



Sole Structure Design for the Disabled

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Abstract: This article provides an elevated sole design which can be custom-made to the desired height for people with Leg Length Discrepancy. The heels are equipped with solar panels that are chargeable during sunny days. The sole edge is installed with LED and provides illumination when there is insufficient light. This creation gives disabled people a safe and dignified walking experience even at night.

Keywords: leg length discrepancy, LED, disabled people, sole structure design.

1. INTRODUCTION

Leg Length Discrepancy (LLD) may be structural, caused by unequal length in bones of the lower extremities. It may be congenital or caused by bone fracture due to injury. Functional LLD results from congenital scoliosis. Persons with LLD experience difficulties in balancing due to this condition. Moreover, they are often uncoordinated in movement and stumble easily when walking. Special insoles or heel pads are often used for treatment or correction, but their prices are exorbitant.

Due to difficulty in walking, currently encountered people with LLD use wood, can, high-density PU, and other items as an alternate approach, which not only lack beauty but is also undignified, even possessing safety concerns that need to be solved. This article explored the shoe sole structure of disabled persons in order to provide elevated sole design that can be customized to the desired height. This design can also help people with LLD see the road condition and let others be aware of them so as to ensure their safety.

2. LITERATURE REVIEW

Shoes of disabled persons were used as topic in the investigation of musculoskeletal diseases. Analysis and experiments were made on the advantages and disadvantages of shoes and then their improvement [4]. Lumbar spinal stenosis (LSS) is a condition associated with the

degeneration of spinal disks in the lower back. A significant majority of the elderly population experiences LSS, and the number is expected to grow. Lee et al conducted walking experiments to test the elderly's walking ability. He considered the possible obstacles of wearing shoes and resolved them [2]. Evaluation was also made on the effectiveness of unstable shoes in reducing low back pain in health professionals. Results showed that after six weeks of testing, shoes have no significant effect on patients with chronic low back pain. However, it is still recommended that stability shoes be worn [5].

Three dimensional (3D) mapping technology is now very mature. As Luan et al developed Smart Shoes, the production, quality monitoring, numerical calculations, and tests for various conditions were done to assist disabled persons (blind people) avoid obstacles encountered in unknown environment [3]. Disabled persons have less favorable living conditions and need the society to consider their well-being, especially economically [1]. Designing products such as elevated soles, whether for customization or mass production development, is a viable option, but financing of funds from related organizations is urgently needed.

3. CREATIVE DESIGN

This article focuses on the shoe sole structure of the disabled. With regard to shoe height, insoles can provide elevation but only to a limited extent and height of shoes cannot be adjusted. Therefore, it is necessary to design a sole structure with height that can be customized according to demand in order to meet the needs of the disabled. In this design, the transparent soles and elevated soles were combined. Solar panels were placed on the receiving slot of the transparent soles, and LED lights were placed on the inner circumferential surface. A circuit board was connected to the solar panels, LED lights, pressure sensor, light sensor, and battery. The pressure sensor can sense whether the disabled person is wearing shoes. The light sensor can sense ambient brightness. When a disabled person puts on the shoes and the sky is dark, signal is transmitted to the circuit board to turn on the LED lights. This design addresses aesthetic and safety issues for disabled persons.

This study carried out the creative idea, applied for the R.O.C. utility patent, and participated in the iENVEX. iENVEX was held by University Malaysia Perlis (UniMAP). The department of design in this university is very famous. Students who graduated from this department are often thought highly by companies in Malaysia and Singapore. A lot of them have also continued their study in the UK. This international exhibition was very suitable for the students to participate with guidance from the teacher. In the exhibition, there were students from all over the world, exchanging their views and experiences. This was also a good opportunity to promote creative inventions and a good training to improve the students' ability of expression using a foreign language. Moreover, the target participants of the iENVEX are mainly students from elementary schools, high schools, vocational schools, universities, and graduate schools, aged 6 to 25. The purpose is to develop a climate of research and invention among students, in hopes that students can invent products based on what they have learned from school. iENVEX is a stage for young creators and scientists to present and share their creative ideas, offering good opportunities of exposure of newly invented technologies from various fields, attracting related companies to build business relationships.

4. DESIGN RESULTS

One of the members of the creative team suffers from LLD. Her own encounters with walking inconveniences was provided as an important reference for research and design of this article. Eventually, a custom tailored sole structure that can be installed on the favored sole of the disabled person was proposed. This not only solves issues regarding walking safety but also meets the basic aesthetic requirement for shoes (figure 1). This study carried out the creative idea, and not only applied for the ROC utility patent (figure 2) but also participated in the iENVEX (figure 3), where it won the bronze medal (figure 4) and the Korea Special Award (figure 5).

