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The trainee's grasping condition remote analysis: in nursing training

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Abstract - Developing nursing skills is a top priority in nursing education, which is why clinical training is included. It is done simultaneously by a large number of students. As a result, a teacher's adviser has a hard time keeping track of many circumstances at once. A remote situation grasping system that can help teaching advisors identify trainees in need of instruction is the goal of this project. In this study, we examined the variations in trainee behaviour based on sensor-measured nursing behaviour. In addition, we spoke about how the findings may be put to use in the supporting system..

Index Terms—Analysing behavior, Clinical training, Nursing training, Multiple sensors, Grasping situation remotely.

I. Introduction

The healthcare system in Japan has seen considerable transformations in the last several years. There are, of course, several problems. New medical technology and patient safety, for example, often go hand in hand. As a result, improving the clinical competency of nursing personnel is a must [1]. Field training is an important part of a nurse's education since it allows them to put what they've learned in the classroom into practise. Despite this, there is a huge difference between the degree of nursing practise necessary in clinical training and the amount of practical competency immediately after graduation [2]. A teaching advisor in the field has a large number of students. Additional training takes place in every patient room simultaneously for each student.

As a result, the teaching adviser must inspect each room on his or her own own. Checking and breastfeeding behaviour do not always coincide, though. As a result, teaching advisors may miss out on a teaching opportunity. An efficient teaching environment and less stress on the teaching advisor are our main goals in this research project. This study bolsters the idea that a teacher's adviser can remotely observe the conduct of several students. At order to conduct this study, it is necessary to determine what statistical information is most useful for displaying to the teaching adviser in a distant location.

We devised a way to monitor the conduct of nursing students while they are in school. In order to gather information on nursing behaviour, sensors such as acceleration and pressure are included in the system. Each trainee's head, arm, wrist, waist, and leg were fitted with various sensors. Then, as part of our nursing education, we studied the way a nurse's body moved. On the basis of the acquired data, we also looked at differences in the nursing behaviours of trainees.

In Chapter 2, we'll discuss some of the relevant research. After that, we discuss the implementation of the collecting system in chapter 3, the experimentation in chapter 4, and the outcomes in chapter 5 of this

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chapter. Chapter 6 concludes with a discussion of the findings from the gathered data. Other factors to consider are whether or not data can be collected remotely, and whether or not it can be utilised in a grasping scenario.

II. Related Work

A *Support for clinical training in the medical field*

For years, we've helped fund medical students' clinical training. A teaching doctor and trainees who played doctors were shown statistical information in an effort to assess medical behaviour using sensors. When a student pretends to be a doctor in medical interview training, the rate at which they turn their face toward a patient and the greatest amount of time they do not speak are recorded.

We've also got a back-up plan in the works, too. This approach allows trainees to compare themselves to their peers in medical interview training by employing gadgets to enter assessment data for the learner who was playing the doctor. Furthermore, the assessment findings are used to play a video of just the relevant sequences for the student to learn from. Furthermore, it aids the teaching physician in gaining a distant understanding of the context of concurrent medical interview training [5]–[7].

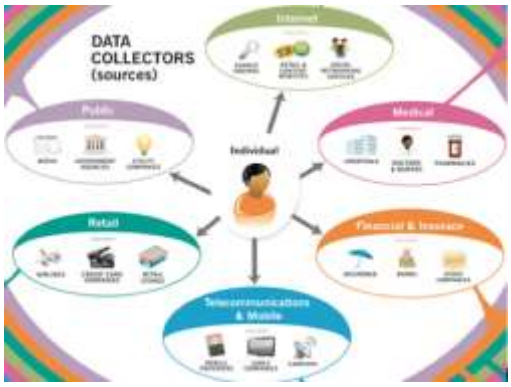

Figure. 1. Overview of a method for collecting data.

