

Improved Peer Review Support System Using WebGL for Practical Work with CG Content

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Abstract—A Web-based system for peer review of computer graphics (CG) works was previously developed. The original system rendered model data from CG works on the Web by using WebGL. A learner could assess a CG work by viewing the rendered work from various angles. Because the original system did not clarify which parts of a work had been assessed, an improved system enables direct tagging of model data. This system was actually operated in practice with students in a CG course. The experimental results confirmed that the learners indeed used the opinions of other learners in revising their own works. The improved system thus proved useful for CG work exercises.

Keywords— *CG education; Learning support system; Peer review; WebGL*

I. INTRODUCTION

Peer review gives learners the opportunity to reconsider their own works by assessing the works of other learners. Therefore, peer review is considered effective for assessment in computer graphics (CG) work exercises. Our group previously developed a peer review support system for CG works [1]. This system renders model data for CG zworks on the Web by using WebGL. It thus enables learners to assess such works by viewing rendered CG works from various angles. The original system had a problem in that it could not be understood at a glance what parts of a work had been assessed. Therefore, we have developed an advanced system that supports direct tagging of model data. As a result, when a learner reviews an assessment of his or her work, the parts that were assessed are immediately apparent.

To test the advanced peer review system, we actually used it in a class, and we analyzed how the students used the system for assessment. The experimental results demonstrated the effectiveness of this system.

II. COMPARISON WITH ORIGINAL SYSTEM

In assessing work in the original system, a clear position can be indicated by entering a comment and matching the camera position to the assessment position in the work. When the learner reviews comments, however, he or she cannot recognize all comment positions by simply looking at the work. Also, it took too much time to review comments and reposition the camera. In the advanced system, on the other hand, comments are tagged directly to the assessment positions in a CG work. As a result, when the learner reviews the assessment, he or she can immediately recognize what parts have been assessed. The learner can also review a comment by clicking on its tag. Figure 1 illustrates the key differences between the original system and the advanced system.

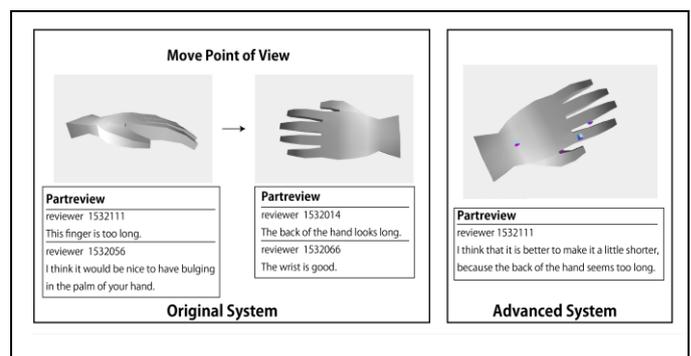


Fig. 1. Comparison of work assessment methods between the two systems

III. THE SYSTEM CONFIGURATION

This peer review support system is designed for Web-based learners to assess CG works created by other learners. Learners can submit their own works and review the works of other learners by accessing the system via a browser. An instructor can view the works created by learners and

review content added by other learners. The system can also be used in lectures to facilitate peer review and demonstrate tasks. In addition, by logging in to a personal page with a username and password, a learner can access several functions, as described below. In this paper, we focus on the system's assessment function. Figure 2 shows the system configuration.

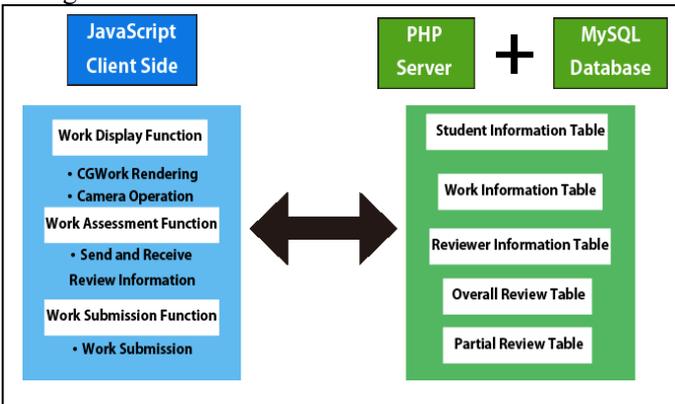


Fig. 2. System Configuration

IV. THE TAGGING FUNCTION

The tagging function enables a reviewer to tag a CG work with an assessment comment directly in the canvas by a mouse click. When the reviewer clicks on the work, the system places the tag and posts the comment via a form for comment posting, which is automatically generated. Figure 3 shows an assessment example.

