Demonstration of The KINECT-Based Auscultation Practice System

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***Abstract*— Students in medical and nursing schools must practice auscultation. Students usually learn disease sounds, correct points and order for locating a stethoscope on a body in the practice. Humanoid-type simulators have been widely introduced to practice auscultation. However, most humanoid-type simulators cannot detect whether a stethoscope is located on a body, and on which part of body a stethoscope is placed. Since they are too expensive, the number of them is not enough for the number of students in a class. We developed a low-cost and high performance system for the practice of auscultation. In this system, students themselves play the role of a patient, instead of a humanoid, and stethoscope locations on the body are measured with KINECT. Also, appropriate disease sounds including normal ones can be assigned at some points on the upper body. Students listen for such sounds, synchronized with breathing movements, through an earphone or speaker when a stethoscope is placed on assigned points. We plan to conduct a demonstration in which participants will practice auscultation with the system after it is explained to them.**

Keywords-simulator; auscultation; physical assessment; demonstration.

I. INTRODUCTION

Generally, practicing auscultation is a required subject for students in medical and nursing schools. Students usually learn disease sounds, correct points and order for locating a stethoscope on the body in the practice. We proposed a new auscultation practice system to learn auscultation techniques effectively [1]. Humanoid-type simulators [2][3][4] have been widely introduced into medical and nursing schools. These humanoid-type simulators are effective to learn disease sounds. However, it is impossible to detect whether a stethoscope is actually placed correctly on a mannequin. Moreover, correct locations vary among patients according to their body size. Cardionics provides a hybrid simulator in which a student plays the role of a patient instead of a mannequin to solve such problems [5]. In this hybrid simulator, patches are attached on a body to identify correct attachment points.

In our simulator, students themselves are the practice subjects instead of a humanoid model, and the location of a stethoscope can be detected with KINECT, which is a line of motion sensing input devices made by Microsoft [6]. The correct locations are normalized with respect to the positions of both shoulder joints and both hip joints for each student playing the role of a patient. Therefore, our proposed simulator can both show correct locations on a body and detect whether a stethoscope is placed on correct points without patches regardless of the change in body size.

In addition, most existing simulators cannot simulate the timing of breathing or the synchronized forward and backward movements of the upper body. However, our simulator can detect these forward and backward movements of the front body and provide expiration and inspiration sounds synchronized with those movements.

We have developed a prototype system and evaluated it experimentally. The results showed that our system could detect stethoscope placement on a body. Also, our system could detect changes of the front body in breathing.

Moreover, we found that all students could set up our system by themselves. The results of a questionnaire for nursing students and practicing nurses showed that our proposed system was useful for them to learn auscultation.

We plan to conduct a demonstration in which participants will practice auscultation with the system after it is explained to them.

II. SYSTEM CONFIGURATION

As a matter of course, the introduction cost is adequate for the number of students in a nursing school. Among the nursing skills that students have to learn are the recognition of different sounds between different kinds of diseases and the knowledge about placing correct points and order for locating a stethoscope on a body. In the case of respiratory auscultation, students have to listen to respiratory sounds for more than one cycle. Therefore, an auscultation practice system requires the following issues:

- Low cost.
- Simulating real sounds produced due to certain diseases at different points on the body.
- Display correct points for locating a stethoscope.
- Determining whether a stethoscope is located at specified points.
- Determining whether a stethoscope remains on a body for more than one respiratory cycle.

Our practice system is only composed of a PC and a KINECT device, as shown in Fig. 1. Students, instead of mannequins, act as patients to decrease system cost. The stethoscope locations and forward and backward movement of a body during breathing are measured with KINECT. The

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students can listen for sounds produced due to certain diseases that are generated by the PC through earphones. Therefore, a specific stethoscope and patches are not needed. These also decrease system cost.

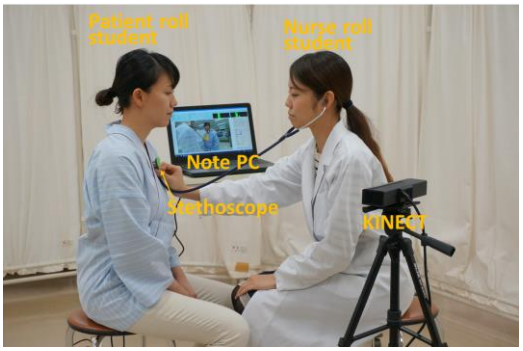
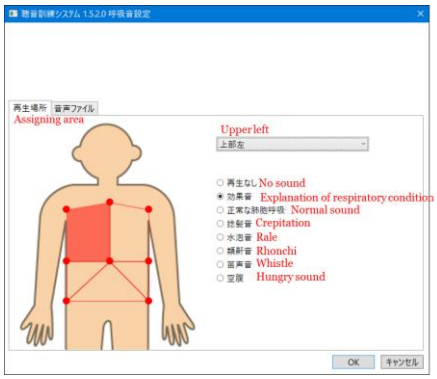


Figure 1. Terminal equipment in our proposed system

III. APPLICATION

We developed a simple application for a teacher to explain practicing auscultation for the lungs:

- Sound assigning program: This program assigns a sound to each area, dividing the upper body into five areas. (See Fig. 2)
- Auscultation teaching program: This program detects on which area a stethoscope should be placed, and it replays a sound assigned to that area. (See Fig. 3)



(1) Assigning sound

(2) Management of sounds

Figure 2. Operation window to assign sounds to divided body areas

In this application, the upper body is divided to five areas as shown in Fig. 3. Currently eight sounds are provided. A teacher can assign a sound from the above eight sounds to each divided area using the sound-assigning program shown in Fig. 2 (1). Since respiratory sounds are different for expiration and inspiration, an expiration-sound file and inspiration-sound file are assigned for expiration and inspiration using the sound-management program, as shown in Fig. 2 (2).

When a stethoscope is placed on a body of a person playing the role of patient, the area on which a stethoscope is placed is colored to yellow, as shown in Fig. 3. Students can listen for such sounds, synchronized with breathing movements, through an earphone or speaker when a stethoscope is placed on assigned points.

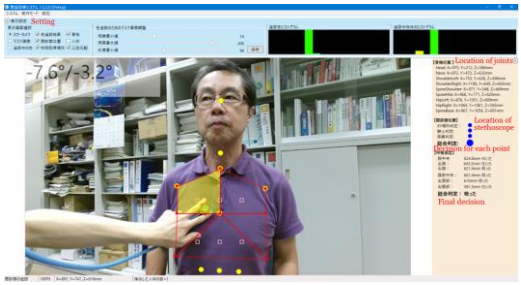


Figure 3. Operation window of the auscultation teaching program

IV. DEMONSTRATION PROGRAM

Since we would like many participants to experience using our simulation system, we plan to demonstrate our auscultation system by

(1) introducing the system configuration,
(2) showing how to set up the system,
(3) explaining how to operate the system,
(4) allowing participants to practice auscultation.

V. CONCLUSION

We believe that our proposed system is less expensive and more useful for practicing auscultation than current humanoid-type simulators. We plan to provide a trial version of this system at no charge for medical and nursing schools to experience our system.

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