Virtual Designing in 3D for Textile Printing

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Abstract

Ink jet printing onto fabric has many advantages when compared to traditional printing methods. The ability for fine line detail and near infinite number of colors enables a near photographic image on the textile substrate. The greatest benefit however is the freedom from the requirement of a print repeat and the ability to engineer a print design. To engineer a print, a product developer brings the garment marker into a textile design software program and creates the textile design within the marker. This design engineering process requires the collaborative efforts of both a product and textile designer, allowing a better marriage of shape and pattern design. For instance, a panoramic scene could continue across a product, or around a three dimensional form. The textile design once created on a two-dimensional surface, now is manipulated across the shape of the body so that it becomes a three dimensional design.

Introduction

Fashion, that ideal that Webster's dictionary defines as "the prevailing custom, usage or style during a particular time", has always been a document or portrayal of its society. Much like a mirror, it reflects the period and culture of its wearers. In the past, the elite of society, such as royalty or religious leaders often dictated fashion. In today's age, our modern technologies have broken down many of the protocols that governed dress. Improvements in transportation, and communication technologies, such as television, have widened the consumer's knowledge base of what is available. We live in a wonderful and demanding age. Many of us in the world have 24-hour access to and are knowledgeable of garment styles and pattern designs pulled from a multitude of cultures and ages. In addition, we demand that our buying environment reflect this. The array of styles that consumers demand has become so large as to be almost individual. Our current age, like our current fashion, reflects a society steeped in and very reliant on technology - especially communication technologies. Increasingly we are immersed in media. Our future generation—children 8 to 18—spends almost 7 hours a day devoted to media, and the majority have their own personal media (Roberts, 2000). The explosion of mass media—TV, Video, Movies, MTV, Video Games, and Cellular Telephones—has speeded the fashion cycle. The commercial suave consumer has become saturated and "jaded". They have become more sophisticated and individual in their selections of fashion items, from clothing to accessories, cars to homes, home furnishings to floor coverings, and computers to cell telephones. We now have the ability to have customized homes, cars, computers, and communication services (digital TV menus, cellular or home business telephone services, etc.). Why not the ability to customize clothing?

The consumer is demanding that fashion not only reflect their own personality, but also the individual functionality that they need. The 24-hour lifestyle of many consumers has caused an increase in use of electronic gadgets to help manage their busy lives (Wagner & Tilbury, 2000). This exposure to media is leading future consumers to be more accepting and embracing of new technological developments and the fashion that evolves. In return, these evolving technologies are affecting the direction of future product development.

The consumer's growing exposure and ease with technology has increased the need for a more interactive shopping experience. Consumers have the ability and desire to be part of the product development process. What is needed for this process to be successful though, are strong visualization tools. Most often items are returned, when purchased via the Internet, because they did not "look like" the customer thought it would. With the careful integration of available technologies it is possible to closely simulate a garment try-on experience without first producing the garment. Following are two models, one an existing model from Shima Seiki, and the other a proposed Model being worked on at North Carolina State University, College of Textiles.

Model of an Existing Personal Order System

Shima Seiki, a manufacturer of knitting machines, has designed a Boutique where in a customer can have a custom knit garment fitted and designed for their individual specifications. The Model, shown in figure 1, allows the customer to be able to pick out yarn, color and sweater shape styles from a swatch book, and then after being photographed, have the virtual sweater modeled on his or her photo. This gives the customer the ability to virtually try on the sweater and approve the design and fit aesthetics before the garment is produced. The garment is then knitted in one piece as a whole garment design.

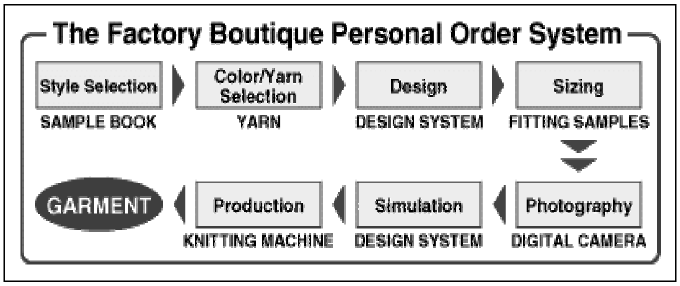

Figure 1. Shima Seiki Model

Proposed Model for Personal Order System

Ink jet Printing onto textiles is similar to whole garment knitting in a several ways. First, the product designer has the ability to keep the product in a digital format up until the point that the consumer approves the design. This allows for a virtual try on without expense. Second, the garment can be created on the consumer for better fit and design. Third, only the fabric actually needed for the garment is produced; no extra fabric is printed. And finally, the product, whether a garment or home furnishing, can be quickly produced for rapid customization. Figure 2 shows a proposed Model for producing a digitally printed garment that capitalizes on these abilities.

