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Ethical Praxis in Body Scanning: An Experimental Study into 3D Laser Scanning in Fashion and Textiles/Surface Design


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Overview of the presentation

• Background

• Introduction to experimental laser scan study

• 3D laser scanner + 3D software

• Ethical approach to scanning male and female bodies

• Pre-test methods

• Methods for 3D body scanning experiment

• Analysis of data

• Results + Conclusions
Aim of the study:

informed by review of literature

- The aim of the study focuses on the evaluation and testing of the 3D scanner and 3D scanner software to understand the value and methods of integrating the 3D laser scanner with 3D CG/CAD software, to extend the research into the areas of wearable technologies.


- 3D fashion researchers at London College of Fashion are exploring collaborative interdisciplinary projects using 3D technologies and smart clothing/products. Marks (2005), University of the Arts (2005). Specific application of 3D body scanning as a tool for improved construction of smart clothing is described by Nam, et al; (2005). The group use a 3D body scanner to test the fit of Liquid Cooled vests currently worn by astronauts, firefighters, and pilots. The analysis of 3D scan data results will assist in the development of improved fitting functional garments, for a wider performance clothing market in the future.
Objectives of the study

1. To evaluate 3D Laser scanner in fashion education

2. To body scan a sample group of students

3. To introduce ethical approaches to scanning bodies

4. To develop new methods for integrating 3D body data
Future Prediction: 3D Body Measurement Systems

• “3D measurement systems will permit inversion of real objects back to CAD models, creating an explosion of custom fit, ergonomically optimised goods, exact replacement parts, and perfect replicas.”
  
3D body Scanning and fit software
original research and developers of high performance fitted clothing
by government military research. Ethical issues.
3D Whole Body Laser scanner & services:
Offers data protection, private changing and specialist service and body scan suits
New Results Indicate \([TC]^2\)

3D Body Scanning Measures have Very High Correlation to Body Fat Composition from DEXA Scanning

By Dr. David Bruner, \([TC]^2\)
http://www.tc2.com/
Body scan data can be imported into OptiTex 3D for pattern design, textiles design visualisation.
high street retailers offer clothes in standard sizes: s, M, L = 8, 10, 12 ,14, 16 ..... 

consumer often has difficulties with body awareness and finding clothes to fit well

“But now, U.S. shoppers can say goodbye to saggy behinds and waists that ride up, as Bodymetrics has made its way stateside, via a partnership with digital agency Razorfish and use of Microsoft's Kinect.”

By Shareen Pathak. Published on March 22, 2012
1st U.S. Bodymetrics Pod Brings Body Scanning Tech to Bloomingdale’s

Posted on August 13, 2012 by Lorraine Sanders in Digital Style News, Fitting Technology, Shopping | 1 Comment
The U.S. Bodymetrics Pod, comes in two versions, one for the home and one for retail outlets, is a bit different from its U.K. counterpart.

Unlike the British pod, which uses a proprietary technology, the Stateside models use Kinect for Windows sensors to map your body's outline and find your "shape," which can be classified as "emerald," "ruby," or "sapphire."

An exact price point has not yet been decided by the company, but the metrics are "very good," for the retailer, said Bodymetrics CEO Suran Goonatilake.

Although Mr. Goonatilake could not disclose how many people currently have Bodymetrics profiles, privacy and data storage is a big issue for the company.

Customer data is stored on Microsoft's cloud storage platform Azure.

"Like any type of information, this is treated sensitively," said Mr. Goonatilake.

"We've made it clear that users are in full control of their data and what they choose to share. They can also delete it anytime."

If you are ever in London I would recommend trying it out, it’s pretty fun! More will come soon when I review the jeans as soon as I can. I do have a couple of other reviews to do before so bare with me! Have any of you tried the Bodymetrics scanner before?

You can now read my review on these jeans here.

