and the western musical concept of focusing more on the accuracy of pitch and rhythm, we have abstracted out the main cognitive process in translating the tablature into music with playing behavior (see Figure 5), which connects the visual, behavioral, and aural senses.

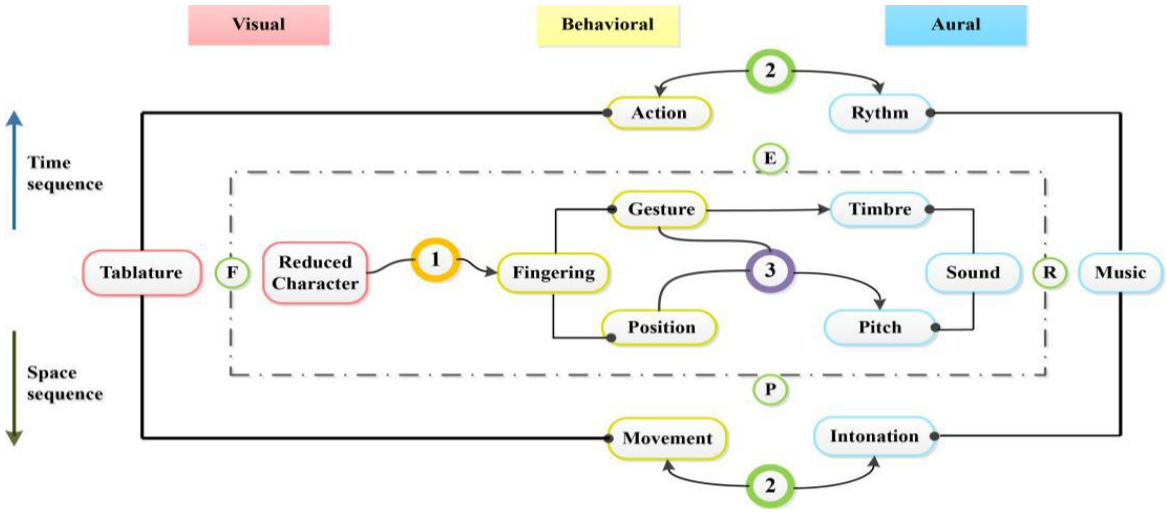

Figure 5: The design concept to enhance the linking between key elements in the learning process of Guqin

The inner layer shows how an isolated reduced character is translated into the specific sound, while the outer layer is its integration in time and space sequence to translate tablature into music. Figure 5 shows the relationship between the three points that we focus on to respectively help the Guqin beginners build easy mapping between the visual note and fingering, the playing behavior and music, and then the fingering and pitch. The second point consists of four learning modes that help the transition between the inside and outside layers in different aspects. The initials of these modes (Perceiving, Following, Enhancing and Reviewing) indicate their major roles in the whole learning process.

1. Tablature Visualization

To reduce extraneous cognitive load in fingering understanding, we designed a sort of graphic symbol, which is obviously intuitive and pleasurable compared with structural semantics [17]. Due to the limited space between strings, the information of reduced characters has been represented with distinguishable visual attributes: simple shapes and bright colors (see Figure 6).

Dynamic shapes are designed to naturally reflect the gestures and gently draw the learner's attention to the current note. For "Fan Yin", empty circles indicate the position of the left hand, which will spread from its center like ripples; triangle indicates the gesture of right hand, which will grow through the plucking directions like strokes. According to the playing posture, we keep the right symbol following the left one in a certain distance that enables convenient observation and avoid switching views.

Color is chosen to indicate the fingers to use since it is less distracting and can be perceived preattentively [6]. We show the colors in front of the instrument with the order of corresponding fingers, and connect them with four of the traditional five elements: metal, wood, water and fire.

2. Learning Modes

In order to consolidate the connection between the playing behavior and music, we designed four steps of learning modes based on common Guqin learning practices: perceiving, following, enhancing, and reviewing.

Perceiving

Perceiving mode encourages the learner to get familiar with the tone and form a general impression of the patterns of finger movements. Symbols will be shown along with music and gradually fade out as it goes on.

