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Interactive complex spatial graphic structures in electronic manuals

Interaktywne złożone przestrzenne obiekty graficzne w podręcznikach elektronicznych

Key words: innovative technologies and materials, footwear, clothes, multimedia education technologies, three-dimensional images, IT environment, web applications, preparation stages, electronic textbook.

Słowa kluczowe: innowacyjne technologie i materiały, obuwie, odzież, multimedialne technologie kształcenia, trójwymiarowe obiekty, środowisko informatyczne, web-aplikacje, etapy opracowania, elektroniczny podręcznik.

Streszczenie
Przedstawiono podstawowe trendy rozwoju innowacyjnych technologii wytwarzania materiałów, obuwia, odzieży głównie poprzez elektronizację i stosowanie technologii informatycznych. Rozwój technologii informatycznych umożliwia zastosowanie w kształceniu specjalistów obuwnictwa i odzieżownictwa nowych mulimediów w procesie projektowania i symulacji wytwarzania, użytkowania, funkcjonowania stawów, kończyn człowieka. Przytoczono przykład funkcjonowania i przedstawienia stopy w nauczaniu antropologicznych i biomechanicznych podstaw konstruowania obuwia w e-podręczniku.

Introduction

The complexity of our anatomy, individual and not only age-related differentiation causes difficulties while designing technically complex objects as clothes and shoes in their variety of models, shapes and size. Clothes and footwear are used in very different conditions (time, temperature, humidity). It creates problems with automation and robotics which results in maintaining many elements of technology and work organization typical of the craftsmanship. Nowadays when we are planning technologies and materials via foresight research, it is justified to set questions concerning the influence of innovative revolutionary IT designing techniques on preparation of modern methods to train specialists in shoemaking and clothes manufacturing. We are presenting an example of modeling a three-

dimensional complex structure – the foot. This article was prepared jointly by Moscow State University of Design and Technology (a grant from the Ministry of Education and Science of the Russian Federation) with Kazimierz Pułaski Technical Uniwersity of Radom (EQUAL – Entrepreneurship in the net. Internet as an opportunity for the growth of entrepreneurship).

Innovative materials and technologies in production of footwear and clothes, education of specialists

Irrespective of existence of many substitutes and processing technologies, leather, natural fibers still remain incomparable materials guarantying the highest comfort of using clothes and footwear.

Nevertheless, even leather and natural fibers require in production and processing the modification, mainly of the inner surface (permeability) and the outer surface (protection) as well as the improvement of materials biocidal properties and metabolic processes stabilisation (Pawłowa, 2012).

New technical possibilities enable to meet the challenges related to the development and improvement of materials properties (a wider application), application of electronics and IT tools and the clothes and footwear individualisation and personalisation.

New properties of leather and textiles are generated by new nanotechnologies, having influence on the materials nanostructure in its entire volume (Pawłowa, Bereznienko, 2011) or the inner and outer surface, e.g. “cold plasma” and “lotus effect” (Tyczkowski, 1990, Shishoo, 2007).

Similar techniques of physical and chemical modifications are applied in order to improve utility properties, comfort of using clothes and footwear, or their elements produces from synthetic polymers, new hybrid composites.

Improved are: materials, technologies of materials cut-out (lasers), joining of clothes and footwear elements: New glues, high-frequency currents, cold plasma etc.

It gives enormous possibilities in production specials footwear and clothes mainly with protective properties related to radiation and sanitary risks or even made especially for (filtration, environment protection) medical purposes etc.

Due to the main idea of this article, we are going to pay special attention to revolutionary changes which incorporated IT technologies in anthropological measurements, designing, improvement of technologies and management, production organisation, distribution, commerce and relations with customers.

The development of electronics enables to use digital printing, optoelectronics, piezo-electronics, applying sensors, textronic technologies to produce materials applied in health and environment protection as well as Radio Freuquency Identyfication textiles monitoring. (Pawłowa, 2012, Teodorczyk, 2004).

The development of IT technology, scan techniques is useful for individualised measurements and designing personification with application of 3D techniques. (Fan, 2004, Nell Rosenbaum, 2006).

Such wide application of IT technologies facilitates using multimedia during the education and vocational training of specialists in production of footwear and clothes. It forms the base for new methods of e-learning.

New innovative education technologies make it indispensable to prepare new didactic tools, inter alia, e-textbooks with 3D models of complex structures. (Bednorz, 2009).

Three-dimensional objects modeling

Essentially new quality brought about by computer technologies in educational process is the interactivity urged to develop active and activity forms of education and to hope for really effective, useful independent work.

