Medical Sign Language Dictionary with 3D Animation Viewer

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***Abstract*—This paper reports on the medical sign language dictionary for medical use, which shows the sign language motions in 3D animation. The dictionary includes a viewer function. Because the dictionary contains 3D images of sign language motions that were obtained using motion capture technology, the viewer function enables users to see the sign language motions from any viewpoint they choose. Further, the dictionary also enables words to be searched by hand shape or motion.**

Keywords–Sign Language; Medicine-Clinical Terms; Dictionary; 3D Animation

I. INTRODUCTION

In many cases, sign language native speakers do not seek medical attention until their condition becomes critical. The causes of this problem include the absence of sign language words that are appropriate for expressing their complaints and the absence of appropriate sign language expressions for explaining their medical conditions. However, accurate sign expressions are required in those settings because vital issues may be discussed. Moreover, existing sign language dictionaries have been compiled with the use of pictures, photos and videos. A problem arises in that medical sign language varies considerably in style from one region to another and has not been standardized. In addition, there are currently no dictionaries that allow users to view sign motions based on 3D animation from any viewpoint.

To address this, we are collecting medical words and studying sign language expressions of the words with the aim of unifying and spreading medical sign language expressions [1]. The data of the 3D sign language motions were obtained using optical motion capture technology. The data of the 3D motions are in BVH (BioVision Hierarchy) format. However, we have not yet established a dictionary.

This paper reports on an unprecedented medical sign language dictionary developed by the authors that enables users to view 3D animated images of sign language motions. This dictionary prototypes a model experimentally based on the request of doctors and nurses. In Section II, the dictionary not only contains medical words, but also provides explanations in sign language about medical terms that are believed to be difficult for a sign language native speaker to understand. In Section III, we developed a 3D viewer that renders animated images of sign language in actual time by reading the BVH data. This 3D viewer enables users to check sign language motions as search results by selecting a viewpoint. In Section IV, the dictionary comes with a search function that can be used by entering Japanese words. This function permits free word searches, searches by category, and other types of searches. In addition, regarding searches by sign language element, the dictionary permits searches by hand shape,movement locus of hands, and relationship between left and right hands, among others.

II. WORDS AND EXPLANATIONS

As for the words contained in the dictionary, we selected those that are necessary and frequently used for medical practice in a hospital, excluding dental technical terms. The total number of words in the Japanese index is 1,113. The number of sign language words corresponding to the 1,113 Japanese words is 1,272 because synonyms of different movements exist for some of the Japanese words.

Medical terms include a large number of difficult technical terms. The meanings of many of these words are not clearly understood by ordinary people simply by seeing them. As a result, the dictionary includes explanations of words that are believed to be hard to understand without explanations and those whose meanings are likely to be misunderstood. The explanations are provided using sign language expressions that allow native speaker of sign language to understand the meanings of the words. For example, the dictionary includes explanations of diseases such as toxoplasmosis and Kawasaki disease, the meanings of words such as remission, and differences in meaning between virus and bacterium and other pairs of words that are confusing to the general public. A total of 122 explanations are provided about 141 words, with some of them explaining multiple relevant words.

III. 3D VIEWER

The data of the 3D sign language motions were obtained using optical motion capture technology. The data of the 3D motions are in BVH format. We developed a 3D viewer that renders animated images of sign language in actual time by reading the BVH data.

The 3D viewer developed enables users to check the sign language motions of the avatar in a selected direction or from a selected viewpoint in the 3D space. The control panel on the right side of Figure 1 permits the adjustment of the viewpoint (camera position), to zoom in/out, move the image parallel, and rotate it.

IV. SEARCH FUNCTION

The dictionary comes with a search function that permits two types of searches: search by Japanese keyword and search by description of sign language. The search results can be checked by viewing animated images of the sign language using the 3D viewer mentioned in Section III.

