Summary of Biomed2009 paper[8]

An internal examination training system supporting abnormal labor conditions

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Abstract

For obstetricians and midwives, “internal examination” refers to an important diagnostic technique in which the progress of labor is examined using the index and middle fingers inserted into the vagina or rectum. Training of this internal examination technique has been commonly performed using a model of the human body (manikin). However, with this method, it was impossible to determine visually where and how the examining fingers are touching, making it difficult for trainers to teach advanced examination skills efficiently and evaluate training achievements. Against this background, we have developed a training system for internal examination that enables simulation of normal and abnormal conditions of labor by detecting the position and direction of the examining fingers in real-time via tactile and visual perceptions using anatomical and virtual models. This system allows trainees to experience both normal and abnormal fetal descent into the pelvis. The more detail of this paper is described in the reference [8].

Keywords: virtual models, manikin, magnetic sensor, internal examination, a training system.

1 Introduction

Previously developed training systems for internal examination include our own system[1, 2, 3], ePelvis[4, 5, 6] developed by a group from Stanford University, and the peripartum diagnosis/delivery assistance training system[7]. The ePelvis attaches several sensors inside the mother's body and is not suitable for close monitoring of fingers and the evaluation of examination techniques. The peripartum diagnosis/delivery assistance training system is basically a visual learning system using video images, and is suitable for teaching and explanation but not for training of the internal examination itself. Our approach in our training systems described in references 1) to 3) is different in comparison with the two system, ePelvis and the peripartum diagnosis/delivery assistance training system. We utilize magnetic sensors that is attached with two fingers, and monitor the motions of two fingers in internal examination.

Our previous system was used to simulate the normal labor condition and thus was not suitable for simulating various abnormalities that can occur during labor. We thus developed a system based on fetal models that could reproduce various abnormal labor conditions (frank breech presentation, complete breech presentation, placenta previa, and face presentation). Our newly developed internal examination training system consists of models of maternal body parts, including the vagina and the uterine ostium, and fetal body parts (anatomical models), a personal computer (PC), and a magnetic sensor (Fig. 1). The magnetic sensor consists of a transmitter (XMTR), a location sensor, and a controller (miniBIRD, Ascension Technology Corp.). Magnetic information transmitted from the transmitter is detected by the location sensor, and the location information is received by the PC. The location sensor is attached and fixed to a fingerstall made of silicon rubber, which is worn on the index and middle fingers, with which internal examination is performed.

2 System Overview

Figure 2 shows the external appearance of the training system. The system supports normal labor conditions of one-finger dilatation, two-finger dilatation, full dilatation and type C (another type of full dilatation) and abnormal labor conditions of frank breech presentation, complete breech presentation, placenta previa and face presentation. Other conditions can be added if necessary. The monitor displays geometric models (i.e. virtual models of human body, examining fingers, etc.) of the same size as the anatomical models. An advantage of the system is that it can display on the monitor the position and the direction of the examining fingers during internal examination via the magnetic sensors worn on the examining fingers. The system thus allows trainers to evaluate visually the skill level and accuracy of examination techniques on the monitor. Inside the human body model shown in Figure 2 is a guiding structure to install models of the pelvis and the fetus. An appropriate anatomical model of the fetus should be placed in the human body model before starting training. The skin in the virtual model was created by measuring the skin with a noncontact 3D digitizer, and converting to polygonal shape.

