A Method for Discussing Musical Expression between Music Ensemble Players Using a Web-Based System

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Abstract. Music ensemble players discuss musical expression of the piece of music they perform, and determine how to play each note in a score such as the length and the dynamics of tone or phrases in every detail of the music. This paper introduces our system that supports the discussion about musical expressions on the web. Our system enables the users to write comments, draw symbols, and link videos on the score where they are discussing about. We also conducted an informal usability study to evaluate the usefulness of the system.

1 Introduction

Most music ensembles, groups of musicians, discuss musical expression to make their performance more impressive. They consider every detail of the piece of music they perform, i.e. the length, the dynamics, the articulation such as accent or staccato, and so on. They also discuss together what they feel and imagine in the piece of music and how the music is written by the composer. However, it is time-consuming to discuss them face-to-face. When they meet together, they prefer taking time to practice playing together rather than discussing. Therefore, there is a great demand for a system that enables the discussion about musical expressions asynchronously and remotely.

Current BBS and other web-based systems for remote and asynchronous discussions have problems to use for discussing musical expressions. First, since they are basically text-based system, it is difficult to specify the part in the score where the user wants to discuss. Specifying the position in the score in text requires lengthy explanation. Second, it is difficult to express various musical notations in text, since they are usually represented graphically. Third, it is not easy to refer to sound and video data.

This paper proposes a method to describe musical expressions and describes our web-based asynchronous discussion system. In our system, the users proceed discussions based on writing or drawing directly on the scores, so the users can always associate all discussions with the scores. The users can post text-based messages, musical symbol, freehand drawings and links with images and videos hosting sites. Our system can be also used for the purpose of sharing decided

directions of music ensemble i.e. fingering, timing of breath, and so on. Our system has three features:

Distant and Asynchronous Web-based System. Our system provide distant and asynchronous communication especially for amateur ensembles that cannot spent enough time for practicing. We implement our system as a web application so that the user can use various devices such as PCs and Tablets.

Discussion Along the Context of a Musical Score. In our system, the users write comments on a musical score, which makes them easy to specify the part they want to discuss about.

Visualized Description of Articulation. Articulation in the field of music means adjusting the shapes of tones, phrases and links of tones by put dynamics, emotion, and so on. General musical symbols (i.e. staccato, tenuto, portato, etc.) only represent basic articulation, not precise one in detail. In our system, the user can draw articulation "shapes" in various colors to exprese their feelings.

2   Related Work

2.1   Asynchronous Collaboration

In the studies of asynchronous discussion using graphical annotations on web browser, Heer et al. developed *sense.us* that supports asynchronous collaborative information visualization[1]. *sense.us* provides information visualization of census data in the U.S. and communication system for analyzing on web browser. Phalip et al. also developed the system that supports filmmaker and composer to make videos at a distance[2]. The feature of the system is web-based video editing sequencer that can attach annotations to its screen. Farooq et al. developed the system for scientific and creative discussion between distant places[3]. The system, named *BRIDGE* that means Basic Resources for Integrated Distributed Groupe Environments, provide virtual spaces containing timeline, chat rooms and representation to share the users' opinions. Cadiz et al. researched communication between web editors by implementing the system that can write notes directly to web pages and making an long term experiment for a few handred participants[4]. Ellis and Groth developed an asynchronous communication system that can attach annotations including texts, images and sounds to the video[5].

We supported distant and asynchronous discussion concerned with musical expression. Our system possesses faculty to attach annotation along the context of a musical score and to represent concrete shapes as image of the music.

2.2   Computer-Supported Ensemble

As the study of computer-supported musical performance, Bellini et al. researched supporting of real-time music performance[6]. They developed *MOODS*:

a cooperative editor for musical scores that can automatically synchronize written notes on their sheets of music. Sawchuk et al. developed *DIP* that enables players to participate their practice at a distance[7]. Akoumianakis et al. developed the prototype toolkit for the purpose of distant and asynchronous ensemble practicing[8]. The system *DIAMOUSES* records performance every part of the music and enable the users to enjoy distant ensemble by using the recorded data.

