

Design of Intentional Controlled Turnover Bed Based on Body Pressure Change

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Abstract: Under the action of gravity, the buttocks of long-term bedridden patients are oppressed often appear bed sore. In order to reduce bed sore, physical turning over or necessary auxiliary equipment is required. In this paper, a self-controlled multi-function nursing turning bed is designed. Firstly, the three-dimensional modeling of the turning bed is carried out, and the pressure sensor mattress is selected to detect the pressure change in each position of the experimenter. The hardware and software of the main system and the bed are designed to fuse the automatic detection system with the intention control.

Keywords: Intention control turnover bed, structure design, turnover intention algorithm design, automatic detection roll over system design.

1. INTRODUCTION

At present, the most serious social problem of the world is the population aging[1]. For some elderly families that is aging or have suffered accidental injury, they need to stay in bed for a long time because of their congenital paralysis, cerebral hemorrhage and other diseases. Patient care problems make nurses tired. Also caused certain psychological and economic burden to the patient's family[2]. Long-term bedridden patients, under the action of gravity, their buttocks are oppressed for a long time, often appear bed sore. The usual way to solve bed sore is to turn over the patient within a certain period of time, relieve local pressure and make blood flow. The patient wants to sit for a long time, to support some pillows, quilts, clothes and so on behind the patient, often need to be accompanied by someone around, nursing staff will be very tired[3]. Therefore, the use of automatic turning bed has a broad market.

At present, there are three main types of medical care beds: the first are sitting bed, as shown in figure 1 a. A second is a rollover bed, as shown in Figure 1 b. A third category is the multifunctional turnover bed, as shown in Fig .1 c, which has the functions of the above two types of nursing bed, and is more automated and intelligent [4-5].

In this paper, a kind of intention control turning bed based on body pressure change is designed. The

main research contents include: the whole structure design of intention controlled turning bed, the algorithm research of intention control turning bed and the hardware and software designs of intention control turning bed automatic detection system. This turning bed can accurately measure the pressure on the patient under pressure. If a certain part reaches a predetermined pressure value, the turning bed will receive instructions and automatically turn over for the patient, which can effectively prevent the occurrence of pressure sore.



Figure 1 Common nursing bed structure

2. INTENTION CONTROL TURNING BED STRUCTURE

The whole nursing bed revolves around the old people's life characteristic, the life activity and the nursing development, through the electric push rod push the bed body to realize the functions of turning left and right, lying flat, legs up and down, etc. The whole structure design adopts the dual-purpose variable attitude design of sitting and lying, in which the left and right rollover, the back of the support and the leg extension need the corresponding planar linkage mechanism to realize. After calculating the relevant dimensions, the related members of the mechanism are drawn with the help of UG and other software, and finally assembled into an assembly diagram. The overall assembly structure is shown in figure 2.



Figure 2 Overall Assembly Structure

3. STUDY ON THE ALGORITHM OF BODY PRESSURE MONITORING AND INTENTION CONTROL ROLL OVER BED

3.1 Principle and Selection of Body Pressure Monitoring Sensor

Pressure sensors are made entirely of polymers such as rubber and polyurethane foam and do not use any metal components. the dielectric layer made of this material are sandwiched between the upper and lower electrode layers. each electrode layer has multiple parallel electrodes. the electrodes on the upper and lower electrode layers are mutually oriented and orthogonal distributed, so each two

orthogonal electrodes form an independent capacitive sensor unit. as shown in Figure 3.

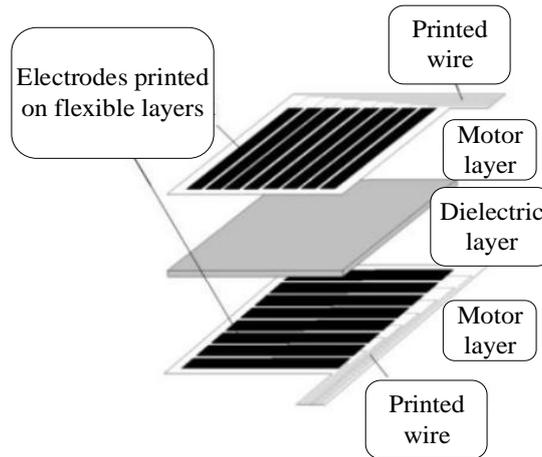


Figure 3 Schematic diagram of the sensor

According to this method, SR intelligent rubber sensor can scan the electrode layer by sampling circuit to obtain the capacitance value of each capacitor unit. The pressure signal is collected. A SR intelligent rubber sensor pressures pad of Donghai Rubber Co., Ltd. is used in this paper, as shown in figure 4. SR intelligent rubber sensors print electrodes and wiring together on polymer substrates to measure the pressure distribution of various parts of the body by sitting on the measuring area or lying on the measuring area. and connected with the automatic detection system by USB.