Photocopies of Fashion lecturers handouts:
Sourced from UK Fashion design courses
Photocopies of Fashion lecturers handouts: Sourced from UK Fashion design courses with researchers notes recorded from conversations with academics
## SIZES

<table>
<thead>
<tr>
<th></th>
<th>90 cm / 36&quot;</th>
<th>95 cm / 38&quot;</th>
<th>100 cm / 40&quot;</th>
<th>105 cm / 42&quot;</th>
<th>110 cm / 44&quot;</th>
<th>5 cm / 2&quot;</th>
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<tr>
<td>To Fit Chest</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A Full Chest &amp; Hips</td>
<td>106</td>
<td>111</td>
<td>116</td>
<td>121</td>
<td>126</td>
<td></td>
</tr>
<tr>
<td>B Half front chest/hip</td>
<td>26</td>
<td>27.5</td>
<td>29</td>
<td>30.5</td>
<td>32</td>
<td>1.5</td>
</tr>
<tr>
<td>C Half back chest/Hip</td>
<td>27</td>
<td>28</td>
<td>29</td>
<td>30</td>
<td>31</td>
<td>1.0</td>
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<tr>
<td>D Neck buttoned</td>
<td>40</td>
<td>41.5</td>
<td>43</td>
<td>44.5</td>
<td>46</td>
<td>1.5</td>
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<tr>
<td>E Neck Line</td>
<td>41</td>
<td>42.5</td>
<td>44</td>
<td>45.5</td>
<td>47</td>
<td>1.5</td>
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<tr>
<td>F Half front neckline</td>
<td>13.6</td>
<td>14.0</td>
<td>14.5</td>
<td>15</td>
<td>15.4</td>
<td>0.45</td>
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<tr>
<td>G Half back neckline</td>
<td>6.9</td>
<td>7.2</td>
<td>7.5</td>
<td>7.8</td>
<td>8.1</td>
<td>0.3</td>
</tr>
<tr>
<td>H Dropped Shoulder</td>
<td>19.4</td>
<td>19.7</td>
<td>20</td>
<td>20.3</td>
<td>20.6</td>
<td>0.3</td>
</tr>
<tr>
<td>I Half Cross Front</td>
<td>22.5</td>
<td>23.5</td>
<td>24.5</td>
<td>25</td>
<td>26.5</td>
<td>1.0</td>
</tr>
<tr>
<td>J Half Across Back</td>
<td>25</td>
<td>23.5</td>
<td>26</td>
<td>26.5</td>
<td>27</td>
<td>0.5</td>
</tr>
<tr>
<td>K Scye Depth</td>
<td>28.6</td>
<td>29.6</td>
<td>30.5</td>
<td>31.6</td>
<td>32.6</td>
<td>1.0</td>
</tr>
<tr>
<td>L Length</td>
<td>77</td>
<td>79</td>
<td>81</td>
<td>83</td>
<td>86</td>
<td>2.0</td>
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<tr>
<td>M Upper Arm</td>
<td>44</td>
<td>46</td>
<td>48</td>
<td>50</td>
<td>52</td>
<td>2.0</td>
</tr>
<tr>
<td>N Slv head depth</td>
<td>8.5</td>
<td>9.5</td>
<td>10.5</td>
<td>11.5</td>
<td>12.5</td>
<td>1.0</td>
</tr>
<tr>
<td>O Slv Length &amp; cuff</td>
<td>56.5</td>
<td>58.5</td>
<td>62.5</td>
<td>62.5</td>
<td>64.5</td>
<td>2.0</td>
</tr>
<tr>
<td>P Cuff Buttoned</td>
<td>20</td>
<td>21</td>
<td>22</td>
<td>23</td>
<td>24</td>
<td>1.0</td>
</tr>
</tbody>
</table>

![Diagram of Fashion Clothing Measurements](image)

Photocopies of Fashion lecturers handouts: Sourced from UK Fashion design courses
Photocopies of Fashion lecturers handouts: Sourced from UK Fashion design courses