This study does not support realtime performance but discussions of the performance. We focused on discussions that is a significant part of ensemble practice, and had an eye to indirect supporting musical performance.

3 Web Client Interface for Discussing Musical Expressions

This system enables ensemble players to discuss musical expression anytime anywhere not only when they are together. In this system, the users can post their comments and reply to the other users' comments on a musical score. They can also describe graphical tone shape as their images of articulation and represent pictures or videos for their argument. The users can write musical symbols to a musical score directly in order to explain or write the result of the discussion.

Fig.1 shows the interface of the web client in this system. Tool palette(Fig.1 [A]) and help bar(Fig.1 [B]) are fixed at the left and the top of the browser. Clicking the tool palette changes the mode of this interface. There are three modes: "view", to view comments of others and to reply to them, "post", to create new comment regions on a musical score, and "stamp", to write musical symbols on a musical score. The help bar always displays advices and tips depending on the mode of the system. On a musical score(Fig.1 [C]), there are comment regions(Fig.1 [D]) and comments(Fig.1 [E]). Clicking a comment region shows or hides the list of comments there.

Comments on a Musical Score. In our system, all comments are attached to a specific region on a musical score. This makes it easy to specify the part in the musical score the comment is referring to without writing a lot of words.

When the user clicks the "post" in the tool palette, the user can create a new comment region to post a new comment. A comment region is created by a dragging operation on the musical score. When the user drags on the musical score, the system displays a comment region represented as a red and transparent rectangle (the top of Fig.2). After the dragging operation, the system also displays a comment posting box where the user can enter a text message and an articulation figure (the bottom of Fig.2). The comment posting box consists of an area for a text message, a checkbox for whether articulation is posted, and three buttons labeled "articulation", "post", and "cancel". The articulation button starts the editing an articulation figure. The user can post the entered text comment to the server by clicking the post button, or cancel it by clicking the cancel button.
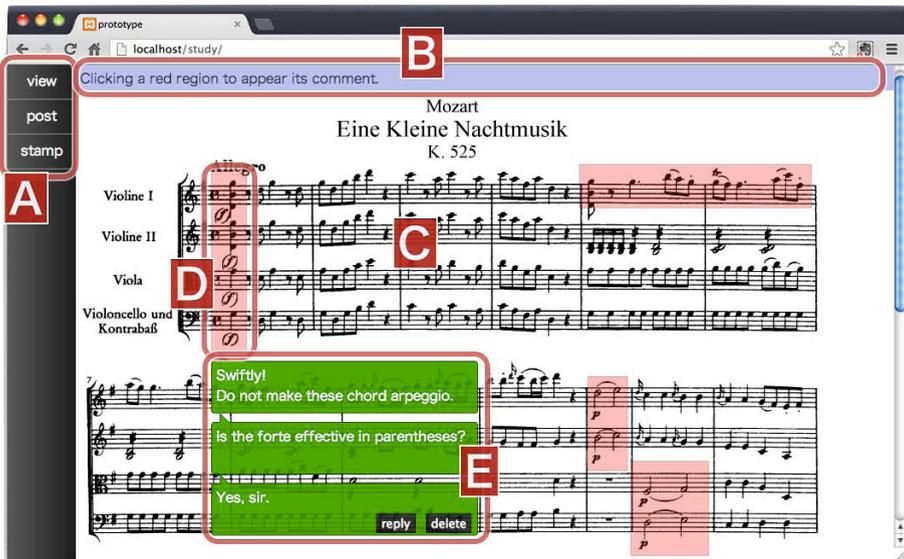
Fig. 1. Web Client Interface. [A]Tool palette. [B]Help bar. [C]Musical Score. [D]Comment region. [E]List of comment belonging to the region([D]).

A posted comment is displayed as shown in Fig.3. It has two buttons labeled "reply" and "delete". By clicking the reply button, a new comment posting box appears, where the user can enter a reply comment. The delete button deletes the comment. The comments to the same region are listed vertically as shown in Fig.1[E].

Articulation Figures. To represent and post the image of how to play the specific part in a musical score, our system provides an interface to draw an articulation figure. The articulation figure represents the image of the volume variation and the color of a specific phrase. The user can easily edit and color it only with dragging operations.