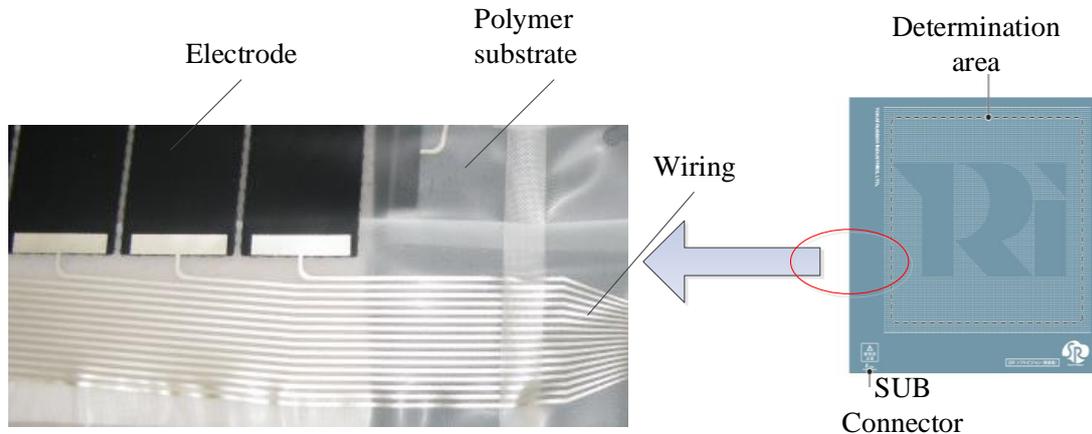
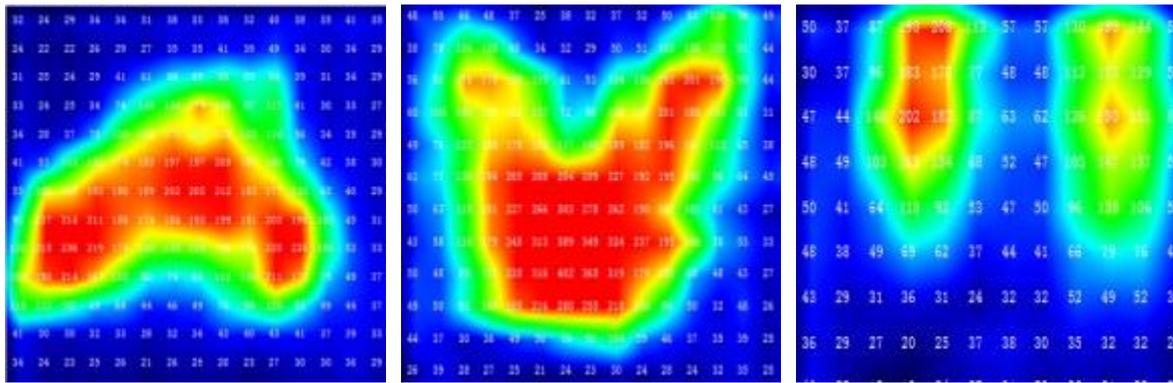