The learner can then review the comment associated with the tag by clicking the tag after the comment has been posted. Figure 4 shows an example of the tagging screen.

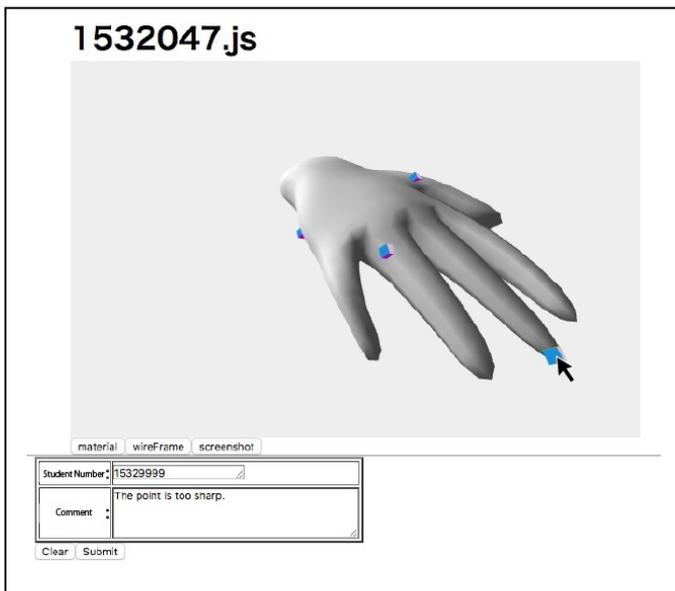


Fig. 3. Example of comment submission

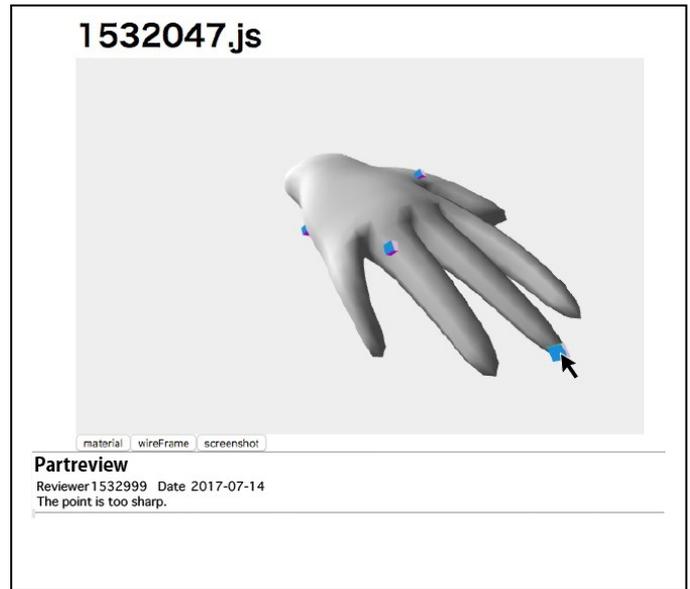


Fig. 4. Tagging example

V. IMPLEMENTATION

The system was developed with HTML5 and the JavaScript library three.js. To implement the tagging function, the Raycaster class was used to handle rays emitted according to the arbitrary reference coordinates of three.js in any direction. After a mouse click, the system acquires the absolute coordinates of the canvas element and converts them into the position coordinates of the mouse pointer in the clip coordinate system. From this, the positions of the mouse pointer and the current camera view are set, and a ray vector extending straight from the mouse position is generated.

At the same time, the system creates a variable that collects objects intersecting the ray vector, and it performs arbitrary processing for such intersections. In the process of using conflict judgment, the reviewer tags an arbitrary place in the CG work. There are cases in which the reviewer clicks the work and performs partial assessment, and in which the learner clicks an arbitrary tag and reviews the partial assessment. In other words, processing is classified into two cases: one for assessment, and one for review.

A. Implementation for assessment

For clicking on a CG work, the system must enable the reviewer to prepare a tag at an arbitrary place and fill out a form for partial assessment. To do so, the system acquires the coordinates of the intersection of the ray vector and the creating a form with a name and a comment field at the work at the time of clicking. It then creates a tag object with the intersection coordinates set as position information. By creating a form with name and comment fields at the same time it creates the tag, the system enables the

reviewer to post only partial evaluations when tags are created at arbitrary positions.

