A MODERN APPLICATION FOR CUSTOMIZED FOOTWEAR DESIGN

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The aim of this article is to present a modern application for customized footwear design using MindCAD software. These CAD systems are the next generation of design solutions and engineering for the footwear industry. Designed entirely for use with modern operating systems and environments, it provides a full range of instruments, intuitive and easy to use. 3D computer aided design techniques (3D CAD) enables direct modelling of footwear on the last, so even before the product is fabricated, it can be analysed in terms of visual, functional, industrial and financial criteria. Starting with a shoe last (digitized, scanned or from database), it can quickly be designed a complete footwear model, in any colour or material combination. The result is a 3D realistic view of the product, ideal for presenting it to the buyers, customers or producers.

Keywords: computer aided-design, shoe last, footwear design, 3D modelling

INTRODUCTION

The foot is the interface between the body and the ground, opposes both static and dynamic compression and considerable shear forces. Its protection is assured by the particular architecture. Plantar aspect of the heel and foot arches are the main weight-bearing structures (Biga, 2009).

During walking, the foot plays the role of a flexible shock absorption system, deforming on uneven surfaces before undergoing through a series of biomechanical changes that allows it to act as a rigid lever of force (Dawe and Davis, 2011; Kitaoka, 2008).

Elements such as toe cap shape, sole and heel shape and dimensions should be taken into consideration in order to solve the main problem of static and dynamic foot pathologies.

CAD (Computer Aided Design) systems should be as discrete as possible so that an engineer can concentrate on what it designs and not on the interface or system procedures that are to be used. For many years, the main purpose of CAD software manufacturers was growth and development of parameters and geometric characteristics. But lately, it has been introduced an intuitive approach called direct modelling. It was originally designed for conceptual design and architectural planning, but direct modelling successfully integrates commercial packages for various industries. Direct modelling allows the user to intuitively select and manipulate real-time geometric entities (Fiorentino *et al.*, 2010).

Consumers' requirements focus more on comfort and functionality in terms of shoes, making these features to be important considerations for modelling, designing and evaluating the footwear (Rupérez *et al.*, 2010).

The shoe last, a 3D instrument used to design and produce the footwear, influences the shape and size of the shoe. Current software design or process focuses mainly on reverse engineering and modification of existing lasts (Drsicu and Costea, 2013; Costea and Mihai, 2013; Vasilescu *et al.*, 2012).

3D scanning technologies and CAD solutions, recently developed, allow reconsidering the design process of lasts, and providing useful tools for designing customized footwear (Sikyung *et al.*, 2007).

Product performance can be assessed based of its functions (the product works as designed), its shape (aesthetic) and its fits (purpose). The shape follows function in case of bare feet, but for many consumers, the dimensional comfort can govern function and therefore, being an important criteria. In traditional applications of mechanical engineering, there are different types of matching according to function.

METHOD

Footwear role in ensuring correct body posture and balance condition during static or dynamic phase requires the study of ergonomic factors in product design. It is applying a new design concept, footwear product should reflect the normal anatomical and functional state on the foot and gives a natural feeling of barefoot walking.

In shoe modelling and design activities a series steps have to be followed, which must fulfil the footwear criteria, namely: aesthetic, functional, economic and technological. Current 3D CAD systems enables direct modelling of shoe last, so that even before the producers made the product, it can be analyzed in terms of these criteria.

MindCAD is the perfect solution for the product designer and engineer, offering a balanced mix of creative and technical 2D and 3D CAD tools (Mindtech).

The unique and innovative features of MindCAD solutions contribute decisively to your effectiveness and productivity.