Following

Following mode allows the learner to produce each sound appropriately by following the word-by-word indication with their fingers. The system will wait until there are input

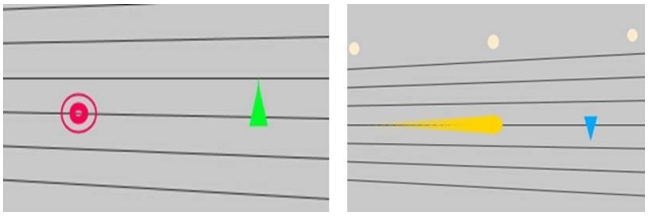

Figure 6: The visualization of the tablature the "fan yin" (left) and the "an yin" (right)

acoustic signals sharing the same frequency features with the standard sound of the present symbol note.

Enhancing

Enhancing mode will divide a long phrase of music into several sections considering both the fingering and the melody. It can be helpful to acquaint the learner with the rhythm and corresponding actions of each section by showing the string of symbols while playing its recorded sound in a loop, allowing learner to control his or her own pace.

Reviewing

Reviewing mode can test learning effectiveness by recording the performance accompanied with the audio model and providing visual feedback. When the recording is playing back, the symbol of the correctly played sound will show with the rhythm of the model, so that the leaner can find out the missed or defective part and recognize discrepancies in speed by inspecting the synchronism of sound and visual feedback. We do not show the score measured by the machine but just offer subtle reference instead, so that it will not interfere the user's self-perception.

In brief, these four modes together, lead to a process of iterative, spiral development in achieving harmony. Especially, the intermediate level of harmony is prepared in the Perceiving mode, experienced in the Following mode, formed in the Enhancing mode, and then tested in the Reviewing mode

3. Static Instruction for Musical Temperament

In addition to the dynamic instruction of the tablature, we also provide mapping of the fingerings and pitches by visualizing the computational results based on the Guqin musical theory. Specific tune determines the pitches of the open-stringed "San Yin" of each string, which in turn determines the fundamental frequency of "Fan Yin" and "An Yin" on the same string. "Fan yin" is harmonic based on the standing wave of strings' vibration, so the touching position of the left hand fingers on the string controls its pitch relevant to its fundamental frequency [23]. "An yin" is also determined by the position of left fingers which is not always under the mark, but should be calculated according to the temperament [1].

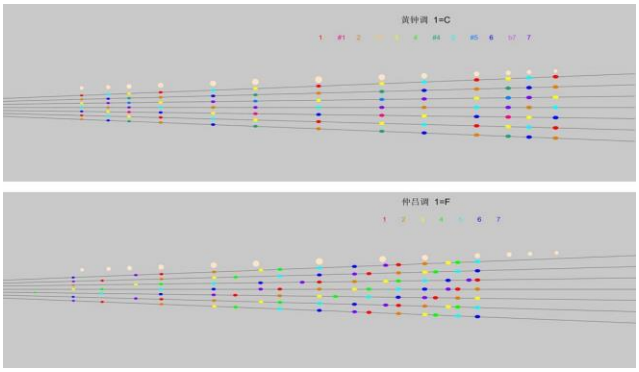

Figure 7: The static instruction of musical temperament the "fan yin" (upside) and the "an yin" (downside)

We map the seven colors of the rainbow to the seven heptachord notes (see Figure 7), so that users can easily combine eastern and western musical theory by observing colored dots on the strings. To fulfill further needs of Guqin players, we offer five basic tunes to choose, and allow the seven notes to highlight separately. With the color mapping, users can either adjust their fingers to accurate positions of a given pitch, or find the sound they like and play it with proper fingering (see Figure 8).

PROTOTYPE

Natural User Interface

In order to provide a convenient and interesting operation method for Guqin learning, we have designed a natural user interface applying a 3D camera. Users can switch the learning modes by showing the number of the mode with their right hand in front of the camera (15~ 30cm). We also designed three kinds of gestures to control the procedure in proper learning mode: "thumb up" to switch between play and pause, the "V sign" to start recording, and "swipe and hold" to relocate the progress bar. Thus during the learning process, the user can manipulate by moving their hands in the air, as an alternative to mouse and keyboard controls.