One of the most complex publications is mathematical modeling of three-dimension objects (Wójcicki 2010, Bohem, Proutzsh 1994).

In this article the general approach is the solution of a task of development of the electronic textbook on discipline "Applied anatomy and biomechanics", the preparation studied by students on specialties and faculties "Technology of products of light industry" and "Designing of products of light industry".

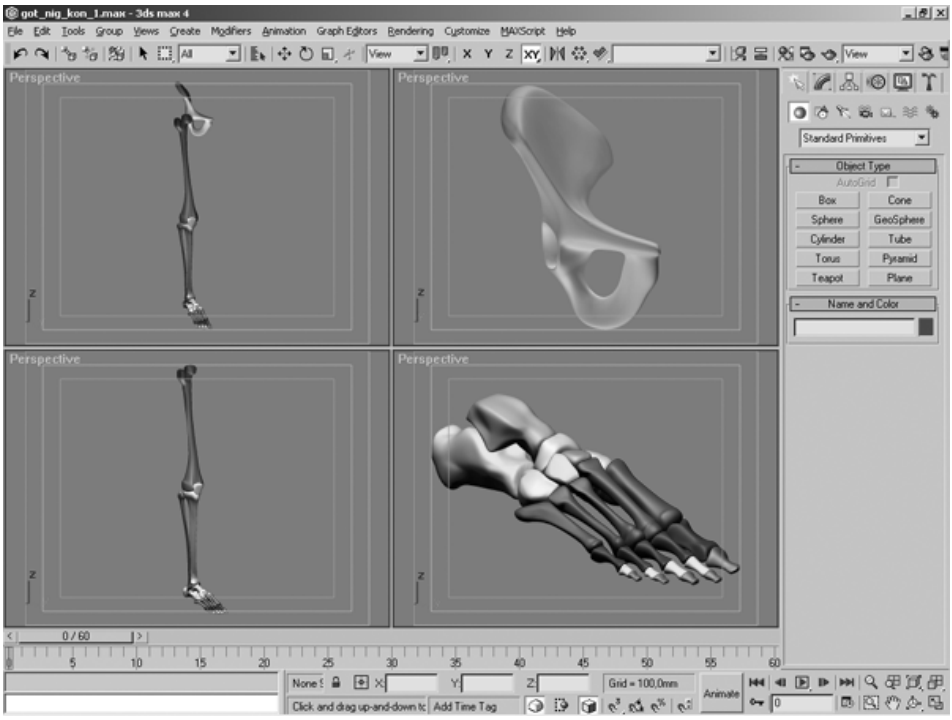
At implementation of this task various IT environments, among them can be used: creation of a manual in the environment of the program for a flash - animations of Macromedia Flash MX; other option – creation of the Internet appendix by means of Macromedia DreamWeaver MX; the third – to involve the programming system like Visual Basic or similar for creation of software products.

The textbook offered by us is created in the form of a web application. The manual in the form of a web application has to answer a high level of quality, both at the substantial level, and at the level of visualization. For this purpose it is necessary to define accurate structure and the scenario of actions. In our case the whole process of creation of the manual consists of four stages.

We will consider each separate stage of an application creation below. Application programming begins with modeling of the three-dimensional image of the lower limb in the software package of three-dimensional modeling 3ds MAX of AutoDesk firm. On the basis of the designed general three-dimensional model four independent graphic objects were created: model of the lower limb, model of a pelvic bone, model of a free lower limb and model of foot. In figure 1 it is shown how the models created 3ds by MAX look. After all four models are prepared, they need to be presented to the user. For expansion of opportunities of the standard version 3ds MAX as the additional module we used "Cebas MAXVR QT.

The model operates as follows: after setting the rotation range of the object, then the steps of the rotation on the horizontal and vertical axes, the rendering process begins. All received images serially register in the file with the MOV expansion, to see which it is possible by means of the Quick Time video player. The three-dimensional model of foot turns on 360z round horizontal and vertical axes, the angle of rotation thus for both axes makes all 7,8z.

Models of the lower limb, pelvic bone and free lower limb rotate only round a vertical axis. They can deviate a horizontal axis on 60z, thus the angle of rotation round a horizontal axis makes 6z, and round vertical – 7,8z. Incomplete rotation round a horizontal axis is made in order that during rotation these models kept the natural vertical orientation. But even such incomplete rotation doesn't prevent to consider these models in all their aspects.