MindCAD SOLUTIONS

- 3D Design & Engineering for Footwear
- 3D Viewer
- 2D Design & Engineering for Footwear
- 2D Design & Engineering for Luggage
- 2D Design & Engineering for Automotive
- 2D Design & Engineering for Furniture

Main features of MindCAD 3D Design & Engineering for Footwear are:

- Last digitizing and editing (see in figure 1)
- Sketch style lines (see in figure 2)
- 3D upper part modelling (see in figure 3)
- Sole modelling (see in figure 4)

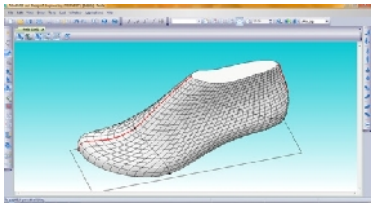


Figure 1. Last digitizing and editing

Figure 2. Sketch style lines

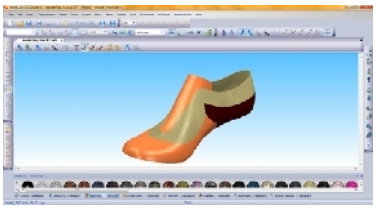


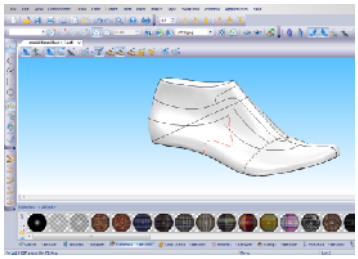
Figure 3. 3D upper part modelling

Figure 4. Sole modelling

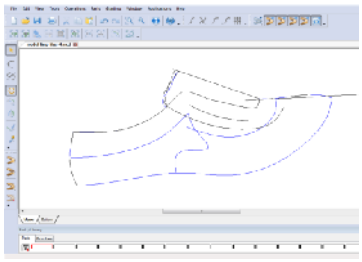
Starting with a last, it can be rapidly designed a complete footwear model, in any colour or texture combination (Pastina *et al.*, 2011, Pastina and Mihai, 2011). The result is a 3D realistic view of the product, ideal for presenting it to the customers, buyers or producers.

The main advantages of MindCAD compared to other software applications are:

- An intuitive interface that allows the user to work in a productive way
- The interaction in real time with the design (see in figure 7)
- A realistic representation of the product (see in figure 4)
- The integration between 3D and 2D applications: for example, a change made in 3D reflects in 2D in the same time and also form 2D to 3D (see in figure 5 a and b)
- The instruments, the way of using it, the interface, are similar from 3D to 2D, so the user doesn't have to learn how to use 2 applications (see in figure 7)
- The software producers stay in touch with all their partners and clients form industry and schools, so the software benefits from their feedback
- A precise method of patterns grading and a full range of size numbers that can be obtained (see in figure 8)



a



b

Figure 5. a, b. Integration between 3D and 2D

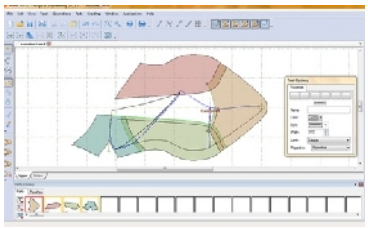


Figure 7. 2D patterns design

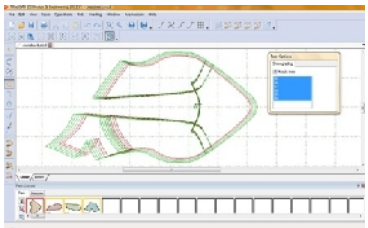


Figure 8. Pattern grading

CONCLUSIONS

CAD / CAM revolutionary systems solutions represent the next generation of computer-aided design and engineering in the shoe industry. Unlike manual methods for retrieving foot measurements and shoe design, the development of current systems allow designing different models according to feet structure. There are used procedures and techniques that were not possible in the case of manual methods, such as 3D scanning and 3D modelling, 3D viewing, automatic analysis of forms, extracting and interpreting patterns.

Dimensional correspondence of the foot with the shoe size (length, width, circumference, height) is a very important requirement to ensure dimensional comfort. To ensure this requirement, the shoe must be designed and produced in order to allow the foot to function normally without severe constraints, both in static and dynamic conditions.

The main advantages of using MindCAD: reduces the number of physical samples; a fast way to design a product; modifying operation directly on the model; applying or eliminating new components; model visualization from different angles by interactively rotating the last.

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