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CREATION CLOTHING PRODUCTS PATTERNS WITH THE HELP OF A MANNEQUIN FOR CLOTHING DESIGN

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Abstract: *These The industrial manufacturing of clothing products involves obtaining, with great flexibility and speed, the patterns necessary to make the products. Now, nowadays, it is possible to draw them with the help of computing techniques, through software dedicated to this design process. Considering these aspects, what is wanted in this paper is to carry out, with the help of a dimensionally adjustable mannequin and with the help of a high-performance apparatus for taking and processing photographed images, a study through which the mannequin is obtained virtual. In this way, as many anthropometric measurements as possible were used on people with different shapes and sizes, so that the creation of mannequins for fashion design and then the construction of patterns for the various clothing products could ensure consumer demand. This virtual mannequin was created starting from the knowledge about the anatomical structure of the human body and especially its external shape, and after researching the possibilities of geometric modeling of curves and surfaces, it was possible to obtain the complex shapes of the human body. The work aims to create a virtual mannequin for clothing design, whose shapes and sizes can change depending on the dimensional typology of the population. In the end, it was passed to the computerized obtaining of the patterns for the clothing products.*

Key words: *virtual, 3D shapes, mannequin, pattern, clothing, AutoCad*

1. INTRODUCTION

In the conventional technology of obtaining clothing products, they are made from a different number of pieces, cut from flat materials and assembled by different processes. The fundamental problem of clothing construction is the adaptation of flat textile structures to the irregular shape of the human body and solving this problem conditions the correct position of the product on the body and its functionality. Patterns represent the unfolded planes of the landmarks of the clothing products, whose shape and dimensions must be correlated with the shape and dimensions of the human body.

The classical method of pattern construction, still widely used, is the geometric method, the method that is the basis of pattern construction and modern methods, based on the calculation technique. In the geometric method, the construction of patterns is performed based on information about the dimensions of the human body and the size of the additions corresponding to the type of product being designed. In construction, one starts from a limited number of main dimensions of the type of body, and the other secondary dimensions are calculated based on some relationships, mostly proportional, relationships that differ according to the authors of the different variants of the method, which is a disadvantage. Another disadvantage, from the point of view of calculations, is the gradation of the patterns, obtaining the patterns for the entire dimensional range in which a clothing product is made [1].

2. METHODS OF CREATING PATTERNS WITH AN ADJUSTABLE MANNEQUIN ASSOCIATED WITH THE COMPUTER

A faster and easier way to make patterns for clothing products is to use the InSpeck Halfbody machine together with the software attached to this machine and with the parallel use of the AutoCad software. To better understand how the InSpeck Halfbody device works, a brief description of this device and its operating principle will be made in the following.[2]

Carrying out the actual investigation, i.e. taking images for the purpose of 3D reconstruction of the surface of interest, requires a special space, which fulfills a series of conditions regarding the dimensions, shape, lighting characteristics, as well as facilities regarding the electricity supply.

The InSpeck system, in various configurations (1 to 4 cameras) is intended for 3D digitization. The 3D digitization technique allows obtaining a three-dimensional copy of a certain physical surface. In the optical digitization process, each camera takes an image consisting of a set of level surfaces, from different angles. The separate images are connected at predetermined points so that a total field angle of 360 degrees is ensured by soft processing. The retrieved images partially overlap so that they contain the preset connection points. The InSpeck technique allows not only the reconstruction of the shape, but also the rendering of the color and texture of the target surfaces.

***Fig. 1**: 3D Mega Capturer II camera*

The content and location of the InSpeck Halfbody device is presented in the following:

- 3 rooms. The cameras used are of the 3D Mega Capturer II type with support, as in the image in **Fig.1**, they are composed, and in addition to the camera itself, it also includes a vertical support with a guide for translational movement and a camera locking mechanism in the position established to satisfy the condition of optical alignment, as well as a support - sole for supporting and fixing the other elements;

- a PC for data retrieval and access processing (**Fig. 2**).

- a closed enclosure with professional lighting for placing the cameras in a position established by the manufacturer, and this placement is done as in the image in **Fig.3**.