B *Analysing characteristics in nursing behavior*

When a patient is transferred from a bed to a wheelchair, skilled nurses and trainees with little or no nursing experience are examined in an article [8]. When evaluating the characteristics of competent and unskilled people during nursing behaviour, it may identify an index of trainees who need to be taught. At addition, the indexes may be utilised to provide statistical information to the adviser in a distant location so that he or she can better understand the training situation of the trainees.

III. Implemented System

A *A method for Collecting data*

This study necessitates the calculation of statistical data from a variety of bodily components. As a result, several sensors and a video picture are used to gather data from every region of a trainee's body throughout nursing training. Fig.1 provides a general overview of the process.

Multiple sensors monitor the trainee's heart rate, breathing rate, and posture from their bed as well as their voice, pressure on their right arm, and other behavioural characteristics. Because the data is gathered in a single location, many statistical analyses may be performed on the same set of data. Furthermore, the data are adjusted to ensure that there is no temporal lag between them. In addition, video is used to document the actual nursing behaviour.

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B *Implemented devices*

In Fig. 1, each place where an implemented device is attached to the trainee's body and the Installation position are shown. At 50Hz, small cellphones (Jelly Pro) are linked to the upper arm (wrist), wrist (waist), and thigh (leg). In addition, the head is fitted with a wearable device (the JINS MEME of JINS) and acceleration is captured at 40Hz.d.

Small devices (M5stack) coupled to pressure sensors (ALPHA ELECTRONIC pressure sensors (round shape, big)) and heart rate sensors (Pulse Sensor) are mounted to the right arm and neck, respectively. Six BLE tags (Sanwa Supply MM-BTIB1) have been installed beneath the patient's bed, and the distances between the tiny smartphone linked to the left leg and each of the six tag locations have been measured at one hertz (Hz). Near the bed, there's a sound sensor, too. Wearing and mounting the devices are shown in Fig.2.

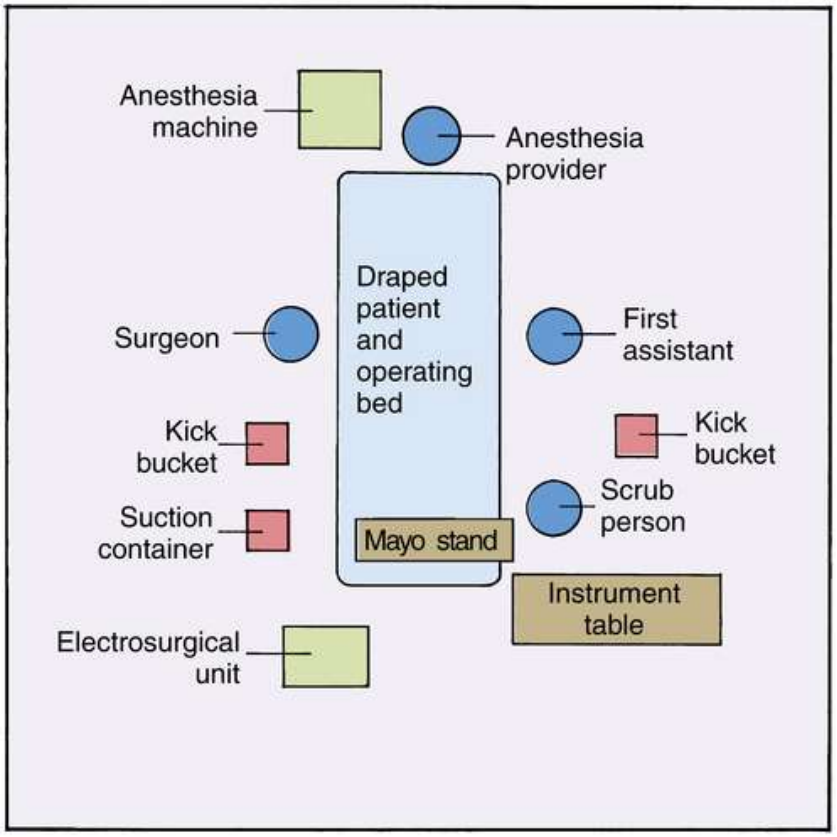

Figure. 2. Attachment position for implemented devices.