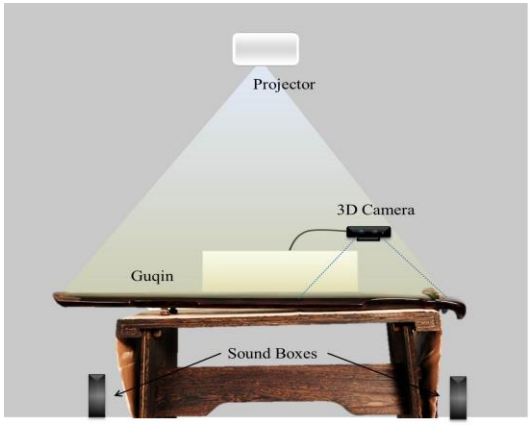

Figure 9: Construction of the prototype of ChinAR

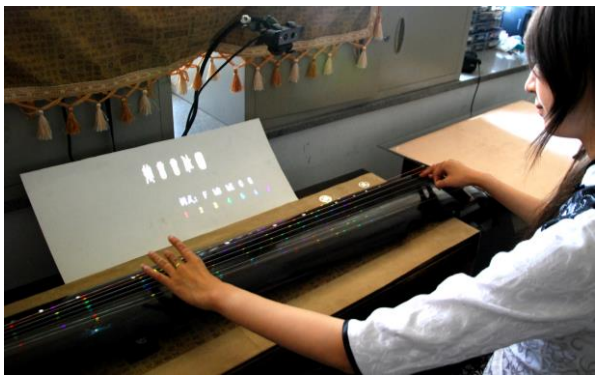

Figure 8: Guqin playing with the static instruction

Implementation

Our prototype shown in Figure 9, consists of a Guqin on a table with a paper board to show supplementary information like the notation, a short-throw projector mounted about 170 cm above the table to cover the full range of the Guqin (about 120×80 cm^2, 1920×1080 px), a Creative Senz3D camera (FOV: 73, Range: 15.24~99.06cm) [7] to input audio and detect gestures, and two speakers to play music.

The augmented interfaces of the dynamic and static instructions are respectively shown in Figure 1 and Figure 8. The software application is implemented in Processing [15]. It uses the Minim library [10] to dispose audio signal and PXCUPipeline library [16] to track and recognize gestures.

USER STUDY

Participants

A total of twelve participants were recruited from the university clubs and other public Guqin forums. All of them were young adults, 9 female and 3 male. All the participants are amateurs with experience of Guqin learning ranging from 6 to 18 months, which we consider fairly representative of our target users who have grasped the basic playing techniques and literacy of the Guqin but are still not fully familiar with its special tablature and musical temperament. According to our pre-session survey, all participants had taken weekly one-to-many Guqin courses, 58% (7/12) of them had auto-didactic experience, and 33% (4/12) of them had experience of other musical instruments.

Experiment Design

We applied within-subject design to understand the influence of different learning methods on the performance across systematic errors and participant bias. Participants were evenly and randomly assigned to Group A and Group B. They were asked to learn two phrases of Guqin music with ChinAR or in the traditional way using the tablature respectively.

Step / Group	Phrase 1	Phrase 2	Recall
A	ChinAR (D)	Tablature	ChinAR (S)
B	Tablature	ChinAR (D)	ChinAR (S)

Table 1: The assignment of the experiment

We choose the playing of "Fan Yin" (the floating sound) as the main object of study, because it requires two-handed interaction and hand-eye coordination, which are the fundamental technique in Guqin playing and often serves as the theme of tunes. The learning materials were two continuous phrases excerpted from the famous Chinese song "Jasmine Flower" [8]. We have consulted a professional Guqin teacher from Chinese Conservatory of Music and recorded her performances of the two phrases as model audio files. By hands-on testing, we consider there were no obvious distinction in length or complexity, and no repetition in fingering between the two phrases.

The experiment, for each participant, was conducted in a quiet laboratory for about 2 hours. As shown in Table 1, the experiment was consisted of three main steps. After a demonstration of the system, members in each group should learn to play the phrases with appointed method successively and finally try their best to recall and perform both phrases after 15 minutes with static instruction (irrelevant with the dynamic instruction). Their ultimate goal was to remember the tune and fingering and finally play the phrase independently. After each step, they were asked to take a video of the learning outcome, finish a relevant questionnaire and talk about their feelings.

