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学位論文題目	A Hand-Washing Support System Based on Center of Gravity in Hand Correction(手部の重心補正に基づく手洗い支援システム)

内容要旨

Every year, the Ministry of Health, Labor, and Welfare announces the infection status, vaccines, and treatment methods due to the emergence of new strains of influenza, noroviruses, and coronaviruses. These diseases are highly contagious and their symptoms are often severe. According to the 2012 Vital Statistics, of approximately 1.26 million deaths, approximately 30,000 were due to infectious and parasitic diseases and approximately 200,000 were due to respiratory diseases caused by infectious diseases. Vaccination is one of the most promising methods for preventing infection, but it is not a panacea. Reasons for this include "high cost," "need for periodic vaccination," and "inability to cope with unknown pathogens." Even though the vaccines is not yet complete, the new coronavirus has killed about 4 million people in the worldwide. In addition, since infectious diseases have different causative pathogens and different routes of infection, their preventive methods also differ. For these reasons, it is difficult to say that vaccination is a perfect preventive method. On the other hand, there are some common preventive methods, such as gargling and hand-washing. In particular, hand-washing is a common method for preventing infection in various places.

Generally, hand washing removes physical dirt from our daily lives (particularly, transient bacteria; transient germs are germs that are temporarily attached to the skin). There are different types of hand-washing, such as routine hand-washing, hygienic hand-washing, and surgical hand-washing. Daily handwashing is handwashing with liquid soap and running water to wash away and sterilize transient bacteria. The latter hand-washing method is commonly found in medical settings and is intended to prevent contact infections. Hygienic hand-washing refers to hand- washing with disinfectant and running water for sterilization and elimination of transient bacteria. Operative handwashing is handwashing to disinfect and eliminate transient bacteria and eliminating indigenous bacteria. Correct hand-washing is a washing method that essentially consists of hygienic hand-washing.

Hand-washing is an important preventive measure, but few people are aware of proper hand-washing. Some reasons for this are: "I don't know how to wash my hands properly," "Hand-washing is tedious," and "It is difficult to know whether my hands are clean or not." The washing method using the hygienic hand-washing movement

is used as the correct hand-washing method in this study.

Several studies on hand-washing have demonstrated that proper hand-washing is effective in terms of hygiene. To prove this, it is necessary to verify that dirt is properly removed via chemicals or visual inspection by experts However, while it is a good idea to use chemicals to check if dirt has been washed properly during experiments, it is not convenient to use chemicals or instruments for washing in daily life because it is expensive and difficult to check.

In this study, we focused on the correct behavior of hygienic hand-washing based on the premise of alcohol disinfection and developed a system to verify whether hands are being washed correctly. By comparing hand-washing videos taken at a washbasin with those of a learning model, the system can notify a user in real time whether he or she is following an appropriate hand-washing pattern. To determine the appropriate hand-washing pattern, we developed a system for extracting features related to "correct hand-washing" by applying methods using motion and shape features as features related to hand movements in research on sign language recognition and gesture recognition. We have developed a system for extracting features related to "correct hand washing."

Aiming at solving the problem of recognition accuracy decrease during hand-washing in existing systems due to noise produced by hand-shaking, lighting changes, and so on, we develop a novel system. The system focuses on proper hand-washing patterns to examine whether hands are being washed correctly. By comparing videos of hand-washing captured at sinks and learning model videos, the system informs users in real time whether they are using proper hand-washing patterns. Optical flows and skin-color areas are used as data features to recognize proper hand-washing patterns. Support vector machine is used as the recognition model in this system. The hand-washing pattern recognition accuracy is improved by removing noise sources and capturing pattern characteristics by labeling and using a correction that considers the center of gravity in hand.

The structure of this paper is as follows. First, Chapter 2 describes related research, and Chapter 3 describes the hand-washing support system based on the existing method. In Chapter 4, we describe the hand-washing support system using the proposed method. An experiment to show the effectiveness of the proposed method is conducted in Chapter 5, and a discussion is presented in Chapter 6. Finally, in Chapter 7, we summarize and discuss future issues.