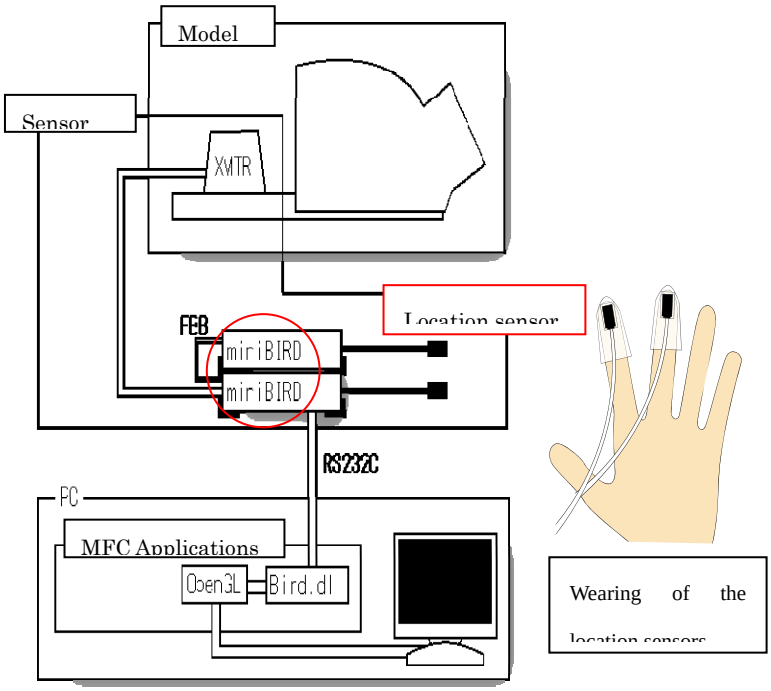

Figure 1: System configuration

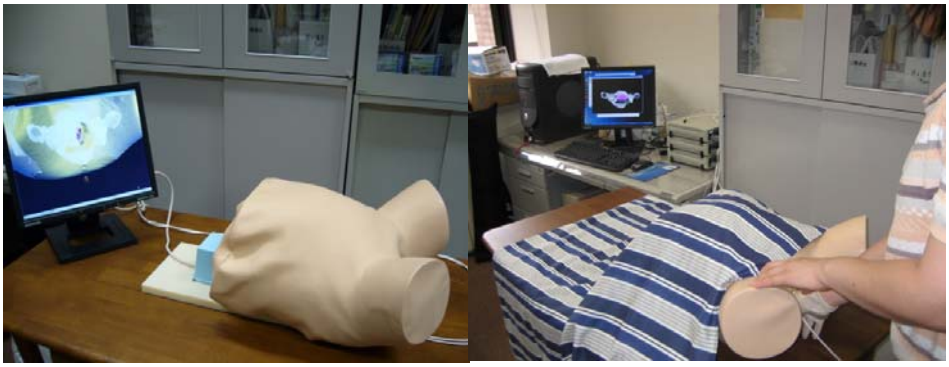

Figure 2: Our internal examination training system

The system provides a unique learning experience that cannot be gained in daily practice. The use of the system in teaching practice will help to nurture competent obstetricians and midwives in a short period.

On the basis of specialist feedback, we included 4 abnormal fetal models in the training system. The availability of additional abnormal fetal models will make the system more relevant to actual clinical situations. Although the present system was developed specifically for internal examination of the fetus, it can also be applied for such purposes as medical training and preoperative planning for other parts of the body (e.g. thorax and abdomen) by using different anatomical and virtual models[8]. The display control allows the selection of the constitutive models to display, the mode of display (i.e. wireframe (display with lines) or shading), transparency, and the display color. The system can also display internal views with 4 cross-sectional images (left, right, front, and back views) (Fig. 3).

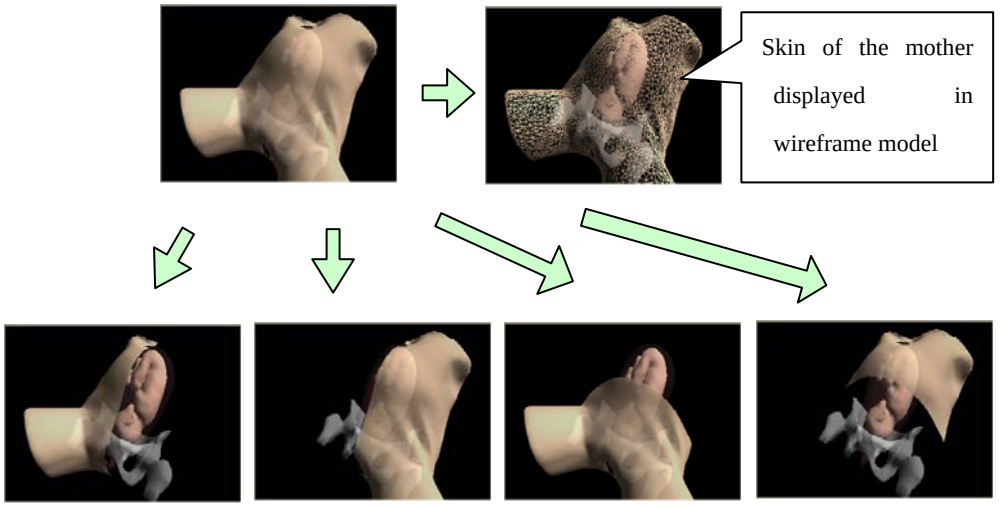

Figure 3: Display function of the internal examination training system

3 Reference

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