IV. Experiment

Our nursing team observed a patient's postural alteration in February of this year and recorded data about it. Eight third-year nursing students from Kochi University serve as examinees. Using a doll that resembled a patient sleeping on their back on a bed at Kochi University's exercise facility, they observed how postural changes in the patient affected the doll. They executed the patient's posture shift in the following order: supine, protracted sitting, sitting, standing, and wheelchair assistance. In addition, this flow is what we refer to as a session.

V. Results

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There were a total of 18 data collection sessions. From the obtained data, Fig.3 displays a graph of the accelerations of the head (upper arm), upper arm, wrist, waist, and leg.

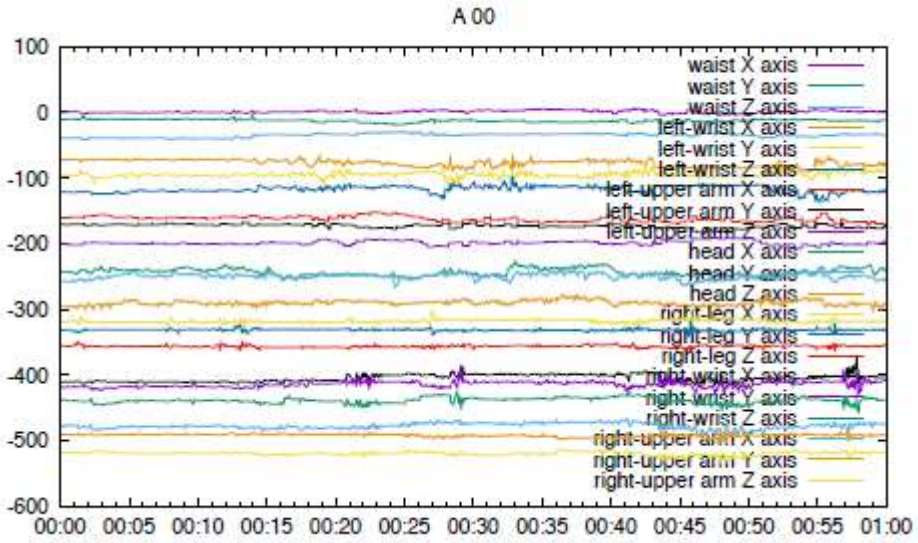

Figure. 3. Accelerations of the data collected from each part of the trainee.

VI. Discussion

A *Differences of behavior in collected data*

We looked at data from 18 different sessions. In particular, we looked at the discrepancies in the data acquired from examinees F and H. In the end, we found that touching the patient's body during a speech made a significant impact in the patient's experience. The examiner F didn't touch the patient's body, but H did when he had completed speaking and the patient had stood motionless. After that, Fig.4 and Fig.5 exhibit graphs showing right upper arm acceleration for examinees F and H, respectively.

Examinee F's acceleration between each step, such as the commencement of the session and the beginning of the posture shift from sitting to standing, is dense. Unlike the other, this one is not thick. By watching the session H film, we were able to determine that examinee H was using trial and error between each step. Between each trial and mistake, we believe there was a lack of density. It was apparent that examinee H was searching for a place on the patient's back to rest their wrist when they transitioned from an erect to an upright posture.

Moving averages for their right upper arm accelerations were derived for each interval 40 in the accelerations for sessions F and H, as well as their right upper arm angles. Examinee F's right upper arm went up and down 1 time, but on the other wrist, the same movement occurred a total of 4 times. On addition, we were able to see in the video that examinee H did, in fact, attempt to raise the patient many times. The right upper arm angles of previous sessions were likewise determined in the same manner. Based on each angle recorded in 18 sessions, we estimated how many times our right arm reached its maximal mobility. The data is shown in Tab.I. It was shown that 5 out of 8 second-time trainees had a lower count of up and down motions of their right upper arm when wrapping their wrist over the patient's back than the first time around. Certain scenarios recommended by the teaching adviser were also verified in some sessions. After that, the teaching advisor established a hierarchy of advice. From 0 to 3, there are three possible outcomes. Level 1 isn't what they suggest, either. The instructional adviser becomes closer to the examinee at level two.