Clicking the articulation button in the comment posting box starts the editing of an articulation figure (Fig.4). The figure in the articulation editing box represents the dynamic transition of the phrase. The left end of the figure corresponds to the attack of the phrase and the right end corresponds to the release of it.

The attack and release expression of the figure changes continuously by dragging up and down on or near each end. The color of the articulation figure can be also changed continuously by dragging at the middle. The brightness is changed by dragging vertically and the hue is changed by dragging horizontally.

After the editing of the figure, the user can post it with the comment by checking the checkbox at the left of the articulation button(Fig.4). The articulation figure is resized to fit in the comment box (Fig.3).
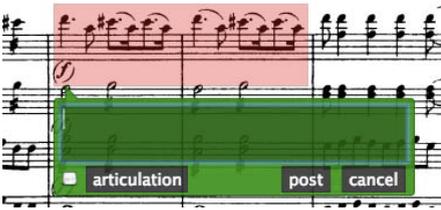
Fig. 2. Comment region(higher, red) and comment posting box(lower, green)

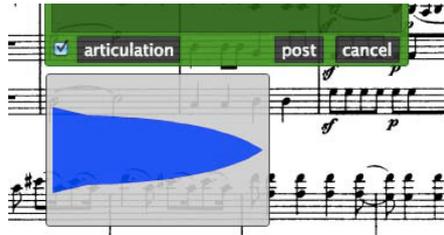**Fig. 3.** Posted comment including edited articulation

Fig. 4. Articulation editing box under the comment posting box

Referring to Images and Videos on the Web. In discussing musical expressions, it is very important to know the background of the piece of music deeply such as the character of the composer, especially in classical music. So, often the users want to refer to the other web site pages in their comments. In addition, ensemble players often think of the other players' performance as examples of how to play a music. Referring to videos is also a necessary function for our discussion system.

Therefore, in our system, the user can link to images and videos on the web to interchange these knowledge. If the URL of an image or a video is included in the entered comment, it is automatically displayed in the comment box (Fig.5). Currently, URLs of PNG/JPEG/GIF files and YouTube videos are supported in our system.

Stamping Musical Symbols. Ensemble players often write various musical symbols on music scores in order to remember how to play the part in the performance. Musical symbols are better to recognize than a textual annotation when playing a music.

Our system also provides an interface to put musical symbols on a musical score. The user can open the stamp palette (Fig.6) by clicking "stamp" in the tool palette. Then the user chooses one in the stamp palette, and put it on the musical score just like stamping.
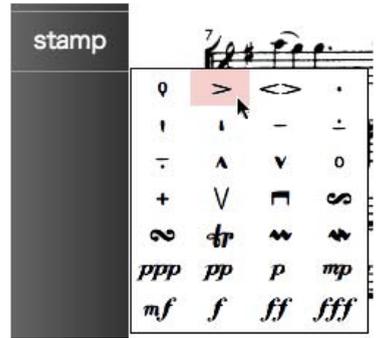
Fig. 5. Representing a video in comment

Fig. 6. Stamp palette beside tool palette

4 Implementation

4.1 System Overview

This system consists of the server and the web client(Fig.7). The web client is implemented as a web application in HTML, CSS and JavaScript for crient-side, PHP for server-side and MySQL for operating database. The system benefits from HTML5 canvas and jQuery. Comment regions and comment are implemented by unordered list of HTML, and click events are controlled by JavaScript / jQuery. The database stores the informations of comment regions, comment and stamps. When the user starts this application or posts new comment, the application loads or saves them.

4.2 Implementation of the Web Client Interface

Comment on a Musical Score. When the user clicks the "post" in the tool palette, canvas element that covers the musical score will be active by changing the CSS. Dragging on the canvas, a red and transparent rectangle is dynamically drawn according to the coordinates of the mouse events in jQuery. When the new comment region is created, the system appends a new HTML li element that size and position are same as the red and transparent rectangle.