This proposed Model offers several changes over Shima Seiki's existing Boutique Model. First, apparel and textile design components such as garment shape and textile patterns and motifs are stored in a digital library. This offers increased speed and flexibility, and customer's profiles can be stored for future orders. Secondly, 3D Body scanning is used for body measurement and virtual modeling. The customer's body image, generated from the scan, can be brought into an apparel program for pattern draping and fit. Once the design for the apparel item has been decided, the garment, modeled on the customer's own body image, can be filled in or painted with the consumer's chosen colors and textile designs. A further advantage of the body scan image is that, unlike the customer's photograph, it can be turned for 360° viewing.

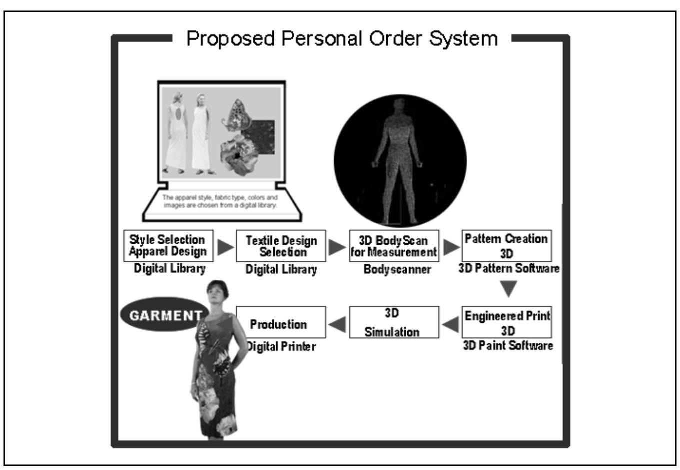

Figure 2. Proposed Model

Supporting Technologies

Computer Aided Design

Advances in computer technology have allowed designers to not only have a broader influence of sources, but also greater flexibility in the design process. Designers are now in closer communication with the consumer, due to the accessibility of point of sale data, forecasting services and online collections, as well as direct online communication with their consumers. Communication between distribution channels has increased, as well. Textile designers can communicate directly with the fabric producers, in addition to the final product designers, integrating more easily in the whole product development process. They also have better access to their sources and their own digitized collections with the computer.

The computer, used as a center of information technology, allows huge amounts of data to be available immediately. We no longer need the investment in real estate for storage of designs. Digital databases control vast quantities of design ideas and inspiration that can be accessed in fractions of a second. Many of these collections would never be accessible to the average designer because of value or the fragile nature of the item.

As well as having tremendous access to design resources, a designer or design team has the ability to build flexible and agile design libraries. At the most fundamental level, these libraries can contain patterns, textures and images that are catalogued according to targeted consumer groups. A more sophisticated library will be built with pattern modules. (Figure 3)