Fig. 2*: PC for data acquisition and processing*

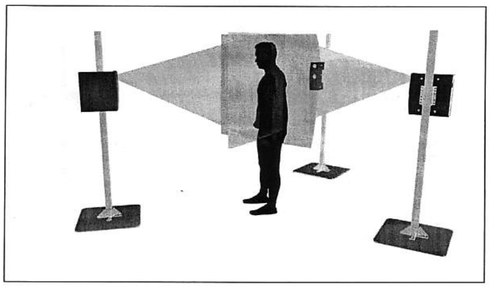


Fig. 3*: Premises for the location of the rooms*

The operating method of the InSpeck Halfbody device uses the imaging investigation technique together with specific software applications: FAPS (Fringe Acquisition and Processing Software) and EM (Editing and Merging). Their installation follows the installation of the drivers for the three digital cameras. The FAPS program identifies the three cameras that it will recognize during all subsequent uses based on the serial numbers written by the manufacturer on the camera housing. To determine such images with digitized physical surfaces, considering that the image acquisition is done optically, it is very important to calibrate the acquisition system, an operation that generates residual information throughout the use of FAPS and EM [3].

3. CALIBRATION OF DATA ACQUISITION EQUIPMENT

Calibration represents a procedure of relating, on a given domain, between the coordinates measured by a device and the coordinates accepted in a standard reference system.

In the case of the InSpeck acquisition system, the cameras take one image from the real space from three conical perspectives with concurrent axes, and the coordinates of these perspectives must be transformed into coordinates related to a Euclidean system. This operation ensures the virtual reconstruction of the real surface at a level of similarity that satisfies a submillimeter precision condition.

For calibration, in principle, any shape can be used, provided that its characteristic points have known coordinates. The InSpeck supplier delivers with the equipment a panel with holes placed at calibrated distances (**Fig. 4**).

For the acquisition of the images, it is necessary that the ambient lighting be sufficiently uniform so as not to introduce stray shadows.

Fig. 4*: Panel with holes placed at calibrated distances*

4. MANNEQUIN IMAGE PROCESSING

With the help of FAPS, the images are acquired by the three cameras in the system and separate files related to each image are generated.

The study is carried out on the adjustable mannequin, whose three main perimeters can be dimensioned: Pb (bust perimeter), Pt (waist perimeter) and Pş (hip perimeter), according to anthropometric standards and according to the dimensional range in which we want to make a clothing product.

The preparation of the mannequin for this study consists in fixing some adhesive tapes on its surface, so that the tapes follow the main contour lines of the body, necessary for making the patterns.

Thus, the following were followed: the line of symmetry of the face, the line of the cut of the neck to the front, the line of the cut of the sleeve to the front, the line of symmetry of the back, the line of the cut of the neck to the back, the line of the cut of the sleeve to the back, the assembly line of the face to the back, as well as the main width sizing lines of the patterns (bust line, waist line and hip line).

After fixing the strips, the anthropometric points specific to the construction of the patterns are positioned, as well as the control points necessary for taking and processing the images [4].

The following figures (**Fig. 5**; **Fig. 6**; **Fig. 7**) show the images of the mannequin, as they are to be used for the 3D reconstruction in a single image.

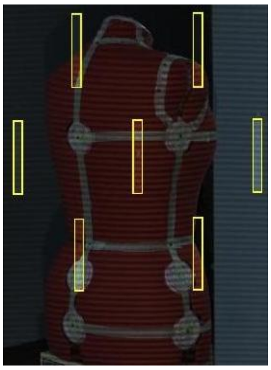


Fig. 5: *Mannequin image provided by camera 1*

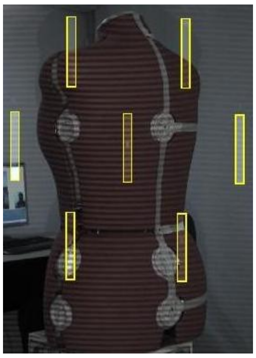


Fig. 6*: Mannequin image provided by camera 2*

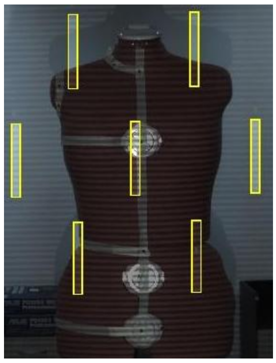


Fig. 7*: Mannequin image provided by camera 3*

5. EDITING AND PROCESSING OF PURCHASED IMAGES

In addition to the acquisition of images, the FAPS program also offers the possibility of editing and processing them.

Several ways of editing and processing the acquired images to obtain the 3D model in EM are explained in the following observations.

1. After the images have been purchased, proceed to their processing by cutting out the area of interest, i.e. the mannequin. Cutting out the area of interest is done with the help of some tools of the FAPS program menu, this is done according to the following algorithm:

- select the cropping tool of the image of interest from the menu, then enlarge the image to achieve the best possible cropping.
- after choosing the area of interest, proceed to the actual cutting, which looks like the figures in the following images (**Fig.8, Fig.9, Fig.10**).