Every comment and comment posting box are formed like a balloon by CSS. When the user clicks a comment region, the list of comment belonging to the comment region toggles between expanded and collapsed states. All information of the comment and comment region are stored in database such as position, size, text message, articulation, timestamp, etc.
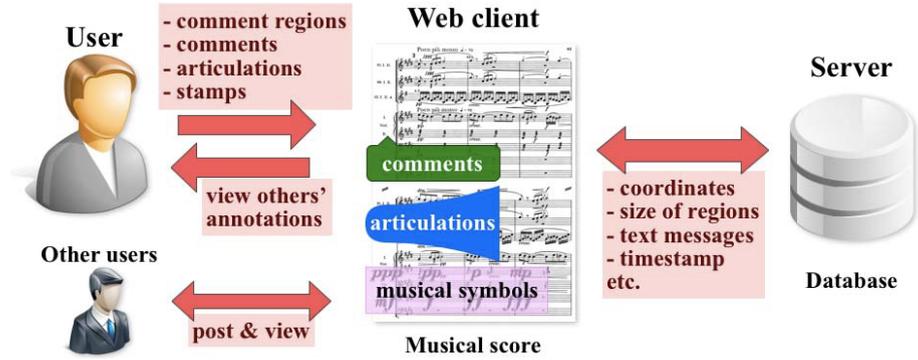
Fig. 7. System overview. The users post their opinion to musical scores. Every annotation is attached to specific region on musical scores. The database maintains data of all annotations.

Representing Image of Articulation. Editing articulation is implemented as HTML canvas. The methods of lineTo(straight line), quadratic-CurveTo(quadratic Bézier curve) and fill(paint the closed area) render the shape of articulation. The system has several parameters that decide attack, release, brightness and hue of the shape. These parameters continuously increases or decreases according to the movement of dragging on the canvas(Fig.8). The system uses toDataURL method of HTML canvas to convert the image of articulation into PNG image which is displayed in a comment.
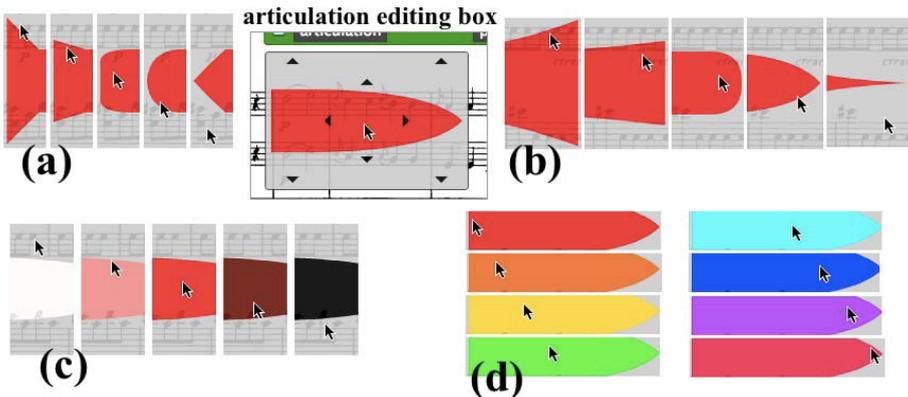

Fig. 8. Editing the articulation by dragging operation. (a)Reshaping its attack by dragging up & down at left end. (b)Reshaping its release by dragging up & down at right end. (c)Changing its brightness by dragging up & down in the middle of the shape. (d)Changing its hue by dragging left & right in the middle of the shape.

Representing Images and Videos. When the user posts a new comment, the system checks the value of textarea for containing image or video data. If the value of the textarea contains .png, .jp(e)g or .gif, the system convert the string into HTML img element. If the value of the textarea also contains URL of YouTube, the system convert the string into HTML iframe element that enables the users to watch the video immediately.

Stamping Musical Symbols. When the users clicks "stamp" in the tool palette, the stamp palette(Fig.6) appears, and the user clicks the musical symbol in the stamp palette, canvas element that covers the musical score will be active by changing the CSS. The selected musical symbol in the stamp palette is rendered near the mouse pointer, and the user can stamp it by clicking on the musical score using drawImage method. Then the stamped information as position, the kind of symbol, timestamp is saved to or loaded from the database.

5   Preliminary Experiment

We conducted preliminary experiment to evaluate the interface of this system and our approaches.