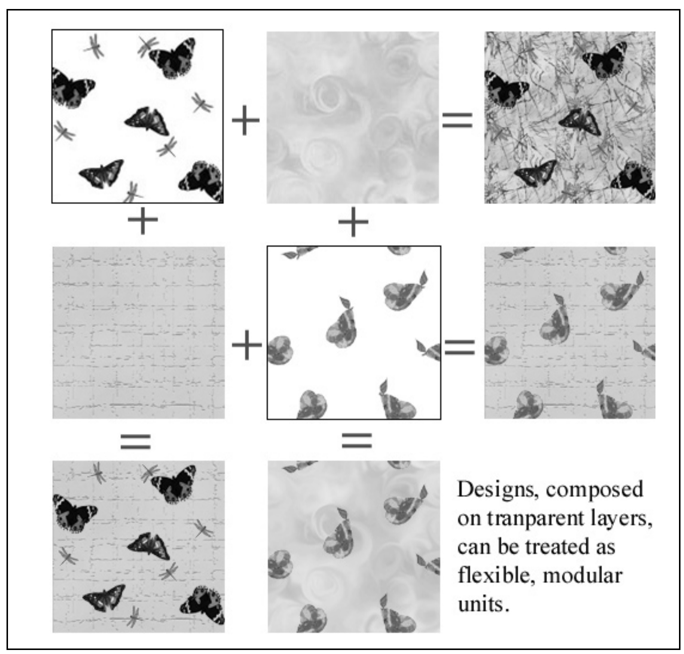

Figure 3. Pattern Modules

3D Body Scanning

Body Scanning technology was developed to accurately and quickly measure the body with no human physical contact. Research in the area of apparel at North Carolina State University has hoped to capitalize on the body scanner's ability to quickly measure the body and store the measurements in digital format. These digitally stored measurements can be utilized for creation of digital libraries of apparel. These personal body forms can be stored as VRML files and brought into an Apparel program, such as ScanVec, for virtual modeling (see figure 4.) and garment creation. The scanner that was utilized for research, mentioned in this paper, is TC2's Body Image.

Digital Printing

Direct printing on cloth was an offspring from CAD. Textile designs, already in digital format, were being proofed or sampled by printing on paper. Eventually these sampling methods demanded more sophisticated representation and that direct printing on fabric be utilized. Initial attempts were not permanent, which led to the development of specialized inks and media that would have the same properties as traditionally printed textiles: light-fastness, color-fastness, and most importantly, accurate color in the finished end product. As well as more accurately representing the actual printed fabric, this sampling method has other advantages, such as reduced cost.

Three Dimensional Visualization Tools

Our current research at NCSU focuses on the integration of all of these existing technologies. For visualization methods there are several strong CAD programs that will integrate apparel and textile designs, such as SGS and BodyPaint 3D. These systems allow the textile design to be placed on a three dimensional image and manipulated in 3D space; however, they do not unwrap to a 2 dimensional, flat image, for final printing. SGS allows a body-scanned image of a specific customer to be imported for visualization of garment fit and drape on the customer's shape. Any changes to the design must be made on the 2D flat patterns, as a separate step.

BodyPaint 3D is software that was developed for the film industry for the creation of animated videos and prototype characters. A VRML file (a file format created as an open standard for 3D multimedia and shared virtual worlds on the Internet) can be imported into the system as the 3D body shape around which a design would be created. Basically, the designer is virtually painting upon a body and the results can be seen immediately. The significant difference between SGS and BodyPaint 3D is the fact that the garment patterns actually exist within the SGS software and can be altered and changed, even though, in a separate step. BodyPaint 3D is entirely a visualization tool at this time.

Engineered Designing

An engineered design, for direct ink jet printing onto textiles, has a textile design image or repeat that continues, unbroken, across closures and seams. This process, refined at NCSU's College of Textiles is as follows:

Figure 4.

Figure 4 is an example of the first step in an engineered print - the virtual modeling. On the left is a modeled garment that has been stored in a virtual library. The image on the right has been virtually modeled with textures, images and patterns that are also stored in an archive. This virtual garment becomes a template for design ideas. Scale, positioning and color of images and patterns can be determined from this model.

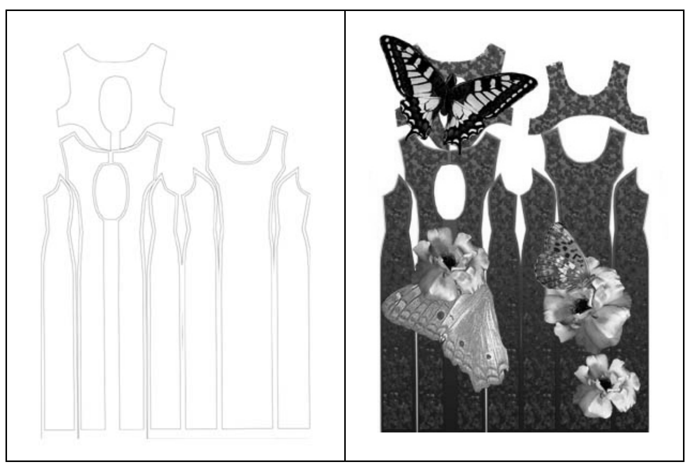

Figure 5.

In figure 5, the left side shows an example of a marker.

A marker is the cut pattern for a garment and is usually laid out for fabric optimization. This marker is optimized for both fabric optimization and engineered designing. For engineered designing the pattern pieces, in this case, three each of front and back panels, are set side by side in the same order that they will be sewed together. The marker is then brought into a design program and the textures and motifs that were chosen from the digital image library are filled or "painted" within the marker shape. The virtual model is used as the blueprint for placement.