The teaching advisor gets closer to the examinee in level 3 and advises on the examinee's nursing actions. The correlation coefficient between advising level and right upper arm count was also examined. There was

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a moderate correlation between the count and a group that was given advice (r = 0.469). It seems, based on the findings, as if counting may accurately anticipate the degree of guidance needed by a nursing student.

We next looked at how the researchers lifted the patient into a wheelchair and then moved him about. When it comes to acceleration, we examined the mean absolute value between those who were instructed and those who weren't.

To put it simply, the worth of the group recommended is greater than that of another group. We also examined the value when the patient was 2, 2 seconds away from being lowered into the wheelchair. Consequently, the interval between the two groups is extremely narrow because of the large difference in the mean. In addition, we used a student t-test with a significance threshold of 0.05 to see whether the means of the two groups differed in any way. Null hypothesis H0 states that the two groups' mean is not different. There is a second alternative hypothesis, H1, which states that the two groups have different mean values. Shown in tab II are the results. Consequently, the two groups had significantly different means of X axis left leg accelerator acceleration during patient transfer into wheelchair (p = 0.05). Thus, the null hypothesis H0 was ruled out. It was clear from the video that some trainees were instructed by their teaching adviser to maintain their left leg straight before placing the patient in the wheelchair. To determine whether or not a student need the assistance of a teaching adviser, we believe this trait to be a useful screening tool.

TABLE I: NUMBER OF TIMES OF UP AND DOWN OF TRAINEE'S RIGHT UPPER ARM

	A	B	C	D	E	F	G	H
1st	4	10	14	11	6	18	2	44
2nd	2	9	17	17	5	3	14	8
3rd	16	8						

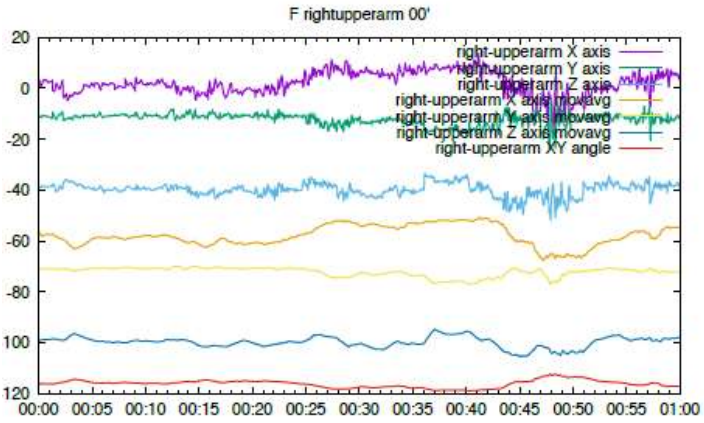

Figure. 4. Accelerations of right upper arm in examinee F.

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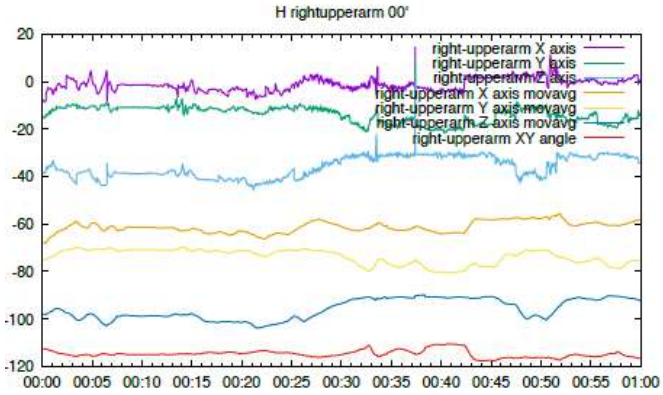

Figure. 5. Accelerations of right upper arm in examinee H.