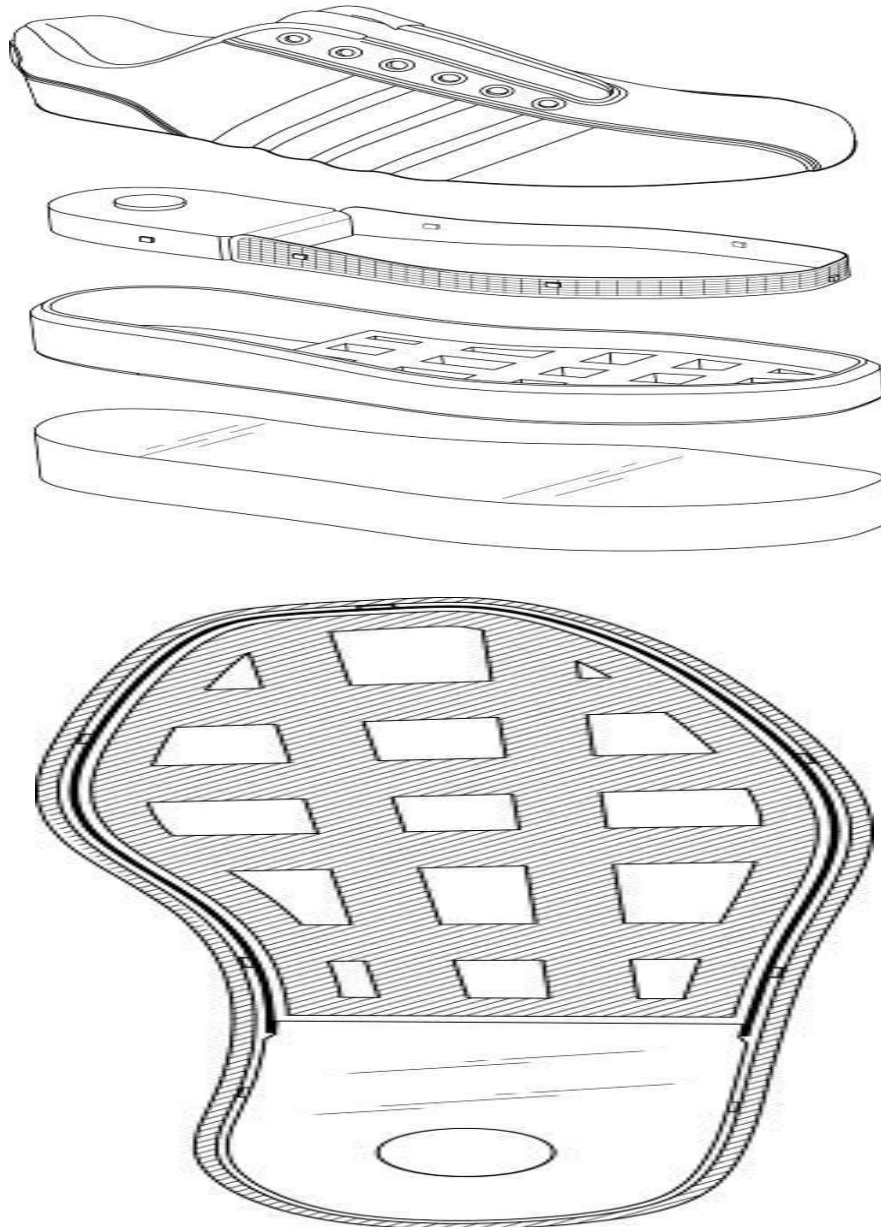




Figure 1: The appearance of the innovative product

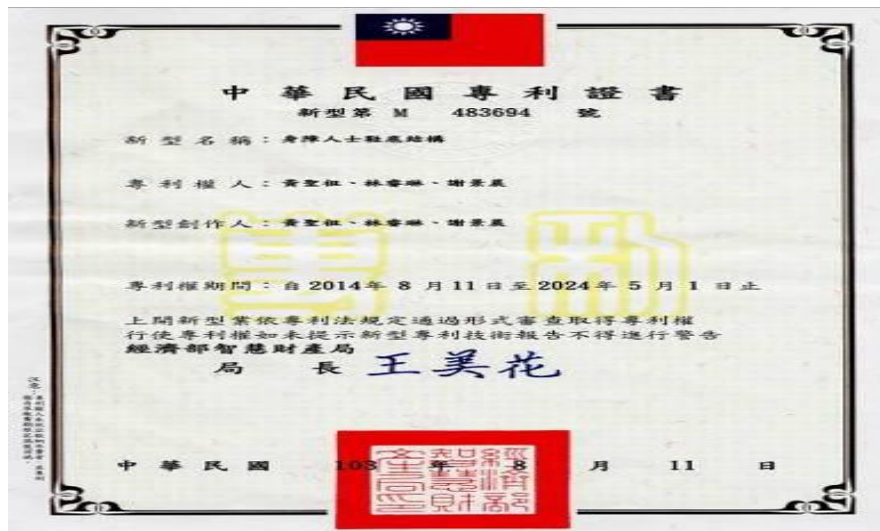


Figure 2: Utility patent



Figure 3: Poster design



Figure 4: Bronze medal



Figure 5: Special work

5. CONCLUSIONS

In general, the results for the innovative research and development of this study are summarized and illustrated below:

- a) A sole structural design that can be a custom-made to the desired height was provided to disabled persons to help them balance when walking and give an aesthetic effect.
- b) LED lights were used as prompters to help them see the road and provide security and dignity while walking.
- c) The innovative idea behind this creative sole structure design can be supplied to related industries as reference for production.
- d) If there are companies willing to customize or mass produce, it is recommended that online marketing be used as sales channel.

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