Design and Research of Intelligent Seats for the Elderly

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Abstract. This paper takes SCM of arm31 as the core to upgrade the function of intelligent seat for the elderly. To ensure that the SCM system can directly take over the system to form an automatic risk change out when the seat is in a dangerous state such as uncontrolled sliding and excessive three-axis inclination. At the same time, the system uses iFLYTEK voice recognition module to realize the voice control of the seat, and the system uses the vital signs related app of the contracted hospital to realize the automatic alarm function of the hospital. The use of the seat can effectively improve the daily out safety of the elderly. It is very important to improve the quality of life of the elderly.

Keywords: Intelligent Seats, Elderly, Automatic change out, Risk control

1. Introduction
The elderly people who are inconvenient to move need the assistance of intelligent seats to fully guarantee their quality of life. The primary intelligent elderly seat can walk by itself and can be locked as needed to facilitate the elderly to sit up, that is to say, it must be equipped with corresponding walking mechanism, which can pass through the general barrier free facilities and have a manual locking device [1]. But there are some hidden dangers in this kind of seat. If it can not be effectively locked or walked on the complex road, it is easy to cause nursing accidents such as elderly falling.

This paper plans to design an intelligent seat for the elderly, which can provide voice command recognition, automatic locking and sitting behavior judgment, and provide basic vital signs monitoring function for the elderly and realize automatic alarm.

2. Demand Analysis
1) Walking. It can provide autonomous walking function of 0.5m/s at least and 2m / s at most, 2 sets of 1kW brushless motors, and safety system of software driving force distribution and anti reverse sliding.
2) Turn. It can provide in-situ steering (radius less than 0.3m) and differential steering (radius greater than 0.3m). The steering function and walking function are controlled by the same rocker.
3) Automatic locking. Worm control is used between the motor and the walking wheel. After the motor loses power, the wheelchair cannot be pushed by the force within 1kW. Manual clutch can be used to facilitate the implementation of the seat. If the sliding speed of the seat exceeds 2.5m/s, worm
control can be automatically recovered to achieve locking.

4) Tilt alarm. The gyroscope module is used to judge the three-axis tilt angle of the seat. When the tilt angle exceeds 15 degrees, the seat will automatically give an audible alarm and slow down, and automatically judge the walking direction to restore the tilt angle.

5) Adopted. In self-propelled mode, the seat can pass an 8-degree slope.

3. Drive hardware selection

The system is equipped with two 1kW DC brushless motors, three 12V150AH complex lithium batteries. SCM system is used to realize the safety system functions of anti reverse sliding, anti tilt, anti tilt, differential control, etc. The independent servo mechanism is used between the brushless motor and the traveling wheel [2]. The servo mechanism takes the titanium tungsten alloy steel worm drive as the core mechanism, providing mechanical servo action execution functions such as drive shaft locking, drive shaft clutch, drive shaft temperature monitoring, drive shaft active lubrication, etc. All actions are assigned to the motor or servo device according to the SCM system controlled by the rocker in the hand of the elderly. As shown in Figure 1.

![Figure 1. Drive Hardware Selection](image)

Through the combination of multiple groups of varistor and frame deformation, the system can judge the movement characteristics of the elderly, and judge the actions of the elderly such as standing up and sitting down, so as to make a prediction.

4. SCM module design

The lower part of SCM module is connected with five systems. In addition to the network module, it is connected with the status monitoring module group of walking wheels on both sides, the overall status monitoring module group of seats, and the control module group of motors and servo modules on both sides. Finally, it realizes the state control of the whole seat and the connection to the Internet [3]. SCM's built-in Bluetooth module can be connected with the elderly's Bluetooth bracelet to monitor the elderly's vital signs.

The SCM module selects arm31 module, configures 8GB running memory, 8 core processor, 4G data storage module, etc. In order to ensure that the fuzzy control algorithm module and neural network algorithm module used in this system can run at the lowest delay.
Figure 2. SCM architecture of intelligent elderly seat

5. Software Development and Design
Because of the small amount of data and simple action, the core algorithm of the intelligent seat for the elderly is implemented by the neural network algorithm driven by direct data. According to the analysis in Figure 2, there are 15 groups of data at the input end and 6 groups of data at the output end. Therefore, 15 nodes are set at the input layer and 6 nodes are set at the output end. The software design mode of 5 hidden layers is adopted [4]. There are 30 nodes in the middle layer 1, 50 nodes in the middle layer 2, 30 nodes in the middle layer 3, 18 nodes in the middle layer 4 and 12 nodes in the middle layer 5. All the nodes between the adjacent layers are connected in two to form a simple neural network deep learning system. After sufficient data feeding (generally 30000 sets of data and 72 hours of cumulative training) in the laboratory, the neural network was trained outdoors under different weight and road conditions. Finally, the parameters of the node are initialized and loaded into the seat system.

The tilt alarm runs on the linear regression algorithm, the system can judge the tilt trend of the wheelchair, and the sampling frequency period is 0.5 seconds [5]. After the system judges that the seat tilt amplitude exceeds the limit, it automatically deprives the driving control right of the neural network, enters the slow mode, judges the effect of slow travel modification, and selects the nearest path to change the tilt road condition.

The anti sliding module also runs on the linear regression algorithm. When the seat speed sensor judges that it is not the same as the seat shaft speed, or judges that the seat speed is more than 2.5m/s, it will automatically deprive the neural network control right and enter the slow mode. If it can not be changed, it will send out an audible and visual alarm. At the same time, it will calculate the gravity sliding situation according to the tilt detection, which is obtained by the fuzzy control matrix algorithm Wheelchair direction control results.

The speech recognition module adopts iFLYTEK assembly module to reduce the amount of development and achieve higher speech recognition rate.

The vital signs module is directly realized by the formed app of the contracted hospital. The automatic alarm device is directly connected with the emergency center of the contracted hospital.

6. Summary
The core function of the intelligent elderly seat designed in this paper is still the auxiliary walking function, but many intelligent security functions based on high configuration SCM system are added to the auxiliary walking function. For example, the seat can judge the walking speed, seat inclination, etc. when the seat appears passive sliding, a number of protection measures will be started. The system
can change the dangerous state of over inclining and uncontrolled sliding without intervention, so as to prevent the complex road condition injury caused by the old people's slow stress response. At the same time, the seat uses iFLYTEK voice recognition module to support the elderly to use voice outside the rocker to control the seat, and uses the health app software of the contracted hospital to realize the function of automatic alarm of the elderly's health status. These functions are necessary and important in the elderly's daily life and normal going out process.

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