International Journal of Latest Research in Engineering and Technology (IJLRET)
ISSN: 2454-5031
www.ijlret.com || Volume 11 - Issue 09 || September 2025 || PP. 57-60

Caring for the Elderly - Auxiliary Walking Machine

Zhou Yuehan, Wu Yilin, Chen Mengyuan, Yang Guangyan, He Junyao
School of Mechanical and Automotive Engineering, Shanghai University of Engineering Science

Abstract: Aiming at the problems of traditional walkers, such as single function, lack of power support, insufficient stability and comfort, which make it difficult to meet the daily walking needs of the elderly, this paper designs an elderly walker with an openable and closable seat based on Jansen linkage for auxiliary walking and walker power assistance. This walker provides stable support through the Jansen linkage mechanism, simulates a natural gait, and ensures stable walking. The walker power assistance mechanism (including a motor and a battery) provides power support for walking, reducing the user's burden. The openable and closable seat mechanism adopts a five - link design, which can be manually separated and combined to meet the needs of walking or resting, saving space. The foldable armrest mechanism and the opening and closing part of the walker further enhance the user's comfort during use. In addition, the control system integrates a display screen to show real - time information such as speed and battery level, and is equipped with safety devices (such as brakes and anti - slip devices) to fully ensure the safety of the elderly. This walker combines functionality, stability and portability, and is suitable for home, community and rehabilitation scenarios, significantly improving the quality of life of the elderly.

Keywords: Elderly Walker; Jansen Linkage; Openable and Closable Seat; Power Assistance; Intelligent Control

I. Introduction

With the increasing aggravation of China's aging problem, the quality of life of the elderly has become the focus of social attention. According to the data from the National Bureau of Statistics, by 2022, the population aged 60 and above in China has reached 280 million, accounting for 19.8% of the total population. The rapid growth of the elderly population has brought about many social problems, especially the health and safety issues of the elderly. Many elderly people face the problem of mobility inconvenience in their daily lives, especially when walking, standing and sitting down, they are prone to accidents such as falls. According to statistics, more than 30% of the elderly over 65 years old experience at least one fall every year, and about 10% of these falls lead to serious injuries, such as fractures or head injuries.

Falls not only pose a threat to the physical health of the elderly, but also have a negative impact on their psychology. After experiencing a fall, many elderly people will develop a fear of walking, thereby reducing their daily activities, which leads to further degradation of their physical functions and forms a vicious circle. In addition, falls also bring a heavy economic burden to families and society. According to relevant research, the annual medical expenses caused by falls of the elderly are as high as tens of billions of yuan. This paper designs an elderly walker, which aims to help the elderly carry out daily activities safely and conveniently and improve their quality of life. The walker can not only help the elderly walk, but also be equipped with functions such as a lifting seat, a resting function and an auxiliary standing function to meet the diverse needs of the elderly in daily life.

II. Mechanical Structure Design

A. Overall Design Objectives

Based on the analysis of human gait, the Jansen linkage structure is adopted as the movement mechanism of the human thigh, and a stable linkage system formed by hinge connection is used for power transmission. The overall frame can not only support most of the gravity of the human body when walking, but also play a role in standing and resting. The opening and closing part of the walker is convenient for the user to enter and exit the walker, and can flexibly adjust the space range of the walker according to the space constraints. The hinge connection adopts a silent design, and no noise is generated during the opening and closing process, which further enhances the user's experience. Command input can be realized through voice recognition or Bluetooth APP, and finally the auxiliary movement of the human body is achieved. It has the characteristics of simple working principle, easy control and intelligent integration.