RESULTS

Here we analyses the experimental data, records, videos, survey responses, and interviews, in order to find out the effect of ChinAR on learning efficiency, memorability, and user experience.

Effectiveness

All the participants admitted that despite strong motivation in Guqin learning at first, figuring out how to improve learning efficiency in limited practicing time has become their main concern. So the main metrics we chose to evaluate the effectiveness of our system were the learning time for participants to get their personal satisfied level, and the performance measured by the teacher.

Learning Time

We utilized within-subject one-way ANOVA to analyze the data. Indeed, results showed no statistically significant difference between the two phrases in terms of the learning time in both the traditional method [$F(1, 10) = 0.45$, $p = 0.52$] and new method with the system [$F(1, 10) = 0.36$, $p = 0.56$].

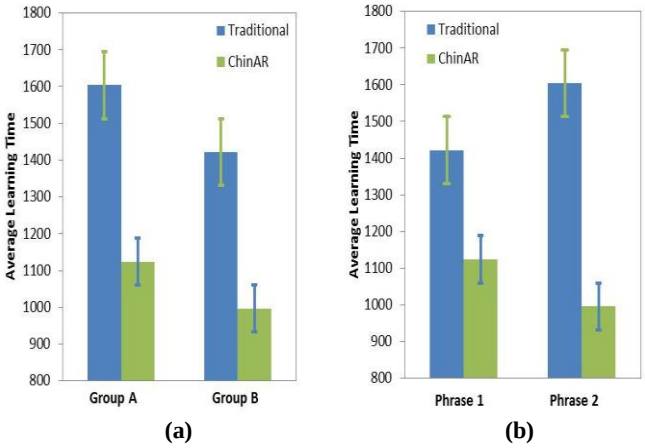

Figure 10: Learning time of different methods

Time (in seconds) of learning with ChinAR was significantly shorter than using tablature for both Group A [$F(1, 10) = 7.76$, $p = 0.0193$] and Group B [$F(1, 10) = 5.58$, $p = 0.0398$]. Figure 10(a) shows the average learning time of the two methods among members in the same group. The learning time presents a similar significant reduction for both the Phrase 1 [$F(1, 10) = 4.04$, $p= 0.0722$] and Phrase 2 [$F(1, 10) = 9.19$, $p = 0.0126$]. Figure 10(b) shows the average learning time of the two methods for the same phrase. The result illustrates that ChinAR could obviously curtail the learning time to grasp a phrase of Guqin music, regardless of the learning order and individual difference in skill. Integrally, average time using ChinAR ($M = 1060.1$, $SD = 283.7$) was only 70.06 % of that by reading the tablature ($M = 1513.1$, $SD = 320.4$).

Performance

Although the outcome of learning depends more on their previous foundation which cannot be changed in a moment, most of the participants (10/12) enjoy the progression with the help of ChinAR, and the teacher's subjective evaluation still presents a general increase ($M = 4.25$, $SD = 5.01$). In Figure 11, participants were ranked by their score for the traditional learning method on the horizontal axis, to clearly show the impact based on their prior ability. The result verified the effect of ChinAR in assisting learners to get relatively better outcome in a markedly shorter time.

