



Extension of Annotation Function in Collaborative Composition System

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Abstract. Due to the development of social media networks, there are now increasing opportunities for multiple people to collaboratively compose music using desktop music and digital audio workstation systems. To facilitate such efforts, we have been developing a system that supports creative, collaborative compositions, have analyzed the conditions required to support such efforts, and have proposed and implemented a collaborative composition system that satisfies these conditions. This system is an asynchronous groupware application with which communications among users are performed by exchanging character-based text comments. In this paper, we describe how we extended the comment function of this previous system to support handwritten annotations.

1 Introduction

In recent years, there have been increasing amounts of research and growth related to services supporting multiple people engaged in collaborative composition efforts over the Internet. In our previous study, in which we explored ways to support network-based collaborative compositions by multiple people [1], we proposed and implemented asynchronous-type groupware that supports those efforts. That study also analyzed collaborative arrangements from the perspective of co-creation and proposed a model for use in the joint composition process. That model is based on our hypothesis that a compositional approach in which all members examine and reexamine work in progress is crucial to the creation of collaborative compositions. We also implemented a collaborative composition support system for that model.

The system framework itself is a presentation and investigation process tree, with which each member can create songs in his or her own working space and present his or her results to all other members while examining and commenting on the process and progression of their compositions via the system's comment function. However, in such collaborative work, it is important to support the externalization and communication of workers' intentions that are difficult to convey in text, such as figures or symbols. With that point in mind, this paper reports on the introduction of a function that can be used to create and share handwritten annotations. We also provide an outline of our system and describe the added annotation function in detail.

2 Collaborative Composition

2.1 Creativity and Problem-Solving

When creativity is viewed as a problem-solving activity, it is generally expected that group problem-solving based on exchanging ideas and information possessed by various group members will lead to better results than individual problem-solving efforts.

There are two well-known bases for this argument. The first is the micro-macro conversion model [2], which converts and aggregates micro-inputs such as intellectual resources, information, and intentions into group-level macro-outputs such as group decisions and solutions. The second is the social combination model [3], which is based on the process of members considering their own information in group problem-solving efforts.

2.2 Collaborative Composition as a Creative Task

For individual composition, Sloboda presents the act of composition as a diagram, in which one of the reasons for a composition failure is the inability to transition an arrangement from a theme to an intermediate form [4]. The primary reasons for this are as follows:

- Lack of ideas and knowledge accumulated by the creator in the past.
- Encountering mind blocks.

To facilitate creative compositions, it is crucial to eliminate these problems. For collaborative composition, such actions can be interpreted via McGrath's task circumplex model [5], in which tasks are classified into "planning and execution" and "creativity and judgment" categories. Most existing collaborative composition software applications (such as the KORG Gadget for Nintendo Switch (https://www.korg.com/jp/products/software/korg_gadget_for_nintendo_switch) and Ohm Studio (<http://www.ohmstudio.com/>)), as well as previous studies such as Refs. [6] and [7], focus on data sharing and manipulation ease in support of planning and execution tasks. In contrast, this paper focuses on music composition in terms of creativity and judgment tasks.

In order to make creativity and judgment tasks work well, proper attention to the following two items is essential [8]:

- Reexamination and elaboration through externalization of thoughts and validity confirmation/explanation.
- Integration and sharing of hypothesis and experiment space.

Hypothesis space is defined as a personal space for setting forth a problem, developing a hypothesis, and engaging in trial and error. In contrast, experimental space is defined as the space where the conclusions drawn from the hypothesis space are externalized and presented to others.

Based on the above discussion, our previous study [1] extended Sloboda's diagram to support creative, cooperative composition and defined the following three conditions necessary to support those efforts:

1. Easy presentation and hypothesis sharing in the theme and intermediate form production stages.
2. Ensuring members can freely discuss and exchange opinions on the presented hypotheses.
3. Making it possible to record and refer insights to the production process for evaluation and reexamination.

2.3 Annotations for Collaborative Composition

In our previous study, the only means of communication was exchanging text comments among members because our system was designed to support asynchronous work. However, in collaborative work, it is vital to support the externalization and communication of the creator's intentions, which are often difficult to convey in words. For this reason, we think that supplementing text information sharing with handwritten annotations is sometimes necessary.

This is expected to make it easier to meet Condition 2, the need to discuss and exchange opinions freely, and Condition 3, recording and referring insights to the production process for evaluation and reexamination, described above in Sect. 2.2. In addition, sharing annotations makes it possible to have a common understanding among members, which facilitates the work process [9]. In our proposed cooperative compositional behavior model, it is assumed that annotations will be made using diagrams and symbols that all group members know because they share common interests and background knowledge.