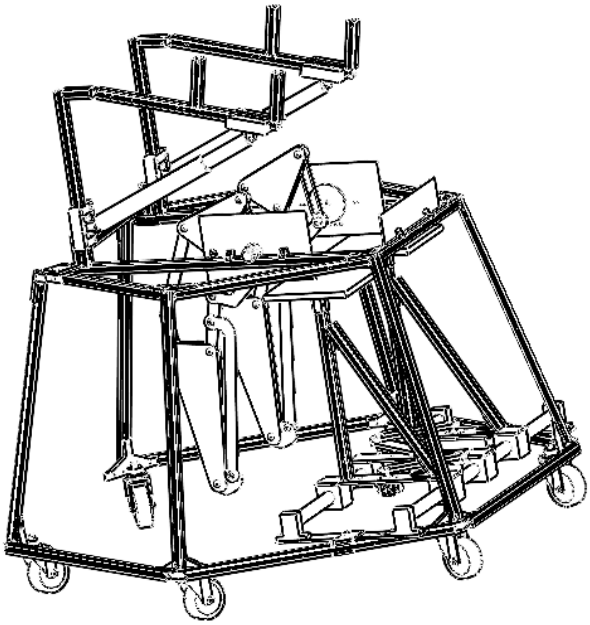

Fig. 1: The overall Model

B. Mechanical Structure

(1) Jansen Linkage Auxiliary Walking Mechanism

The basic triangular part of the Jansen linkage mechanism is composed of a triangular plate made of acrylic, with lengths set as L_1 = 160mm, L_2 = 180mm and L_3 = 100mm respectively. This design aims to construct a stable triangular frame and provide a solid foundation for the subsequent complex movements. The links are connected by shoulder bolts, and there are flange bearings, deep groove ball bearings and thrust ball bearings. These bearings can ensure the flexibility of the links during movement and prevent wear caused by direct contact between various components.

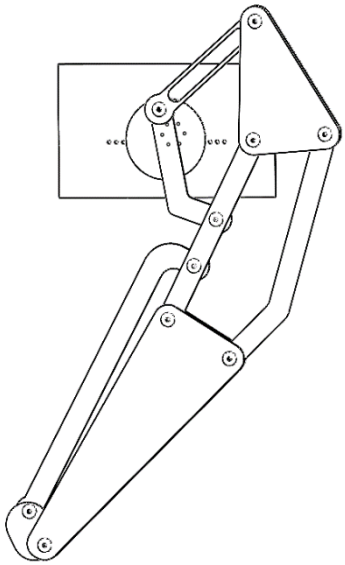

Fig. 2: Jansen Linkage Auxiliary Walking Mechanism

(2) Seat Opening and Closing Mechanism

The lower part of the seat installation uses a five - link mechanism to control the separation and combination of the seat. The seat is divided into left and right halves. Through the linkage effect of the five - link mechanism, when it is necessary to walk with the assistance of the linkage, it can be manually separated to both sides to form a spacious use space; when it is necessary to rest, it can be closed through the reverse movement of the five - link mechanism. In order to ensure the stability and reliability of the folding mechanism, high - strength bolts are used for fixing at the joints.

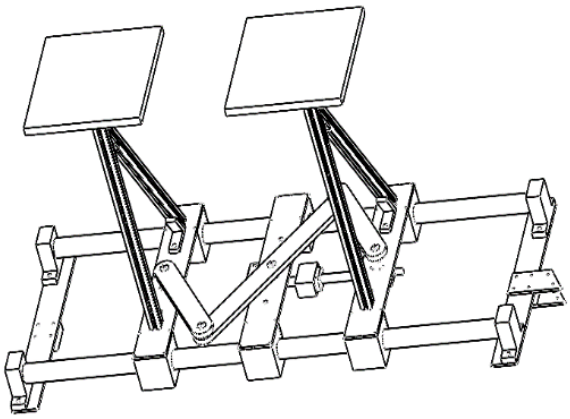

Fig. 3: Seat Opening and Closing Mechanism

C. Theoretical Calculation

In order to obtain a variable step length, a motor can be introduced into the linkage to increase more degrees of freedom for the Jansen leg mechanism. By analyzing the changes in the toe trajectory with the changes in the crank length and the fixed link length, the gait optimization scheme of the Jansen leg mechanism is considered. By changing the crank length of the Jansen leg mechanism (while keeping the lengths of other links unchanged), the changes in the toe trajectory are observed. It can be seen from Fig. 4 that with the increase of the crank length, both the step height and step length of the toe trajectory increase. At the same time, the change of the step height with the crank length is nonlinear, while the change of the step length with the crank length is linear.

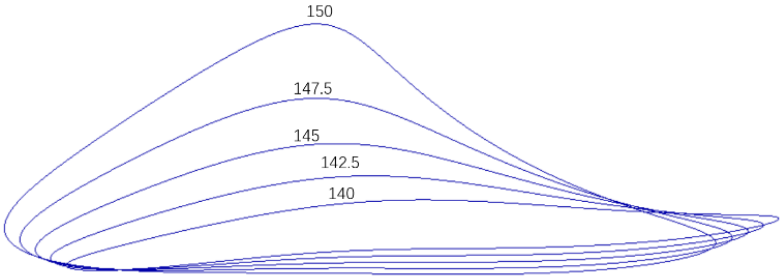

Fig. 4: Toe Trajectories under Different Crank Lengths

By changing the length of the fixed link of the Jansen leg mechanism and observing the changes in its toe trajectory, it can be seen from Fig. 5 that with the increase of the length of the fixed link, the step length of the toe trajectory decreases, while the step height increases. At the same time, with the increase of the horizontal length of the fixed link, the step length of the Jansen leg mechanism decreases, but the reduction range is very small, approximately a horizontal straight line; while the increase range of the step height is relatively large, but the slope of the curve decreases, indicating that with the continuous increase of the length of the fixed link, the change of the step height will become larger and larger.