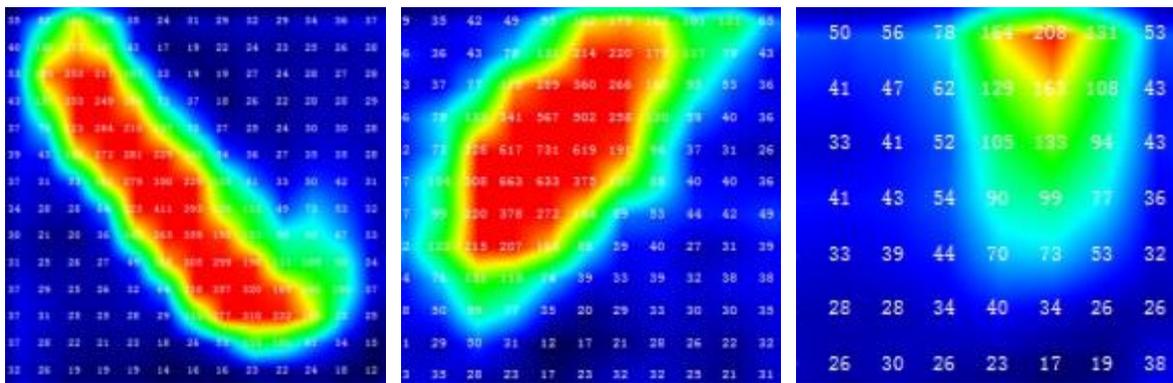
Figure 4 SR Sensor

3.2 Body pressure distribution test

By using the method of connecting the SR intelligent rubber pressure sensor with the automatic detection system, the pressure in each part of the human body lying flat and lying on the side is measured to judge whether the person wants to turn over. people lie on the pressure pad, the pressure pad will detect the pressure in each part of the human body, feedback on the automatic detection system and display images, put the back, buttocks and legs SR the intelligent rubber sensor pressure pad, respectively, to measure the pressure in each part of the body. The pressure images of each part of the body are shown in figures 5 and 6.



(a) Back (b) hips (c) legs
Figure 5 Pressure charts for all parts of the body lying flat



(a) Back (b) hips (c) legs
Figure 6 Pressure diagrams of various parts of the body

3.3 Turnover Intention Algorithm

By SR the intelligent rubber pressure sensor pressure pad and the automatic detection system, we can easily know that when the human body is lying flat, the pressure distribution of the back is more average, while when the intention to turn over, the pressure on both sides of the back will increase and the pressure in the middle will decrease; By observing the pressure distribution of the legs in detail, we can see that the pressure of both legs is relatively average when lying flat, but when in the stage of intention to turn over, the pressure on one side will increase a lot, and the pressure on the other side will disappear.

According to this, we can judge whether there is intention to turn over by the characteristics of body pressure distribution of human intention to turn over, and then help the elderly to carry out the functions of rollover, back rise, back flat, and so on through the algorithm of intention to turn over.

4. DESIGN OF AUTOMATIC DETECTION AND TURNOVER SYSTEM

4.1 Hardware design

The principle of controlling the roll over bed based on the change of body pressure is shown in figure 7. SR intelligent rubber sensor placed on the bed surface is connected to the automatic detection system. SR intelligent sensor can detect the body pressure in all parts of the user's body, and then feedback the detected pressure signal to the automatic detection system. The automatic detection system identifies the intention of the user through the change of pressure in each part, and judges the

position state of the bed surface at that time. When the pressure reaches the predetermined value, the automatic detection system will drive the motor push rod to drive the movement towards each part of the bed surface to achieve all kinds of posture that the user wants. The automatic detection system of intention control turning bed adopts STM32F103ZET6 micro-processing device, which can support the development of C language.

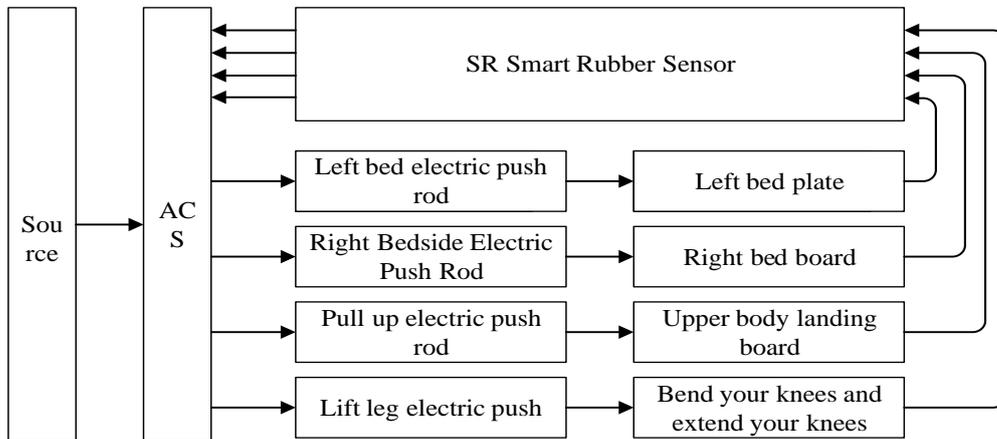


Figure7 Schematic diagram of roll over bed

4.2 Software design

After the automatic detection system of the intended control turning bed is initialized, its workflow is shown in figure 8. Identify the pressure signal from the SR intelligent rubber sensor. When the pressure reaches the predetermined value, drive the motor to rotate and realize the position conversion; when the predetermined value is not reached, return the pressure recognition and re-identify.