<table>
<thead>
<tr>
<th>Standard size chart</th>
<th>Workroom toile stand</th>
</tr>
</thead>
</table>
| ![Image of size chart](image1.png) | ![Image of toile stand](image2.png)

### Size Chart

<table>
<thead>
<tr>
<th>Size Symbol</th>
<th>SML</th>
<th>MED</th>
<th>LGE</th>
<th>XLGE</th>
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</thead>
<tbody>
<tr>
<td><strong>Bust</strong></td>
<td>82</td>
<td>88</td>
<td>94</td>
<td>100</td>
</tr>
<tr>
<td><strong>Waist</strong></td>
<td>62</td>
<td>68</td>
<td>74</td>
<td>80</td>
</tr>
<tr>
<td><strong>Hip</strong></td>
<td>87</td>
<td>93</td>
<td>99</td>
<td>105</td>
</tr>
<tr>
<td><strong>Back Width</strong></td>
<td>32.8</td>
<td>34.4</td>
<td>36</td>
<td>37.6</td>
</tr>
<tr>
<td><strong>Chest</strong></td>
<td>30.6</td>
<td>32.4</td>
<td>34.2</td>
<td>36</td>
</tr>
<tr>
<td><strong>Shoulder</strong></td>
<td>11.9</td>
<td>12.3</td>
<td>12.6</td>
<td>13</td>
</tr>
<tr>
<td><strong>Neck Size</strong></td>
<td>35.5</td>
<td>37</td>
<td>38.5</td>
<td>40</td>
</tr>
<tr>
<td><strong>Dart</strong></td>
<td>6.1</td>
<td>7</td>
<td>7.9</td>
<td>8.8</td>
</tr>
<tr>
<td><strong>Top Arm</strong></td>
<td>26.4</td>
<td>28.4</td>
<td>30.4</td>
<td>32.4</td>
</tr>
<tr>
<td><strong>Wrist</strong></td>
<td>15.3</td>
<td>16</td>
<td>16.7</td>
<td>17.4</td>
</tr>
<tr>
<td><strong>Ankle</strong></td>
<td>23.1</td>
<td>24</td>
<td>24.9</td>
<td>25.8</td>
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<tr>
<td><strong>High Ankle</strong></td>
<td>20.1</td>
<td>21</td>
<td>21.9</td>
<td>22.8</td>
</tr>
<tr>
<td><strong>Nape to Waist</strong></td>
<td>39.2</td>
<td>40</td>
<td>40.8</td>
<td>41.6</td>
</tr>
<tr>
<td><strong>Front Shoulder to Waist</strong></td>
<td>39.2</td>
<td>40</td>
<td>41</td>
<td>42</td>
</tr>
<tr>
<td><strong>Armhole Depth</strong></td>
<td>20.2</td>
<td>21</td>
<td>21.8</td>
<td>22.6</td>
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<tr>
<td><strong>Waist to Knee</strong></td>
<td>57.7</td>
<td>58.5</td>
<td>59.3</td>
<td>60.1</td>
</tr>
<tr>
<td><strong>Waist to Hip</strong></td>
<td>20.2</td>
<td>20.6</td>
<td>21</td>
<td>21.4</td>
</tr>
<tr>
<td><strong>Waist to Floor</strong></td>
<td>102.5</td>
<td>104</td>
<td>105.5</td>
<td>107</td>
</tr>
<tr>
<td><strong>Body Rise</strong></td>
<td>27</td>
<td>28</td>
<td>29</td>
<td>30</td>
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<tr>
<td><strong>Sleeve Length</strong></td>
<td>57.4</td>
<td>58.4</td>
<td>59.4</td>
<td>60.4</td>
</tr>
<tr>
<td><strong>Sleeve Length (Jersey)</strong></td>
<td>51.4</td>
<td>52.4</td>
<td>53.4</td>
<td>54.4</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Extra measurements (garments)</th>
<th>SML</th>
<th>MED</th>
<th>LGE</th>
<th>XLGE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cuff Size Shirts</strong></td>
<td>21</td>
<td>21.5</td>
<td>22</td>
<td>22.5</td>
</tr>
<tr>
<td><strong>Cuff Size, Two-Piece Sleeve</strong></td>
<td>13.5</td>
<td>13.75</td>
<td>14</td>
<td>14.25</td>
</tr>
<tr>
<td><strong>Trousers Bottom Width</strong></td>
<td>21.5</td>
<td>22</td>
<td>22.5</td>
<td>23</td>
</tr>
<tr>
<td><strong>Jeans Bottom Width</strong></td>
<td>18.5</td>
<td>19</td>
<td>19.5</td>
<td>20</td>
</tr>
</tbody>
</table>
Body measurement, Body awareness, Ethical awareness in FE Fashion Design & ‘live student demo in Tailoring module:
BA(Hons) Fashion final year Marketing & Production fit session tutorials. Students selected for fit model duties.
BA(Hons) Fashion final year Marketing & Production fit session tutorials.
Students selected for fit model duties.
UK Fashion courses – 2D communication of the 3D body.