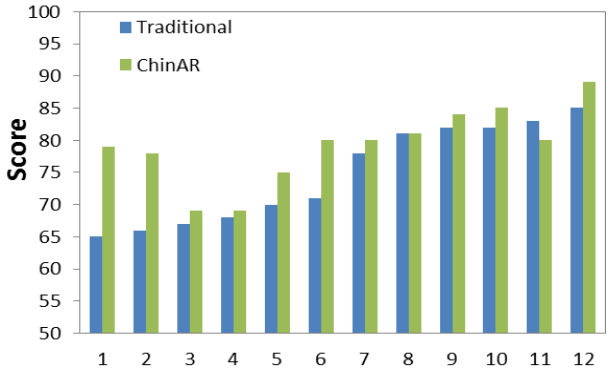

Figure 11: Outcome of two methods

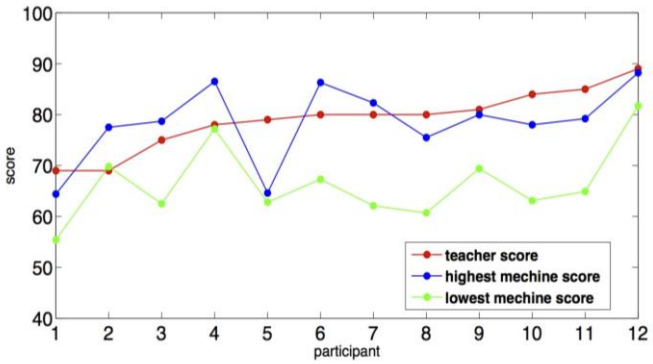

Figure 12: Comparison between the measurements of the system and the teacher

In the Reviewing Mode, our system measures the recorded performance automatically according to the characters that were well played, missed and played in advance or delay to provide a relative reference. An interesting comparison was made between the evaluation of the system (machine score) and the teacher (see Figure 12). It is reasonable that measurement was more relevant to the highest machine score (Cov = 0.51), because the video to measure was taken right after the last reviewing. The deviation can be partly explained by the comprehensive consideration of the teacher including the factors like coherence and fingering skills other than the accuracy in rhythm and intonation. Since maintaining steady tempo despite making mistakes is a skill that musicians need [4], even for music enjoying widely freedom like the Guqin, it can also be helpful for beginners to have a proper test and feedback mechanism in the absence of tutor.

Memorability

We defined memorability in this experiment as a subjective measurement of short-term recall tasks. When the participants finished the learning of both phrases and tried to recall what they learned with static instruction after an interval, we found 41.7% (5/12, 2 in Group A and 3 in Group B) of them only remember the phrase learned with ChinAR. The rest of them could remember almost all the content but mostly (6/7) exhibited more accuracy and fluency in the new method outcome.

The observation results express better memorization through ChinAR, even though the traditional method costs more time and might have taken place more recently. A participant said, "The system can help me pay more attention on the proper gestures and match them with music while playing, so I do not need to depend so much on my own memory and imagination to remember it."

User Experience

Dynamic Instruction

Generally, it is encouraging that all users could understand the meaning of the symbols, get used to the interface, and feel curious and excited about our system. According to the interviews, 91.7% (11/12) of participants found the feedback is easy to follow. All of them felt the interface is interesting, 75% (9/12) thought the control flexible. The mean value of their subjective measurement of the enjoyability, learnability, usability, and acceptability is correspondingly 91.3, 85.6, 78.8 and 75.6 in 100.

All participants thought the design of learning modes were reasonable and the average value of the 5-point Likert scales for the four modes are 4.06, 3.98, 4.17, and 3.61 respectively. To summarize the results of the survey, the Perceiving Mode served as a role for casting general imagery and cascading the whole phrase, the following mode could successfully relieve the pressure in coming up with correct gestures and positions, the enhancing mode is critical to achieve fingering skills in continuous actions and fit it to the rhythm, and the Reviewing Mode could help participants identify their problems in intonation and rhythm with feedback.

Static Instruction

When the participants were shown static instructions to review the phrases, 33.3% (4/12) of them could make use of the color marks to find the right notes in the phrases, since they were more familiar with the number notation and could easily remember the notation in previous sessions. 41.7% (4/12) of the participants could not remember the exact number in notation, but still found it interesting and effective to map the color with relative relationship of the sounds. The other 25% (3/12) lacked the concept of number notation and still used memory of absolute location to recall, but all of them affirmed that it would be beneficial to gain cross musical thinking between the eastern and western method.

ADDITIONAL CASE STUDY

As a supplement to the experiment, we also perform an informal case study to explore more impacts of ChinAR on diverse levels of users. In this session, two of users are novices with no experience but great enthusiasm; the other two are senior learners who had played Guqin for more than three years.

Novices

For the novices, we would offer a brief training session preceded the learning process, ensuring they can understand and apply the basic knowledge in need to play the specific phrase. They should also try to learn the two phrases both in the traditional way and with ChinAR under the guidance of the experimenter, but can stop anytime they feel too difficult to continue. We would consider about their acceptability, experience, and temporary effectiveness and difficulties.

