Teaching System for Operation of Artificial Respirator

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Abstract: This study deals with a computer supported teaching system for artificial respirator operation. The system is characterized by the capability of learning both operation techniques and related medical textbook knowledge. Effort was given on the improvement of proficiency and trouble-shooting during practice. After a certain teaching practice, the effect of the system was verified with experiments. Obtained results were well feed-backed for some adjustment and improvement in the system for better teaching effects. Useful hints for new approach to technical teaching in medical machine operation has been obtained through our sequential work of the proposal, construction, teaching practice and effect verification of the system.

Keywords: Computer Training System, Skill Learning Support, Clinical Engineering, Operation of Medical Machines, Trouble Shooting

1. Introduction

With the rapid development of ICT (Information Communication Technology), various computer-supported training-learning systems have been proposed for medical treatments, particularly for those in practical skill training which has been difficult in conventional teaching and training methods. Similarly, advanced technologies in information and engineering are applied to clinical engineering as well (Education IT Solutions EXPO, 2019).

This study deals with the construction of a training-learning system for the operation of medical machines in clinical engineering (Kanehira, et al., 2016). Although there have been various teaching systems for conventional knowledge learning using E-learning, those with practical operation capabilities are still rare. The reason may lie in the difficulties to share the knowledge of operations (obtained though experience and body physical memory) only by language communications (Furukawa, K., 2009). Accordingly, this study proposed a computer-supported teaching system capable of learning both operation and theoretical knowledge at the same time, taking the operation and trouble shooting in respirator as an example.

Artificial respirators used in hospitals are quite different in the panel shape, button position, and operation methods for different system makers, making the operation complex to produce mistakes. In fact, an investigation on the 4th grade students in our university shows that most of them are poor in knowledge and operation technique on respirators. Therefore, this study pays attention to a more effective teaching on the operation and trouble-shooting with artificial respirator.

2. Supporting to Operations on Medical Machines

A clinical engineer must to do a wide range of works such as the operation, management, maintenance and repairing of medical machines. They are asked to master high level of professional knowledge and operation skills. On the other hand, there is only limited time in university for their study, so it is difficult to master knowledge and skill on so many medical machines, particularly those for trouble-shooting.

As a solution, computer supported teaching systems with low cost and good operation capability and repeatability for clinical engineering are required.

In this research, while clarifying the problem in the operation method acquisition of the medical equipment, the problem solving method has been examined and proposed. The necessity of real-time teaching using teacher data that emphasizes operability and skill improvement using multimedia was confirmed (Kanehira, et al., 2017).

3. Technique Training System for Operation of Artificial Respirator

3.1 System Construction and Teaching Contents

In this study, we constructed a virtual environment with computer for learning and training for the panel operation of respirator. Operations can be easily and repeatedly done on computer without practical use of a real machine. Special attention was paid on training and learning on trouble shooting during operations.

The respirator of [Servo Ventilator 300A] was chosen as the system model. The operation panel of the model was realistically reproduced on computer screen as the top page of a Power Point electronic teaching material, each operation button being linked to related [knowledge] and [operation] pages as shown in Figure 1.
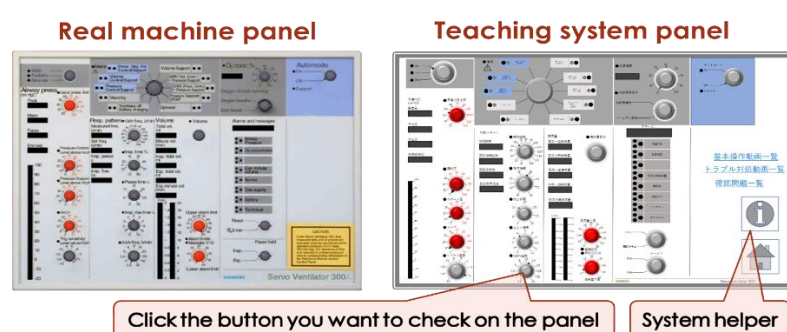

Figure 1. Top screen of system

The related [knowledge] page explains with an easy understand way the general knowledge of a respirator, while the operation teaching such as model setting and trouble shooting was done using animation textbook. The confirmation of knowledge and operation was done using questions in national examination with software of THINQ Maker. A right or wrong judgement was given real timely with detailed explanation (Fig.2).

Figure 2. Confirmation after learning

Serious medical accidents may occur if an operator makes a mistake in the panel operation of the respirator. Therefore, the mistaken operation should be reset as quickly as possible. This study paid special attention to such trouble shooting. The situations for 9 possible troubles were selected, and the set value as the cause of trouble and whether there is self-breathing were provided on the computer screen.

3.2 Verification Experiment

A verification experiment was carried out on 20 students of the 4th grade in our university to confirm the effect and the points where needs improving. An environment was prepared with the teaching system on PC and a real respirator beside (Fig.3).

The following steps were arranged for a comparison with or without using the teaching system: 1) fill in a questionnaire before experiment, 2) an instruction to respirator, followed by practice operation of 5 minutes, 3) trouble shooting practice before using the teaching system, provided with 3 troubles randomly selected from the most frequent 9, 4) fill in a questionnaire once more, 5) trained using the teaching system, 6) trouble shooting practice after being trained with the teaching system, 7) fill in the final questionnaire.
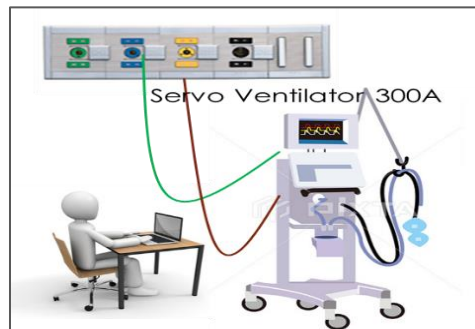

Figure 3. Experiment configuration for verification

On the average time used for trouble shooting, it is 2 minutes 41 seconds before and 1 minutes 9 seconds after the use of teaching system, with a large reduction of trouble shooting time of 1 minutes 33 seconds. 18 students of the total 20 examinees are with decreased trouble shooting time, and 95% of the examinees claimed a resolution of the weak feeling against respirator, indicating an increased confidence to trouble shooting. There are some suggestions for further improvement of the system such as to enrich the textbook knowledge, to provide more figures and tables to make the screen much easier to understand, and to increase the number of questions provided with different difficult levels.

4. Conclusion

This study deals with a computer supported teaching system, taking an example of the panel operation of the respirator. The system is characterized by the capability of learning both operation techniques and related medical textbook knowledge. Spatial effort was given to the trouble-shooting experience, and the effect was confirmed by comparing the trouble shooting time with or without the use of teaching system. Further improvement of the system was also suggested for better training results.

Acknowledgements

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