Are we repeating old methods and encouraging outdated traditional 2D instead of 3D thinking?

Can 3D tools provide opportunities for evolving new methods of creativity and design experimentation through use of 3D thinking, 3D CG technologies or 3D CAD systems?
Literature Review identified interview opportunities:

- Current academic research using 3D whole body scanners to enhance the curriculum in fashion and clothing universities worldwide, emphasises the extent of acceptance in 3D technologies. Bougourd (2005), Bunka (2005), ExploreCornell (2005).
Interviews _ emailed SIZE UK & 3D Research group Director Jennifer Bougourd at London College of Fashion. In the first interview, Jenni talked about 3D scanning and kindly gave ethical confidentiality agreement developed for SIZE UK as a scanned document. And also explained the methodology from the survey. Then I re-visited, as I was invited to talk the 3D research group during a University of the Arts collaborative meeting. Before presenting 3D research, I asked for their permission to record the meeting as a focus group using questions as a framework. Participants all agreed. The meeting was recorded as a focus group.

**NOTES:**
- I setup scan firstly wearing clothes, this was as expected and not really useful for recording 3D body data to provide accurate fit. I tested tight fitting clothing and found that dark colours wouldn't reflect data back to the scanner. Skin is perfect and gives good results.

- Setting up a educational body scanning experiment and scanning a sample group of fashion students doing final collections in their final year was ambitious and not going to easy but I felt it was important and new educational experiment which could provide quality results for the PhD. A group sample reflecting size labeling range S, M, L, fashion students who have 8-10, 12 and usually do fit checks were invited to join the experiment. Some of the girls approached for the large size weren't interested in the idea, but an MA student working with the Textiles and body happily volunteered. And I was the male standard size 40 which helped.

- There were isssues to be overcome on privacy, trust and confidentiality. One of the ways I solved this was to have made S, M, L scan outfits to protect body and some privacy, but also reflect data effectively. I had developed a research relationship over the year with observation and informal interviews so they were familiar with the research and me. But nevertheless, data confidentiality can be abused so I drafted a legally approved confidentiality agreement which we each signed protecting the volunteers and me if the digital data was mis-used by others.

- Different idea and tools were tested for improving the processes necessary for scanning the body.

- Fashion dept in QS teaching annexe, private teaching portacabin/room off workrooms, changing screen, and blinds to protect privacy of the scan. I invited small groups to ask questions but I rejected this to focus on the experiment, and also the volunteers weren't keen on being watched by their group.

- Manual measurement methods were also used to compare effectiveness of scanner.