Fig. 8*: Image 1 of the mannequin, provided by camera 1 and processed*

Fig. 9*: Image 2 of the mannequin, provided by camera 2 and processed*

Fig. 10*: Image 3 of the mannequin, provided by camera 3 and processed*

2. After cutting out the area of interest, proceed to a new stage of image processing. This consists in the appearance of a parallax image in which only the area of interest appears with the calibration points where an X is located, and if this X does not appear, it means that the marked area has an error that must be repaired. This error may be due to improper cropping. To solve this problem, the manufacturer and the staff who use this equipment suggest in this case a move of the points, which appear on the outline of the img3 mannequin, to another defining position (**Fig.11**).

3. The following images represent the area of interest, the area that will be exported in EM to make the 3D model [5].

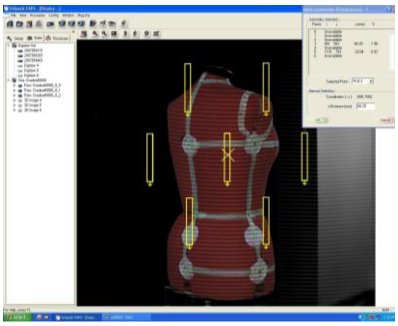


Fig. 11*: Image with the area where the X is must be an area on the mannequin*

After the images have been processed in FAPS, the aim is to create the model in EM (**Fig. 12**). As in FAPS and EM, there are a series of stages that must be completed to reach the 3D model from which the data will be taken to make the patterns of the clothing products.

The EM processing program presents the following facilities:

- opening and viewing 3D models
- correcting model defects (closing gaps, cutting overlaps)
- selection of some polygonal shapes
- editing models
- scaling
- creating symmetrical models
- interpolations
- measuring distances

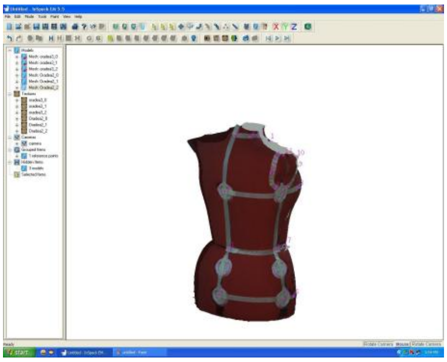
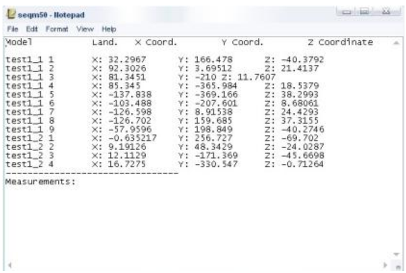


Fig. 12*: Image of the graphical interface of the EM program*

6. EXPERIMENTAL RESULTS

In EM, after creating the 3D model, with the help of the 3 images processed in FAPS and by calibrating them in EM with the help of a calibration matrix, the next step is to mark the points of interest on the mannequin and through this marking I get the coordinates of the points on the mannequin, coordinates that will be saved in files created in EM that can be exported to various other software, which allow more complex numerical determinations, but easy to perform.