Also, when a partial assessment is submitted, the name and position information of the tag created at the same time as the comment are stored in a database. Even when the Web page is reloaded, the system creates tags related to the partial assessments of each work. One problem is that there may be a case in which a reviewer wants to change a tag's position rather than doing partial assessment at the time of tag creation. In that case, since tags not related to reviews might be created, the original tag needs to be deleted. To remedy this problem, if there are tags that do not have submitted partial assessments when a reviewer clicks a CG work, the system removes such tag objects. Associated geometry and material information is also deleted, so that unnecessary cached data does not remain in memory. Also, to prevent form duplication, the system enables form deletion. This allows the reviewer to create and modify a tag at an arbitrary position and intuitively post a partial assessment with the tag.

B. Implementation for review

When a learner clicks on a tag, the system must display the partial assessment associated with the tag. Therefore, it acquires the position information of the clicked tag object and retrieves the name, comment, and time matching the position information from the database. The system implements a function for displaying partial assessment on a Web page, with the above data as arguments. In addition, for the case of clicking on another tag with partial assessment related to the tag being displayed, the system implements a function that deletes the displayed comment and displays the partial assessment of the new tag. This makes it easier for the learner to recognize which part of a CG work has a problem.

VI. COURSE USAGE EXPERIMENT

The advanced peer review system was used within the "Computer Graphics" course in the third year of Chiba Institute of Technology's Information Network Department curriculum. An experiment was conducted with 73 students taking this course. Assessment was basically done outside the lecture hours. Since the system is Web based, assessment can be done from any learner's PC. In preparation for unexpected problems, however, a computer lab was prepared as an environment that would always be available for assessment. Also, since students in this course use Maya to produce CG works, they often work in a computer lab associated with the course. For this reason, a preliminary experiment was conducted in the computer lab with the actual system. After that, the experiment was carried out, and then a questionnaire was administered to the students to evaluate their feelings about using the system.

A. Preliminary Experiment

The preliminary experiment was meant to investigate the system's server load and usage by students beforehand. Registering the students in the course all at once and checking the server load showed that it was possible for all students to register without problems. After teaching the students how to use assessment tags and how register comments, we gave a lecture on the assessment method. In addition, we confirmed that the server could withstand the system's load by having the students' comments registered all at once. Finally, we confirmed that assessment can be performed without problems by having students in the computer lab assess via Chrome or Firefox.

B. Main experiment

The CG task during the experiment was hand modeling. The duration of the experiment was one week after work submission. The overall assessment was for modeling accuracy. Partial assessments were to highlight both the good points of a work and problems needing correction. Each student was required to assess other students' work before and after revision. This was followed by assessment of other, arbitrary works. Finally, each student submitted his or her revised work after receiving assessment.

C. Analysis of assessment comments

Figure 5 shows an example of assessing a CG work. The number of comments is equal to the number of tags, as seen in Table I. Other learners offer both positive opinions on the work and points for correction. On the whole, many comments focused on corrections. By referring to these opinions, a learner could understand which aspects of a work needed improvement and which aspects were positive. In addition, by receiving and applying comments, a learner could improve the quality of his or her work through revision. Figure 6 illustrates the process of revising a work after assessment.

D. Analysis of questionnaire results

After completing the task, each learner received a questionnaire about their feelings in using the system. The questionnaire addressed the appropriateness and utility of the opinions from other learners. Figures 7 and 8 shows the results obtained for the first and second questions, respectively.

In response to the first question, "Were the comments from the other learners appropriate?" , 26% of the students answered with "Strongly Agree," and 22% answered with "Agree." This result confirms the effectiveness of receiving assessment from other learners.

For the second question, "Were the comments useful for revision?" , 7% of the students responded with "Strongly Agree," and 25% answered with "Agree." This result confirms that the learners could use the opinions of other learners in revising their own works. On the other hand, 51%

responded with “Neither,” showing that there were also many learners who knew where points for correction were located but did not know exactly how to fix them.