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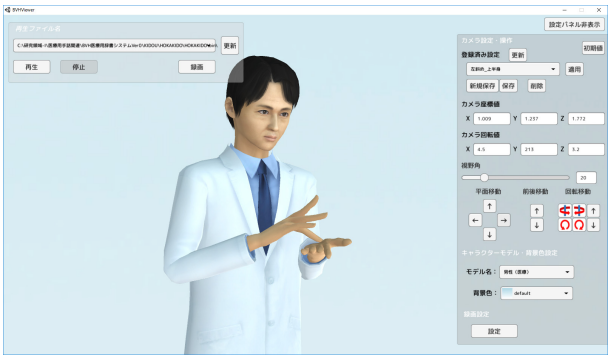

Figure 1. Example of the 3D viewer's screen

A. Search by keyword in Japanese

1) Search of the list of words and explanations: A list of headings in the dictionary is displayed for the search.
2) Search of kanji and hiragana: Search by entering headings consisting of both kanji and hiragana (partial match).
3) Search by hiragana characters for the word: Search by entering hiragana characters for the word (partial match).
4) Search by category: The words contained in the dictionary are classified into 20 categories, including diagnosis and treatment department, name of disease, symptom, and body part, with some of them classified into multiple categories. The dictionary permits searches of the list of words in each category (Table I).
5) Search by keyword used in explanation.

TABLE I. MEDICAL WORD CLASSIFICATION AND EXAMPLE WORDS

Classification	Example words
Parts of body	head, eyelid, foot
Internal organs	neurohypophyis, hormone
Care	full nursing, nursing certification
Facilities	germfree room, ICU (Intensive Care Unit), blood sampling room
Food	grapefruit, natto, alcohol
Hospital departments	internal medicine, pediatric clinic
State	critical condition, remission, climacteric
Medical examination	respiration, heart sound, second opinion
Medicine	tablet, antibiotic, anticancer drug
Name of Diseases	gastritis, Alzheimer's disease, atopic dermatitis
Occupation	medical doctor, nurse, dietician
tests and Tools	medical check-up, blood test, gastrocamera
Secretion	blood serum, cerumen, cerumen
Sports	rugby, sky, malathon, mountaineering
Operation	laparoscopic surgery, suture, anesthesia
Symptom	vomiting, hyperpnea, compression fracture
Treatment	hemostasis, laser treatment, oxygen inhalation
Therapy and rehabilitation	speech therapy, dietary care, palliative care
Receptions	accounting, medical certificate, reservation
otheres	survival rate, traffic accident, QOL (Quality Of Life)

B. Search by symbol describing sign language word

The words contained in the dictionary are described using the NVSG (Nominal Verbal Sightline Grammatical) element model that was suggested by the authors [2]. This method describes morphemes in sign language by dividing each morpheme into hand shape, motion, expression, and gaze. Accordingly, the dictionary permits searches of sign language motions with unknown meanings by hand shape using N element (Figure 2), motion, and other elements.

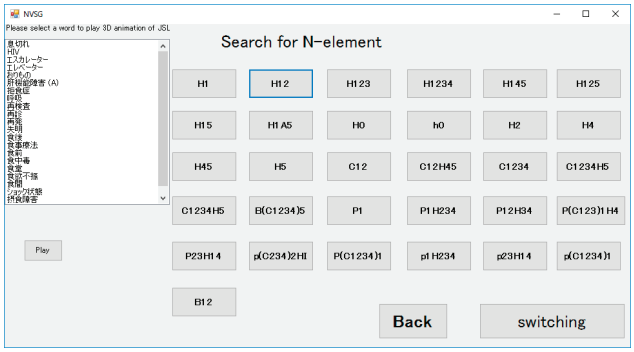

Figure 2. Search screen by the hand shapes

V. CONCLUSION AND FUTURE WORKS

This paper has described the medical sign language dictionary for medical use, which shows the sign language motions in 3D animation. We developed a 3D viewer that renders animated images of sign language in actual time by reading the BVH data. This 3D viewer enables users to check sign language motions as search results by selecting a viewpoint.

As a result, it is possible to use the dictionary as a reverse dictionary in which the meanings of sign language are able to be searched from the shapes and motions of the hands. Moreover, because 3D motion data and the morpheme time structure are linked to each other one by one in the database, it is possible to view sign language based on the morphemes. There have been no sign language dictionaries available with these functions before. The usability and practicality of the dictionary are extremely high. We are getting impression of expressing sign language which can be understood intuitively from medical staff.

We are proceeding with a further study on how to synthesize new words that are not found in the current dictionary by taking advantage of this morpheme dictionary described using NVSG elements. Furthermore, we have to perform a user evaluation in the medical scene of this dictionary.

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