It is noteworthy that all participants in the formal experiment have already used the tablature for at least six months but got used to the new method just in several

minutes. The outcome of novice was more convincing. Both of them found it too hard to finish the learning process in traditional way, but could complete the procedure with ChinAR and play the phrase independently within half an hour. The novice with better musicality even performed pretty well in the phrase learnt with ChinAR (teacher score: 83, highest machine score: 84.1). Both novices could also play out the phrase learned using the system after a while, but had difficulty recalling even a section learned from traditional tablature reading.

Especially, the novices showed great interests in the Following Mode, because it urged them to keep the harmony of fingers and strings and meanwhile inspired their confidence in playing the right tune with the right fingering. They enjoyed the sense of "certainty" and actually showed no obvious distinction with formal participants in reaction time (Beginners: M = 1.53; Novices M = 1.74) and ratio (Beginners: M = 1.43; Novices: M = 1.64), much faster and more relaxing than interpreting a new reduced character for them.

Senior Learners

The senior learners would not be limited to the procedure. Instead, they can play any piece they like with the static instruction after experiencing the dynamic instruction. We would concern more on their acceptance of the AR instruction as well as some details or high level requirements.

The senior players found it practical to locate the left fingers with the help of dynamic instruction and had no obstacle to connect the color with sound and fingering. They could easily remember the fingering and correctly play the musical section just by going through the process. But they were more interested in the static instruction, not only because of its function as a calibration; what is more attractive is its benefit in stimulating their creativity to improvise or express songs without the tablature.

DISCUSSION

Impacts on Various Levels of Users

For beginners, the result of our experiment shows its effectiveness in reducing practicing time while achieving better outcome and memorization. According to the thorough analysis, the better temporal effects might come from the general imagery, the intuitive mapping, the continuous and repetitive guidance and the timely self-test with feedback. Our design concept to considerate relationship between all the elements in the learning process is applicable to design for other musical instrument and even non-musical tasks.

For the novices, the system successfully boosted their interest and confidence in fulfilling their keen desire to play famous tune on the classical musical instrument. For senior players, the most intriguing part might be the concept of exhibiting the musical temperament directly on the strings and connecting it with the western music system, which will hopefully broaden their performing range and expression.

Limitation and Future Work

Although the result of the current instruction state is encouraging, there is still a long way to fully express the rich and subtle fingering techniques of the Guqin. Besides, the dynamic instruction has the possibility to indulge passive learning habits, so how to inspire the autonomy of the user and exert the capacity of their ears and fingers during the interacting with instrument and augmentation is really a challenging theme.

Promising future work includes refining the interaction structure with more flexible control mechanisms, improving the expressiveness of fingering by visualization and animation, and broadening the source of learning material by applying existing digital resources and techniques. We would further explore the method to inspire user's autonomy and initiative in the interaction with projected augmentation and physical instruments.

CONCLUSION

In this paper, we have presented the use of the interactive projected augmentation with ChinAR, an innovative learning system making Guqin learning more accessible and enjoyable. There are three main contributions of this system: (1) a systematic method to design for musical instrumental learning combing eastern and western musical concept; (2) a primary validation of the effect of augmented reality in facilitating learning of the Chinese Guqin (3) a natural user interface for the musical learning system applying gesture detection.

The results of our user study showed that the learning process with ChinAR indeed helped beginners gain higher efficiency and better memorization. In addition, we found that related to the individual fundament and musicality, users showed interests in different parts of the system, but could always find a preferable way to interact with it and get benefits to some degree.

In short, we use a typical case of the Chinese Guqin to validate the impact of AR on narrowing the gap between beginner and expert in a complex activity with suitable methods. What is generalizable in the work is its methodology and validation to design for specific activities in order to promote and reflect on traditional art and heritage.

At last, we should reiterate what we attempt to design is not a substitute, but a supplement to the traditional tablature and courses. We believe it is meaningful to revitalize the old heritage by applying new methods and techniques, and hope this paper serves as an enticement to a wider scope of cross cultural discussion in the field of human computer interaction.

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