5.1   Procedure

The subjects were six university students including one female and five male. All of them has played in ensemble at least three years. We used "Eine Kleine Nachtmusik" composed by W.A.Mozert downloaded from IMSLP[1] for the musical score of this system.

The task for the subjects was to use the all functions of the discussion interface: posting a new comment, replying to a comment, editing and posting an articulation figure, putting musical symbols on a score, and posting a video of YouTube.

After finishing the task, the subjects were asked to answer to the seven point Likert scale questionnaire shown below.

(1) Usefulness of posting comments on the musical score.
(2) Ease of posting a new comment.
(3) Ease of replying to a comment.
(4) Usefulness of articulation figures.
(5) Ease of editing the shape of articulation figures.
(6) Ease of editing the color of articulation figures.
(7) Usefulness of 'stamp'.
(8) Ease of putting a stamp on a score.
(9) Usefulness of posting videos and images.
(10) Demand to use this system.

Finally, we asked them open-ended question about the whole system.

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[1] IMSLP: International Music Score Library Project(http://imslp.org/)

5.2   The Result and Discussions

Fig.9 shows the result of questionnaire. The following are the answers to the open-ended question.

- I want to edit the articulation figure more in detail. For example, I want to change the length of the tone, too.
- I don't understand clearly how to change the color of the articulation figure as desired. Choosing from several colors may be better.
- It's interesting to be able to hear the sound adjusted by the articulation figure.
- Stamping is very useful for inform the decisions.
- Colored stamps is useful for discussion.
- I want to write chord names on musical scores for music understanding.
- The screen is cluttered when many comments are posted.
- I want to use this system very much when my ensemble does not has enough time to practice.

Question \ Subject	i	ii	iii	iv	v	vi	Average
(1)Usefulness of Comment.	7	5	7	7	6	7	6.5
(2)Operation of posting new comment.	7	7	6	6	7	6	6.5
(3)Operation of replying to comment.	6	7	7	6	5	7	6.33
(4)Usefulness of articulation figures.	6	7	6	6	6	5	6.0
(5)Editing the shape of articulation.	7	5	6	7	6	7	6.33
(6)Editing the color of articulation.	6	4	3	5	4	6	4.67
(7)Usefulness of "stamp".	5	7	6	6	6	6	6.0
(8)Operation of stamping.	7	6	6	6	5	6	6.0
(9)Usefulness of videos and images.	7	7	5	7	6	7	6.5
(10)Demand to use this system.	6	6	7	7	5	7	6.33

Fig. 9. Result of questionnaire

Overall, the subjects wanted to use our system (from the the question 10). The result shows that our approach that posting comments on the specific point of the musical score is welcomed by the subjects. All subjects understood how to post or reply to a comment in a short time. However, one of the subject posted a new comment to the title of the musical score, and another subject posted a new comment to the margin of the musical score. In some cases, the user may want to post a comment unrelated to the specific part of the score.

The subjects also favored the idea of articulation figures. One subject said that it is intuitive and interesting to view the continuously changing articulation figure. However, the editing interface must be improved. It seems it is difficult to change the shape and color as they wishes.

Stamping was also mostly liked by the subjects. They said stamping is useful for informing decisions to others, but it may be not so useful for discussions. In the experiment, a lot of symbols were stamped which were not related to discussions. This result tells us, if anything, this system can be used for other process regarding music ensemble beyond discussions.

From the high score for the usefulness of videos, most ensemble players feel that it is essential to listen to other ensembles' performances. Since some video postings were not related to specific part of the score, the video posting interface can be improved to enable the posting that relates to the whole score.

Some subjects add the words that they want to use this system only when they have few time to practice, but not they have plentiful time. We believe it makes this system more demanded to enhance the features using particularity of computers such as articulation figures or referring to images and videos.

6   Conclusion and Future Work

This paper proposed a method for discussing musical expression remotely. We developed a web-based discussion system that enable the user to discuss musical expressions on the musical score. We also informally evaluated the usability of the system. The result confirms the usefulness of the system and also indicated some challenges. As future work, we will conduct the user study in actual situation and improve our system based on the result of this study.

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