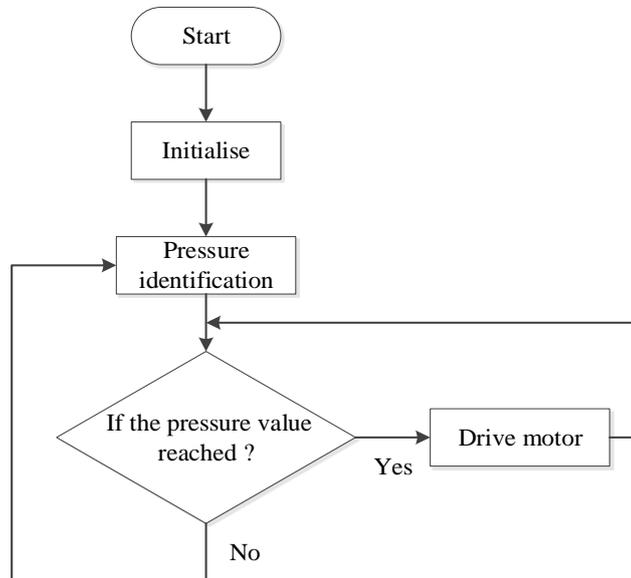


Figure 8 Flowchart of Automatic Detection System

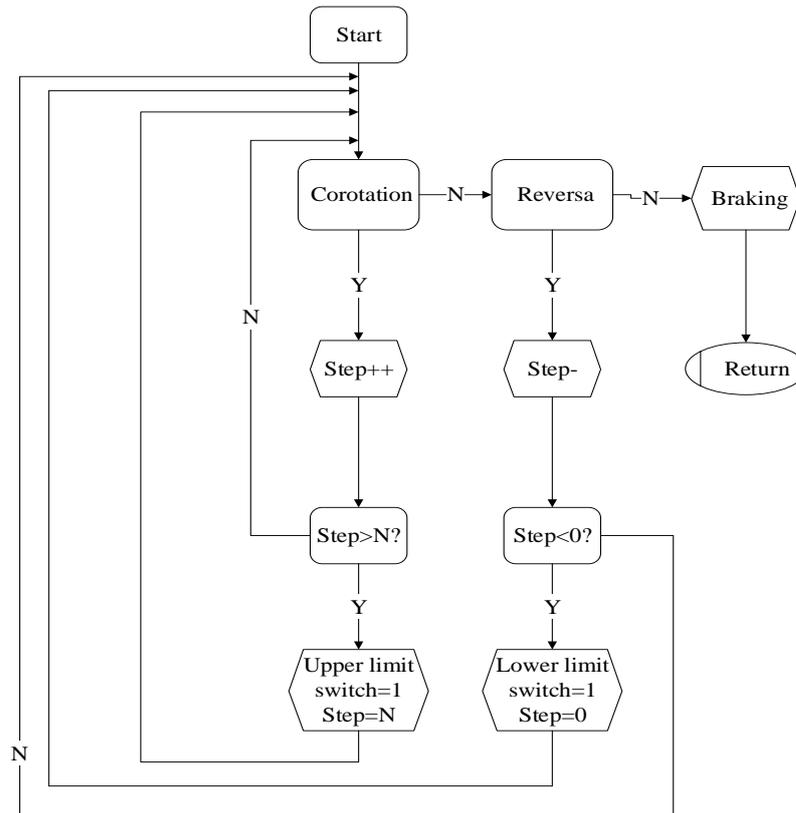


Figure 9 Flowchart of Electrical Subprogramming

The automatic detection system of turning over bed is designed to control the movement of the bed body, such as the left and right flip, the back of the back and the curved leg of the bending leg through the two motor push rods. When the stroke of the motor push rod is the shortest time, the value of the Hall signal is set to Step 0, and when the stroke of the push rod is the longest, the value of the Hall signal is Step considered to be N.. The Suppose the PE0 port of the micro-processing device outputs high voltage, PE1 the port outputs low voltage, when the motor is rotating, its subroutine flow is shown in figure 9.

5. CONCLUSION

The design of turning bed based on the intention of body pressure change solves some shortcomings of general medical turning bed which need the assistance of nursing staff. It can automatically judge the intention of the patient and turn over for it or realize other positions. The intention to control the turning bed can be controlled by the patient himself or automatically turn over for the patient, without the help of the strength of others, improve the patient's autonomous control, comfort and quality of life, reduce the burden of nursing staff, is a more humanized intelligent turning bed. At present, this study only completes the basic function of turning over, and it is still necessary to study the algorithm of intention turning over more deeply in the later stage to make it more intelligent.

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