In this case, saving is done in "txt" format, a format that looks like the image in **Fig.13**.



```
seqm50 - Notepad
File  Edit  Format  View  Help
Model          Land.   X Coord.        Y Coord.        Z Coordinate

test1_1 1      X: 32.2967      Y: 166.478      Z: -40.3792
test1_1 2      X: 92.3026      Y: 3.69512      Z: 21.4137
test1_1 3      X: 81.3451      Y: -210 Z: 11.7607
test1_1 4      X: 85.345       Y: -365.984     Z: 18.5379
test1_1 5      X: -137.838     Y: -369.166     Z: 38.2993
test1_1 6      X: -103.488     Y: -207.601     Z: 8.68061
test1_1 7      X: -126.598     Y: 8.91538      Z: 24.4293
test1_1 8      X: -126.702     Y: 159.685      Z: 37.3155
test1_1 9      X: -57.9596     Y: 198.849      Z: -40.2746
test1_2 1      X: -0.635217    Y: 256.727      Z: -69.702
test1_2 2      X: 9.19126      Y: 48.3429      Z: -24.0287
test1_2 3      X: 12.1129      Y: -171.369     Z: -45.6698
test1_2 4      X: 16.7275      Y: -330.547     Z: -0.71264
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Measurements:
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Fig. 13*: Image of the "txt" file with the coordinates of the points extracted from EM*

A special procedure is required to perform this rescue, following certain steps, namely:

- after opening the marking tool within the EM program and selecting the points of interest, a save is made by the name of the file with the ending "txt".
- after finishing this procedure, open the "txt" file from the folder where it was saved and proceed to the next step, namely entering the coordinates in AutoCad.

The AutoCad program is a 2D or 3D design software that has a series of tools for making different drawings, and in this case, as it is about patterns for clothing products, they will be made with the help of the program. In AutoCad, the coordinates of each point are manually entered in the command line and a series of points in a 2D space is obtained, based on the coordinates entered in the command line.

After entering the points in AutoCad, select the "line" from the tools menu and join the points with it. In order for the pattern to be complete and usable, the points are joined together with lines, thus obtaining patterns for the front and back respectively of the clothing product, and with the help of the AutoCad program, its scale can be increased or decreased (**Fig. 14**).

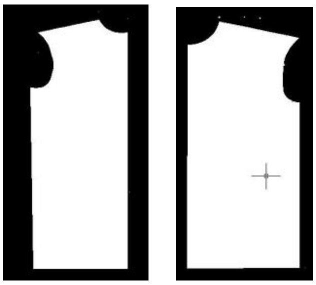

Fig. 14*: The images of the back and front patterns, processed in AutoCad*

Another possibility that the AutoCad program offers for obtaining the best possible pattern is to fill the area of the template with a solid shape and thus be able to plot the template, and the result obtained being a template that can be used immediately [6-7].

Both the front of the template and the back were made in AutoCad at a scale of 1:5, a scale that could not be maintained in word format, but by directly plotting the template in AutoCad the desired size is obtained. Following the processing of the patterns and the corrections made to the characteristic points on their outline, the images in **Fig.15** will be obtained.

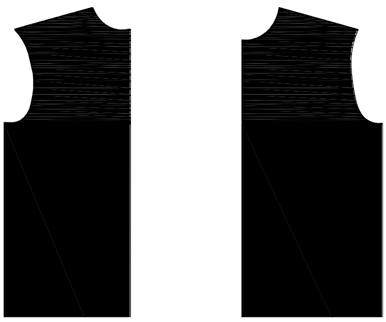

Fig. 15*: The images with back and front patterns, processed in AutoCad, made on a scale of 1:5*

7. CONCLUSIONS

This paper aims to use up to 3 different sizes during the mannequin measurement operation. Each size taken requires a new sizing of the mannequin, which being adjustable makes this easy. The steps to get all the patterns involve the same methods shown previously.

To make the models of the clothing products, the front and back marks are completed by introducing lightness additions, necessary for freedom of movement and breathing, or additions dictated by fashion, depending on the silhouette of the product and the desired model.

This new method of creating models for clothing products, in a wide range of sizes, with the help of the adjustable mannequin, requires some improvements, which, once achieved, will considerably facilitate the construction of the models and will represent a real advance for the textile industry.

REFERENCES

[1] A. Albu, T. Caciora, Z. Berdenov, D. C. Ilieş, B. Sturzu, D. Sopota, G. V. Herman, A. Ilieş, G. Olah, “Digitalization of garment in the context of circular economy,” Industria Textila, vol. 72, no. 1, pp. 102–107, 2021. DOI: 10.35530/IT.072.01.1824.

[2] D. C. Ilieş, C. Lite, L. Indrie, C. Moş, A. Ilieş, M. Ropa, B. Sturzu, A. Sambou, A. Axinte, A. Albu, P. Szabo-Alexi, M. Costea, G. V. Herman, “Researches for the conservation of cultural heritage in the context of the circular economy,” Industria Textila, vol. 72, no. 1, pp. 50–54, 2021. DOI: 10.35530/IT.072.01.1807.

[3] E. Codău, Inginerie generală în textile – pielărie: îndrumar de laborator. Iași: Editura Performantica, 2019, pp. 68–82.

[4] Capture 3D. [Online]. Available: https://www.capture3d.com/

[5] iStock, “Half body illustrations.” [Online]. Available: https://www.istockphoto.com/ro/ilustra%C8%9Bii/half-body

[6] Autodesk, “3D CAD Software.” [Online]. Available: https://www.autodesk.com/solutions/3d-cad-software

[7] E. Pintilie, G. Ciubotaru, and M. Avadanei, Proiectarea confecţiilor textile asistată de calculator. Iași: Editura Performantica, 2006, pp. 82–93.

[8] E. Filipescu, Construcția și modelarea îmbrăcămintei – Îndrumar de laborator. Iași: Editura Performantica, 2013, pp. 36–93.

[9] E. Filipescu, Structura şi proiectarea confecţiilor textile. Iași: Editura Performantica, 2013, pp. 65–87.