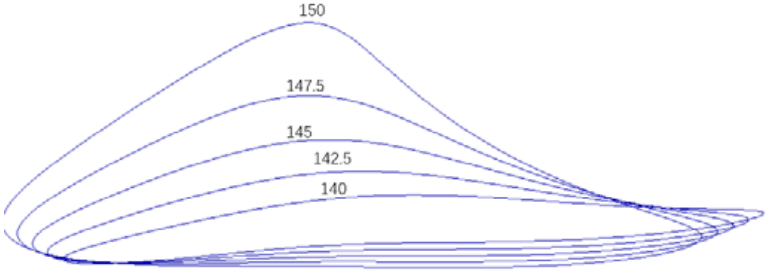

Fig. 5: Toe Trajectories under Different Fixed Link Lengths

Therefore, according to actual needs, the Jansen leg mechanism can appropriately increase the crank length to increase the step length and step height of its toe trajectory, or appropriately increase the length of the fixed link to increase the step height of its toe trajectory, thereby enhancing the climbing and obstacle - crossing

capabilities of the multi - legged bionic mechanical cow. When the length of the fixed link of the Jansen leg mechanism is 157mm, its step length is slightly reduced, but its step height is greatly increased, which meets the design requirements.

III. Electrical and Intelligent Control System

This walker provides stable support through the Jansen linkage mechanism and simulates a natural gait. The power assistance mechanism provides power support for walking. The openable and closable seat mechanism adopts a five - link design, which can be manually separated and combined to meet the needs of walking or resting. The control system integrates a display screen to show real - time information such as speed and battery level, and is equipped with safety devices (such as brakes and anti - slip devices) to fully ensure the safety of the elderly. The core control chip adopts STM32F103ZET6, which integrates modules such as motor drive and relay, reducing the space occupied by electrical control components and facilitating program control and wiring. The main control board integrates 2 motor drives, which are mainly used to drive the operation of the linkage and the push rod.

The user manually opens the opening and closing door of the walker, issues a command through the touch screen, and the microcontroller drives the ball screw mechanism to raise the seat cushion, and the five - link mechanism turns the seat cushion to an appropriate angle. The user manually pushes the door shut, and the bolt inserts into the lock seat to complete the closing. The driving mode and speed are set on the touch screen, and the Jansen linkage mechanism drives the supporting feet to simulate walking, and the walker starts moving. If adjustment is needed during driving, the microcontroller controls the electric push rod to expand the armrest through the touch screen command, and then adjusts the telescopic length of the armrest through the screw nut transmission. When encountering an obstacle, the trajectory of the supporting feet is changed by adjusting the motor of the Jansen linkage mechanism to cross the obstacle. After reaching the destination, the user issues a parking command through the touch screen, manually opens the door, adjusts the height of the seat cushion, and then leaves safely.

IV. Conclusion

This paper designs an elderly walker with an openable and closable seat based on Jansen linkage for auxiliary walking and walker power assistance. This walker provides stable support through the Jansen linkage mechanism, simulates a natural gait, and ensures stable walking. The walker power assistance mechanism (including a motor and a battery) provides power support for walking, reducing the user's burden. The openable and closable seat mechanism adopts a five - link design, which can be manually separated and combined to meet the needs of walking or resting, saving space. The foldable armrest mechanism and the opening and closing part of the walker further enhance the user's comfort during use.

V. Acknowledgements

This research was partly supported by the Shanghai University of Engineering Science student innovation and entrepreneurship project (Grant No. cs2507007).

References

[1]. Ding Fuhong, Wang Xuanzheng. Research on the Design of Elderly Walking Aids from the Perspective of Embodied Cognition [J]. Packaging Engineering, 2023, 44 (S01): 70-78. (in Chinese)
[2]. Zhang Lei, Zheng Jie, Zhao Yafei, et al. Design of Intelligent Walking Aids for the Elderly Based on the Improved Technology Acceptance Model [J]. Journal of Mechanical Design, 2024, 41 (12): 175-180. (in Chinese)
[3]. Wang Xiaowei, Gao Shenglu, Chen Xu. Research on Structure and Motion Simulation of Riding-Type Lower Limb Walking Aids [J]. Mechanical Science and Technology for Aerospace Engineering, 2024, 43 (6): 984-990. (in Chinese)