3 System Implementation

3.1 System Overview

We proposed, implemented, and evaluated our network-based system designed to support cooperative composition by multiple people by satisfying the three conditions described in Sect. 2.2. Figure 1 shows an overview of the proposed system, which was implemented using Python for the server-side and JavaScript for the client-side. As can be seen in the figure, the system consists of the following three functions:

1. Workspace realization function: This allows music data editing in desktop music via the commonly used piano roll method.
2. Hypothesis space management function: The music data created by the members through Function 1 above are managed as hypothesis nodes, and their relationships and histories are presented to the members in a tree structure.
3. Comment management function: This function enables the addition of comments to all information provided to users by Functions 1 and 2.

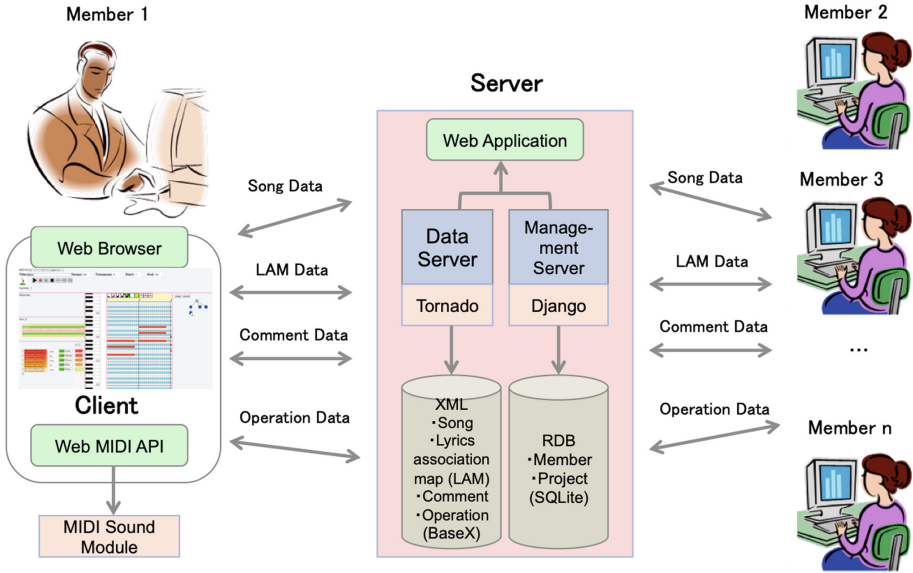


Fig. 1. System overview

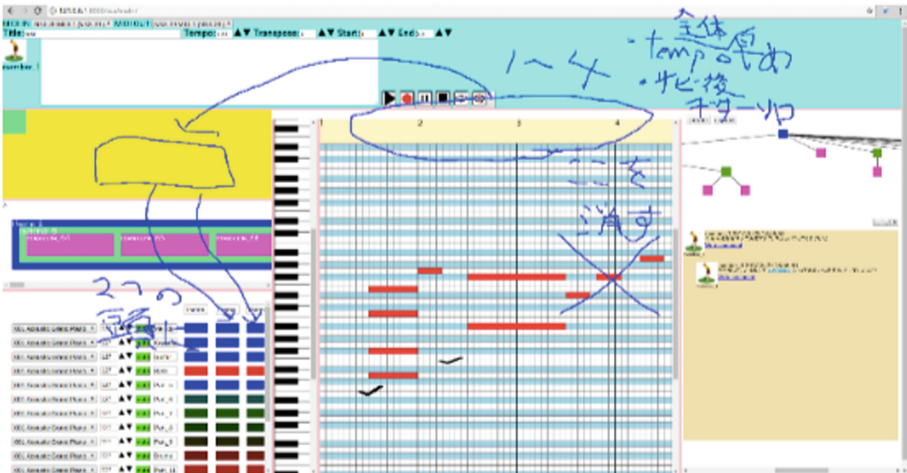


Fig. 2. Annotation function screenshot.

3.2 Extension of Annotation Function

Figure 2 shows a screenshot of a group member using the proposed annotation function with which he or she can embed annotations drawn on the screen into a comment. Other members can then click on the link in the comment to display the annotated comment on their screen. It is also possible to superimpose other annotations on the comment.

4 Conclusion

In this paper, we provided an outline of a system designed to support creative, collaborative compositions and the extension of an annotation function to our previous system. By combining the previous model's comment function with our new annotation function, group members now have access to an additional pathway with which they can externalize thoughts and intentions that are difficult to express in words, such as figures or symbols. In addition, members can also discuss and exchange new ideas about their thoughts and intentions by sharing those externalized annotations. In the future, we plan to conduct medium- and long-term evaluation experiments using this upgraded system.

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