**COMPLETED RESEARCH PAPER:**

During the pre-test experiments, a series of evaluation scans are recorded: variety of head positions, normal everyday clothed bodies and bodies wearing personal choice close fitting sportswear were scanned. These pre-tests were carried out to assess the quality of the scan results and performance of the scanner for recording different physical properties. The properties selected for testing were; environment, light levels, distance/depth and range of the laser in the scanner, the quality of colour, textures, fabrics and shapes of surfaces/objects.

Early results during the pre-tests highlighted important areas. Sleeveless tops and leggings were made from white stretch Lycra to provide scan volunteer uniformity, comfort and overcome unsuccessful scan results with random volunteer choice of certain types of fabrics/clothing.

The scan outfits were made in three sizes, small, medium and large, intended to cover underwear and closely fit any volunteers' body shape.
Confidentiality Agreement

Subject code: 

Date/Time: 

All data collected for this study is covered by the U.K. Data Protection Act (1998) and E.U. Data Protection Directive (95/46/EC). Your data will be stored and will remain anonymous at all times.

It will be used for purposes of research by collaborating organizations in the Centre for 3D Electronic Commerce.

Please tick the boxes below if you will give permission for your body scan and measurement data to be used for certain other purposes.

☐ I give permission for my body scan and measurement data to be used anonymously for demonstration purposes and in publications related to research.

☐ I give permission for my body scan and measurement data to be made available anonymously in the protected data bank.

Please sign and date below if you have read and agree to the above. Your signature is only for use in this study and will not be passed to any external agencies.

Signed: 

Date: 

Measured by: 

Scanned by: 

Ethics confidentiality agreement used with permission of SIZE UK during interview with Jennifer Bougourd at London college of Fashion.
SIZEUK confidentiality agreement. Permission given during interview with Jennifer Bougourd at London college of Fashion. The use Master document was sent by email to be adapted for University of Huddersfield 3D body scan experiments.
University of Huddersfield. 3D Research confidentiality agreement. Permission was given by Dean of the School of ADA, and Ethics advisor in Student Services to conduct body scan experiments using student group as a sample.

**3D PhD Research project Confidentiality Agreement**

Thank you for participating in the 3D PhD Research Project. This document gives permission for the academic institutions: The University of Huddersfield, and The Manchester Metropolitan University to use your data. Please read the following carefully.

**3D Scanners**

To automatically measure your body the project employs a 3D scanner that uses safe light. Please do not participate if you experience problems with flashing light.

**Data Protection**

All personal data collected for this survey is covered by the Data Protection Act 1998 and the E.U Data Protection Directive (95/46/EC). Your data will be use for the purposes of research by the academic institutions (listed above) and will remain anonymous at all times.

Please tick the box if you will give permission for your body scan and measurement data to be used anonymously for the following academic research:

- [ ] I give permission for my body scan and measurement data to be used anonymously for demonstration purposes and in publications related to research.

Please sign and date below if you have and agreed to the above. Your signature is only for use in this study and will not be passed to any external agencies.

Signed by ____________________________

Date ____________________________
Objectives of the study

1. To evaluate 3D Laser scanner in fashion education

2. To body scan a sample group of students

3. To introduce ethical approaches to scanning bodies

4. To develop new methods for integrating 3D body data
3D Scanner on tripod connected to Laptop
Phase 1 clothed experiments
were setup in busy staff office.
Experiment tools tested
White lycra scanning clothing made to fit the body and cover body for privacy
Body scan in process
Comparative manual measurement experiment to analyse body scanning accuracy and user experiences
Point cloud data 500,000 dots
Scan data pre edit
Manual registration to join surfaces
Choose section by plane
Modify selection in manual registration
Global registration
Holes in surface
Quickly filled and smoothed
Merge points
Flexible export in 18 file formats
3D body model completed.
Recording:

Results of experiment(s)

• New methods for 3D practice in Fashion/Textiles BA & MA
• Transparency of Process
• Accuracy of data
• Ethics:
  • Body catharsis awareness
  • Avatar/ virtual body surface data
  • 3D data for wearable fit and functionality