Picture 1. Three-dimensional model four independent graphic objects were created: model of the lower limb, model

At the following stage the theoretical part of the appendix is formed. By results of the analysis of literature on subject of the developed manual as a basis on structure and a way of a statement of material we chose the textbook for higher education institutions "Anthropological and biomechanical bases of designing of products from skin". (Kochetkova, Klyuchnikova, 1991)

All information on this course which was available for us was adapted taking into account that disabled people can be trained. At the third development stage applications are created drawings which it is planned to place directly in the text. The quantity of drawings and their visual aspect are connected with the correct associative perception of material. For descriptive reasons each department of the lower limb and each bone is followed by two drawings.

In certain cases it is the front view and from outer side (the lower limb), in some – the front view and behind (hip), from above and from outer side (foot), and also the bottom view and from the inside (navicular bones). It is known that at the person the color perception is very well developed. Therefore each bone has the individual color. In this case the effect of colour spots takes place. It is made in order that in storing of material took part colour association. In our opinion, multi-colored bones are perceived better, than one-colour, Colours for bones of the lower limb were selected so that they well visually differed from each other and each separate colour wouldn't draw special attention, being an irritant, i.e. each separately taken colour has to be equivalent in colour composition.

To allocate a certain part of the lower limb, it was in the central part of drawing so that it occupied its main part. All fragments, except for those under consideration, are made translucent that distinguishes it from others even more. Separate bones in fragments, except for those considered have not continuous, but mesh filling. In figure 2 the way of allocation of one part from others on the example of ankle bones is shown.

Separate elements in drawings which need special attention, are explained by means of their names or numbering which is deciphered directly under drawings or in text part of the appendix. Also at this stage the minimised copies of models both in the form of usual images, and in the form of GIF animations were created. For this purpose in the program 3ds MAX 60 static photos with a turn step 6z for turn of model on 354z were made. Then these 60 separate frames by means of the program for GIF animation of GIF Construction Set (32-bit) 1.0Q were united in one GIF file. Thus the animation roller with the rotating models was created.

Colours in electronic objects modeling

Minimised copies of models are placed on pages with appropriate descriptions and indicate to a student which model they can choose.

After having prepared texts and graphics the fourth stage, i.e. the creation of WEB pages started. It was decided to prepare an e-manual on the basis of frameworks. In order to prepare the background a drawing with relief facture was applied. It allowed compiling unicolour models on the esthetic background.

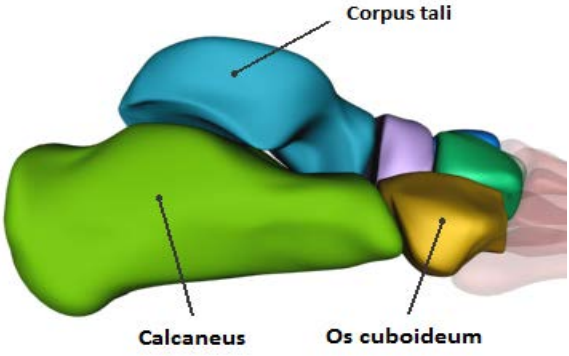
We paid attention mainly to colours preferred by people, the impact of the colour on a human-being, his psychical condition, reactions and associations.

It is necessary to underline that the perception, reaction to the colour definitely varies. It depends on the mood, psychical condition. The perception, the reaction to the same colour is bound to be and it really is different. Therefore, while choosing the colour we may take into consideration the average meaning of defined preferences. Out of all analysed colours in many publications as the most useful for our manual we have chosen yellow and green in many shades.

It is known that green and yellow colors draw special attention, allow concentrating better, are calming and nonaggressive, disseminate negative emotions,

and positively influence adequate power consumption. It has essential value when training disables people.

At a choice of a background about hundred various color combinations are approved and, eventually, as color scale was chose a beige shade, i.e. a combination of white, yellow and brown colours. Such background doesn't distract, doesn't irritate, letters are well visible and at the same time they aren't presented with the increased sharpness. The page can be read both at good (day) and at bad (night) lighting, eyes aren't tired because its brightness and contrast are balanced among themselves and are in admissible limits. All allocations and links are well looked through, but don't distract from the text.



Picture 2. Allocation of one department from others on the example of predplusnevy department is shown

This e-textbook is developed in two forms – for distribution on storage media and on the Internet.

Summary

Here we have presented an example of the foot visualisation as an introductory element to analyse mechanics and to design footwear forms and elements. The electronic form of the textbook and its availability on the internet facilitates its access to students as well as doing exercises and independent studying available anatomic models.

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