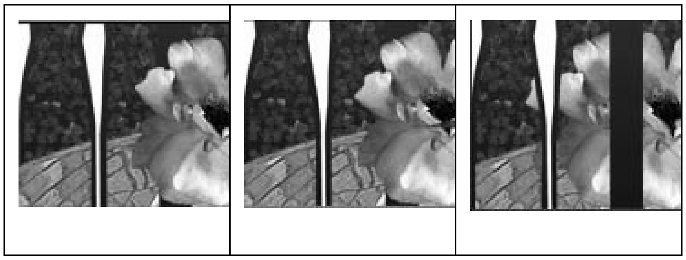

Figure 6.

The design elements are cut apart and rotated around darts and seams to accommodate the three dimensional form of the garment. After the motif is segmented, it is redrawn or painted.

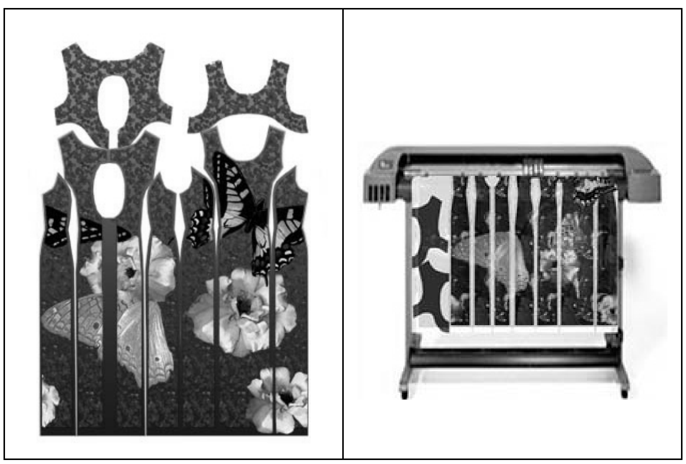

Figure 7.

The finished marker shown on the right in figure 7 has design elements that are split across seam, dart and closure points so that when it is cut and sewn the motifs will continue from the front panel onto the back of the dress. On the right in figure 7 is the finished marker, filled in with the textile design, being printed via an inkjet printer directly onto fabric.

Figure 8 shows the finished garment, front and back.

Figure 8.

Conclusion

Designing in 3D for direct digital printing offers a multitude of advantages and possibilities and is highly feasible. The software and hardware such as 3D Bodyscanning, Computer Aided Design for both apparel and textiles, and Direct Digital Printing are developed and in place. Needed is integration with 3D software such as Scanvec for draping and fitting and BodyPaint 3D for textile design and texture mapping. The VRML file format is very flexible and will allow for the exchange between all of the aforementioned software, as well as allowing for 3D-web merchandising. With the proposed model it will be possible for a customer to be body scanned for exact measurement, have a virtual fitting, see a one-of-a-kind textile design painted directly onto their 3D body form and then, after choosing the material of their choice, have the garment printed out onto the fabric and sewn. As well as providing a unique service to retail customers, other niche markets in animation, fashion and costume could be developed. For instance an actor or actress's body may be scanned and then textured mapped with a garment that may be too difficult to wear or too costly to produce. Fashion shows could be produced for the web without the huge cost of hiring models. One-of-a-kind costumes, once hand-fitted and hand-painted can be digitally stored and re-fitted and printed as needed.

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Biography

Lisa Parrillo Chapman, Instructor**,** has been a member of the faculty at of the Department of Textile and Apparel Technology and Management in the College of Textiles since January 2000. In 1990 she received a B.F.A in fibers from the University of the Arts, Philadelphia PA. While working as a buyer and a manager of a home specialty store she completed a Master of Textiles from North Carolina State University, College of Textiles. Continuing at the College of Textiles, Lisa is working toward her doctoral degree in textile technology and management and is employed as an instructor of computer aided design for textiles and as director of the College's *Digital Design Lab*. Current research interests are in emerging technologies in digital design, particularly ink jet printing.

Dr. Cindy Istook is an associate professor in Textile and apparel, Technology and Management. She holds degrees from Texas Woman's University and Texas Christian University. Her research interests include Mass Customization, Rapid Prototyping, 3-D Body Scanning, Digital Printing, and integration of technologies for product development and production of sewn products. She currently teaches courses in Apparel Production, Product Development, and Advanced Apparel Production as well as multiple Summer Research Workshops in Mass Customization.