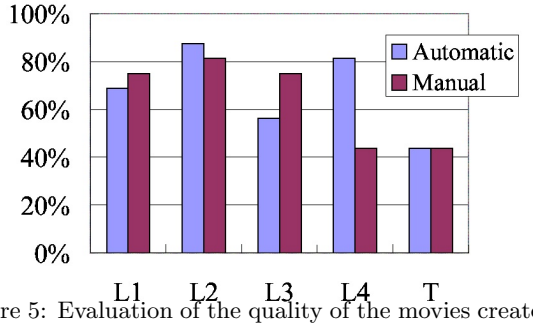

Figure 5: Evaluation of the quality of the movies created by manual process and our automatic Motion Graph construction method.

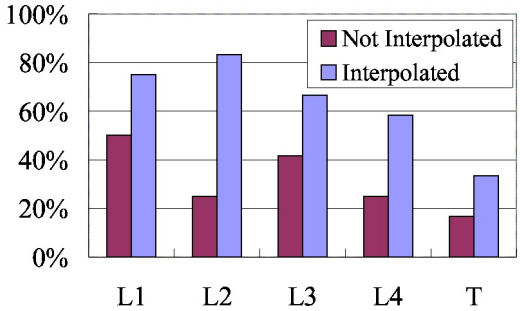

Figure 6: Evaluation of the quality of movie with/without interpolation method.

ure 5. The vertical axis of Figure 5 is the percentage of the viewers who answer the transitions are smooth. These results shows that the Motion Graph is successfully created with smooth motion transitions.

4.3 Evaluation of the interpolation method

We evaluate the effectiveness of the interpolation method which is described in the section 3.3. For this evaluation, we use the same animation in the previous section. Then, 15 viewers are asked which movie is more natural (smoothly change the motions) than the others. The results are shown in Figure 6. The results show that the proposed interpolation method successfully improves the quality on the smooth transitions of the 3D animations for all data.

4.4 Interactive control of 3D animation with tablet devices

Finally, our interactive 3D animation viewing system is evaluated by using our interactive viewing system with the tablet devices where 3D animations are efficiently controlled. 12 viewers are asked five questions after playing the 3D animations with the tablet device. The evaluation results are shown in Table 1. This results show that viewers felt that the contents were more interesting with 3D animation than an ordinary 2D video. It is also confirmed that novelty and user-friendliness of the system are higher than the 2D video. Furthermore, the result regarding the level of comprehension and usability were satisfactory.

5. CONCLUSION

In this paper, we propose an interactive 3D animation system which consists of an automatic 3D animation creation system and an interactive viewing system for tablet devices. For the automatic 3D animation creation system, the automatic Motion Graph creation method and the efficient interpolation technique of 3D point cloud are proposed. To realize automatic creation of Motion Graph, the distance calculation between the series of skeletal motions are proposed. For 3D point cloud interpolation, since the accuracy of estimated motions are generally low with Kinect, the exemplar based re-estimation method of skeletal motions is proposed. The advantages of the method are evaluated by creating the sample 3D animations. As the result, it is confirmed that the system can automatically create the Motion Graph with smooth transitions. More effective re-estimation of the skeleton model is our future research.

Table 1: Evaluation of the viewing system: (Q1) Attractiveness on contents, (Q2) Comprehension on contents, (Q3) Controllability of the contents, (Q4) Novelty of the system and (Q5) Intuitiveness the system interface.

	Percentages of the evaluation				
	Poor	Fair	Average	Good	Excellent
Q1	0.0	8.3	8.3	50.0	33.3
Q2	0.0	0.0	58.3	33.3	8.3
Q3	8.3	16.7	33.3	41.7	0.0
Q4	0.0	8.3	8.3	50.0	33.3
Q5	0.0	25.0	25.0	41.7	8.3

6. REFERENCES

[1] Y. Akagi, M. Furukawa, S. Fukumoto, and H. K. Y. Kawai. Interactive 3d animation system based on touch interface and efficient creation tools. In The 2013 IEEE International Conference on Multimedia and Expo (ICME) 2013 in "Multimedia for Humanity" theme track, 318, pages 1–7, 2013.

[2] K. Apostolakis and P. Daras. Raat - the reverie avatar authoring tool. In Digital Signal Processing (DSP), 2013 18th International Conference on, pages 1–6, July 2013.

[3] L. Kovar, M. Gleicher, and F. Pighin. Motion graphs. In Proceedings of the 29th Annual Conference on Computer Graphics and Interactive Techniques, SIGGRAPH '02, pages 473–482, New York, NY, USA, 2002. ACM.

[4] B. Krüger, J. Tautges, A. Weber, and A. Zinke. Fast local and global similarity searches in large motion capture databases. In Proceedings of the 2010 ACM SIGGRAPH/Eurographics Symposium on Computer Animation, SCA '10, pages 1–10, Aire-la-Ville, Switzerland, Switzerland, 2010. Eurographics Association.

[5] S. Levine, Y. Lee, V. Koltun, and Z. Popović. Space-time planning with parameterized locomotion controllers. ACM Trans. Graph., 30(3):23:1–23:11, may 2011.

[6] Microsoft. Xbox 360 Kinect, 2010. http://www.xbox.com/en-US/kinect.

[7] Y. Yang and D. Ramanan. Articulated pose estimation with flexible mixtures-of-parts. In Proceedings of the 2011 IEEE Conference on Computer Vision and Pattern Recognition, CVPR '11, pages 1385–1392, 2011.

[8] L. Zhao, A. Normoyle, S. Khanna, and A. Safonova. Automatic construction of a minimum size motion graph. In Proceedings of the 2009 ACM SIGGRAPH/Eurographics Symposium on Computer Animation, SCA '09, pages 27–35, New York, NY, USA, 2009. ACM.