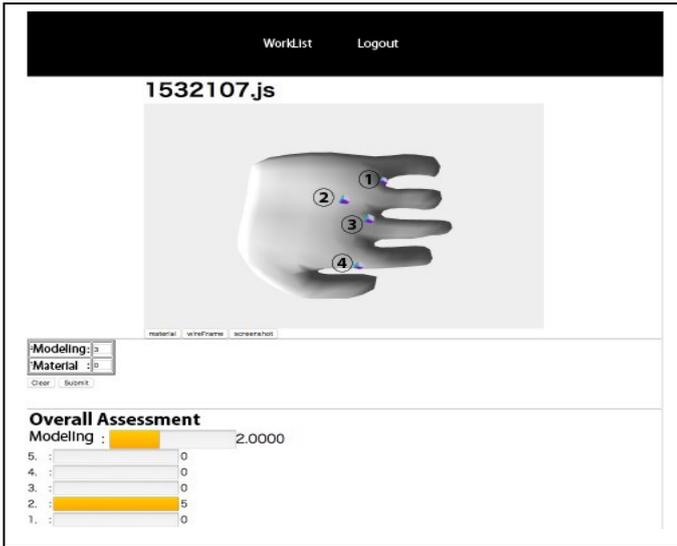


Fig.5. Assessment example for a CG work

TABLE I. PARTIAL ASSESSMENT

tag number	comments
①	Overall the hand is round, and the lengths and thicknesses of the fingers are a concern.
②	I think that the overall balance is bad. The hand is round, and the thicknesses and lengths of the finger are irregular, they require more attention.
③	Since the lengths of the fingers are different, I think it would help the student to pay attention to the finger lengths while looking at their own hands.
④	The balance between finger length and thickness is bad. I wish I had adjusted it when connecting vertices.

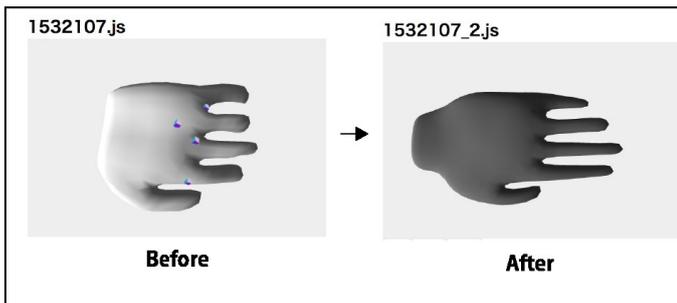


Fig. 6. Comparison of works before and after revision

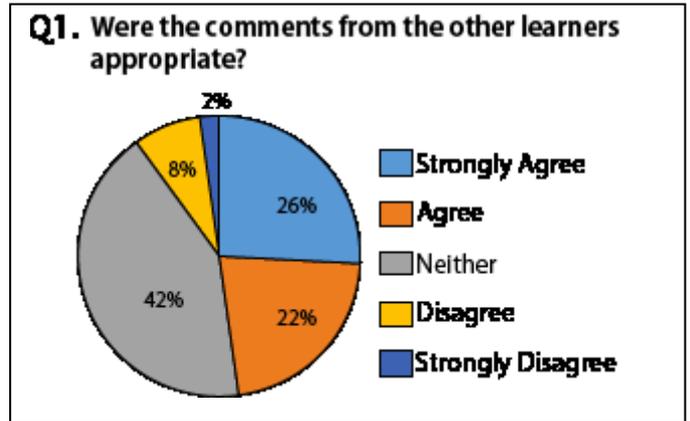


Fig.7. Results of the question 1

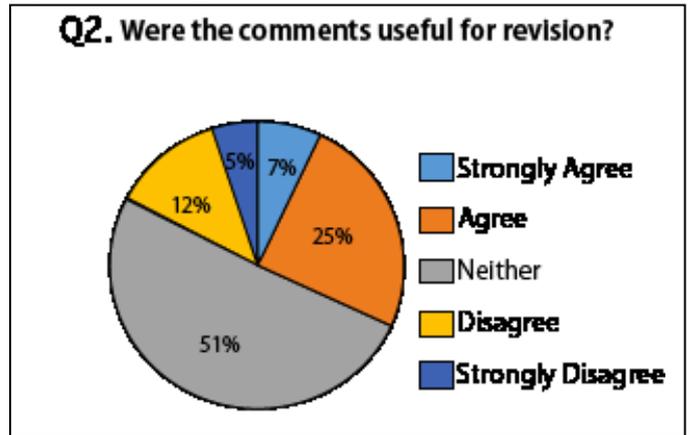


Fig 8. Results of the question 2

VII. CONCLUSION

In this research, the assessment function of the mutual assessment support system operating on the Web was improved. This system is targeted for CG works. By using this system, learners can browse and assessment works created by other learners anywhere as long as they have a network environment and a web browser. Moreover, by using the function of directly tagging and assessing the work, it became possible to add the assessment comment to the detailed part of the work. As a result of using this system in our lecture "computer graphics", it was confirmed that learners are using the opinions from other learners to correct their own works. Moreover it turned out that this system is useful in CG work exercises.

REFERENCES

- [1] H. Kobayashi, S.Mizoguchi, N. Nakamura, M Tonishi, "Development of a Support System for Peer Review Using WebGL in Practical Work of the CG Content", 2017 Proc. of Internationals Workshop on Advanced Image Technology(IWAIT2017), Penang, Malaysia, Session Poster 5A January 2017. .