A Study on Automatic Facial Parts Extraction for Evaluating Facial Similarity of Haniwa

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I. Introduction

Haniwa are clay figures and important archaeological materials because they were made during the Kofun period for rituals and talismans against evil. Archaeologists use their knowledge when they observe visual information such as shapes, sizes, ornaments, and noses of Haniwa for classifying who and where Haniwa were created. However, classification by observation is largely based on subjective evaluation, and therefore an objective evaluation method is required. As an objective evaluation method, [1] was proposed to evaluate the face similarity using 3D point clouds obtained through actual measurements of Haniwa. However, facial parts were manually extracted in previous work [1], which is laborious to apply to a large number of Haniwa. In [1], machine learning is also attempted to extract facial parts, but it is reported that the extraction cannot be done as intended, so an extraction method that does not rely on machine learning is required.Therefore, this paper proposes a method to automatically extract the face parts of Haniwa from 3D point clouds.

II. Related Works

One of the previous studies identifies the position of the eyes and mouths of Haniwa to extract the faces [2]. Since the eyes and mouths of Haniwa clay figurines look like holes, a three-dimensional model of Haniwa is projected onto a cylinder, and the facial parts are identified from the holes on the cylinder. Unfortunately, [2] has a restriction to extract facial parts, such as oblique models.

III. Proposed Method

In this study, general extraction of facial parts from a point cloud is proposed. Since some of the models are skewed or a large amount of noise is arisen when converted to 3D data, the axes are corrected and noises are reduced automatically. Then different threshold values are applied to each model to examine the trend of threshold values for extracting more general facial parts.

A. Identification of Axis

The axes of the 3D model are obtained by the PCA algorithm and used as the axes for creating the cylinder.

B. Extraction of facial parts

The threshold used to identify the contour of the eyes and mouth is changed for each model, and facial parts are extracted. The threshold values are set manually and empirically in each experiment.

IV. Experiment

The method was implemented in a PC with Windows 11 Pro OS, an Intel(R) Core(TM) i5-12400 CPU, and 16 GB RAM.We used 3D models of Haniwa from excavated the Kidomae, Yamada-Houma, and Katano burial mounds, in addition to the Haniwa excavated from the Kyosozuka burial mound used in the previous study [2]. 24 Haniwa data sets were examined, and the average execution time was about 193.8 seconds. The accuracy of facial parts extraction was improved by correcting axes, arranging threshold values, and removing noises.

V. Conclusion and Future work

In this paper, we have proposed a method for automatically extracting face parts from 3D point clouds of Haniwa. In the future, we will construct a system to evaluate the face similarity of Haniwa by applying the method of our previous study [1] to the face parts obtained by this method.

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References

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