B *A collection aptitude of the devices*

From the data we gathered, we were able to discern the devices' varying capacities for data collecting. To begin, we believe it is difficult to do a behaviour analysis based on the data presented in Section VI-A for a variety of reasons. When examining wrist motions, for example, several parameters such as joint range of motion must be taken into account. An upper arm, on the other hand, is easier to analyse since we don't have to worry about the elbow joint.

The obtained pressure sensor data also showed no change. There is a potential that the location where we anticipated the patient to touch may be different from the spot where the patient actually touched. If we utilise the sensor that relies on whether it contacts the point, such as a pressure sensor, we need take into account the location where the patient's body may be touched by a sensor. In contrast, in order to determine the commencement of each step, we must examine not only the single step but also a feature of the whole session. Using a device that can catch the whole event, such as a video camera, we believe that it can identify when the trainee's hand is placed on the patient's arm by calculating their positions. OpenPose, a programme that uses deep learning to predict a person's posture, will also be used in our analysis. As shown in Figure 6, a test film of a person's posture changing to an open pose may be used to analyse the image's joint coordinates. The joints of the human body are shown by the lines in the illustration.

TABLE II: THE MEAN OF ACCELERATION OF LEFT LEG OF EACH GROUP

	Whole	Last 3 seconds*	Last 2 seconds*
Not advised	1.660	1.438	1.407
Advised	2.470	3.008	3.205

*: $p < 0.05$

In contrast to a pressure sensor, however, a degree cannot be measured. The angle at which a video is shot might also make it harder to conduct an analysis. We may deduce from the information presented above that this system is capable of gathering data in several dimensions and putting it to good use.

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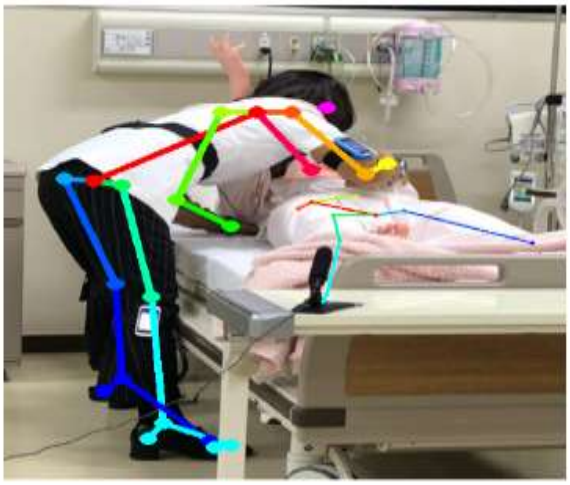

Figure. 6. An example of analyzed coordinates of joints during posture change.

C *A possibility of useful for supporting of remote situation grasp*

We were able to deduce from the gathered data, as discussed in Section VI-A, that there were disparities in trainee behaviour during the nursing simulation. We also discussed, in Section VI-B, the differences in data that may be obtained by using various devices. Because of this, we believe that combining and analysing the various datasets will uncover even more variables that explain behavioural variation. It is also possible to utilise it to help remote situation grasp by automatically identifying the features of nursing conduct and showing this statistical information to the teaching adviser.

VII. Conclusions

Sensors and video were used in this article to gather and analyse data from numerous sections of the trainee's body while they were in nursing training. Japanese healthcare has undergone tremendous transformation in recent years, necessitating an increase in clinical proficiency. Nursing students are required to do fieldwork as part of their curriculum. Teaching advisers in field training may forgo a chance to provide parallel instruction in nursing care if they are distracted by other matters. By showing statistical information in nursing training at a distant location, this study helps the problem. During the course of the student's nursing education, we used several sensors to monitor the student's conduct. Using the data we gathered, we also performed an analysis and discussed how trainees differed in terms of behaviour. In addition, we mentioned the need of integrating numerous devices and gathering multidimensional data since each device has a varied ability to collect data. As time goes on, we'll see whether the trainees' varying nursing behaviours can be converted into a metric for transmitting statistical data to an adviser in another location.

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