

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ZHEJIANG LINGDI DIGITAL TECHNOLOGY CO., LTD.
Petitioner,

v.

CLO VIRTUAL FASHION, INC.
Patent Owner.

Case No. IPR2024-00980
U.S. Patent No. 11,222,448

**DECLARATION OF MUTHU GOVINDARAJ, PH.D.
IN SUPPORT OF PATENT OWNER'S PRELIMINARY RESPONSE
TO PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 11,222,448**

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I. INTRODUCTION

1. My name is Muthu Govindaraj, Ph.D. I have been retained by CLO Virtual Fashion, Inc., which I may refer to as either the “Patent Owner” or “CLO,” for this *inter partes* review proceeding, which I may refer to as an “IPR.” I understand that the IPR proceeding involves U.S. Patent No. 11,222,448, which I may refer to as “the ’448 Patent” for shorthand. I understand that the claims challenged in this IPR are Claims 1-4 and 14-18 of the ’448 patent.

2. I understand that the ’448 Patent is assigned to CLO.

3. I understand that in this proceeding Zhejiang Lingdi Digital Technology Co., Ltd., d/b/a Lintex, which I may also refer to as the “Petitioner” or “Lintex,” filed a Petition for review of Claims 1-4 and 14-18 of the ’448 patent .

4. I understand that the above claims are challenged on the following four grounds:

Claims Challenged	Basis	References
1-4, 14-18	Obvious	Grinspun in view of Graphicextras

5. I have been asked to provide my objective, independent analysis of the ’448 Patent in view of the asserted prior art references cited in the Petition and to provide my opinion regarding the allegations in the Petition.

6. I am not currently, nor have I ever been, an employee of Patent Owner. I am being compensated at a rate of \$250 per hour for my work in conjunction with this IPR. My compensation does not depend on the substance of my opinions nor on the outcome of this proceeding.

II. QUALIFICATIONS

7. I am an expert in the fields of mechanical engineering, textile engineering, software design, flexible material modelling and digital clothing design. More specifically, I have worked in, conducted research in, taught college courses in and consulted with industry in the mechanical, textile, software, apparel, and virtual flexible material and clothing design fields.

8. I am a tenured full professor at Thomas Jefferson University in the School of Design and Engineering in Philadelphia, Pennsylvania. Thomas Jefferson University used to be known as the Philadelphia University, and is one of the relatively small number of universities in the U.S. that offer courses, curricula and degrees in textile engineering, textile design, fashion design, animation and digital media, and user experience and interaction design.

9. Below is a detailed list of my qualifications and expertise in textiles and apparel, as well as mechanical engineering, including computer modeling of physical phenomena, including flexible materials, fabrics and digital clothing. I have

also attached, as Appendix A, a recent curriculum vitae that details my educational and professional background.

10. I obtained a Bachelor of Technology (B.Tech) and a Master of Technology (M.Tech) from the University of Madras, India in 1976. After graduating college, I worked as a research and development engineer. Within two years, I was promoted to Deputy Manager of Research and Development at Machinery Manufacturers Corporation, India, a Mahindra Company. I was part of teams that designed and developed textile spinning machinery for Indian and export markets.

11. After working for two years, I applied for and was selected as the only representative from India for an Indo-Czech Scholarship to study advanced mechanical engineering design at the Technical University of Liberec in the Czech Republic, at the time one of the most prominent textile research, design and manufacturing centers in the world. I researched at some of the highly regarded institutions in the Czech Republic in Usti Nad Orlici and Hradec Kralove. In 1982, I obtained my Ph.D. in Mechanical Engineering from the Technical University of Liberec. I returned to India to continue my work at my previous company. I was involved in implementing mechatronics solutions to improve the performance of the machinery made at the company.

12. In 1986, Dr. Peter Lord, a Distinguished Professor at North Carolina State University, invited me to come to the U.S. and support his work for a consortium of textile mills from the Southern United States. During the next two and a half years, I worked on projects related to automation and electronic process control of textile machinery. I authored or co-authored several journal publications based on this work.

13. In 1989, I joined Cornell University as an Assistant Professor and Director of Industrial Extension in Textiles and Apparel. The position involved teaching, researching, and working with textile and apparel companies in New York State. The Industrial Extension in Textiles and Apparel program was a new program at Cornell University and I served as the inaugural director. I combined my research, teaching, and extension work to find process and product improvement solutions for the apparel industry. I developed both software and hardware solutions. The Cornell Theory Center appointed me to their advisory board in 1989.

14. Around 1989, the apparel computer-aided design field was in its primitive stages, with pattern designs done on two-dimensional CAD (computer-aided design) systems. While three-dimensional CAD was in use, the method was adopted only in modeling rigid materials. Flexible material modeling required a different approach, and it was computationally intensive. I started work on three-

dimensional modeling of flexible materials with initial funding from USDA. I also obtained grants from Digital Equipment Corporation and an apparel CAD company called Investronica.

15. I modelled the drape of textile fabrics using the Finite Element Method (FEM). FEM cannot be directly applied to model flexible materials due to the large deformations that occur when a fabric drapes over an object. Such large deformations result in singularities during the computations. I instead developed software with an iterative, algorithmic method to model fabric drape. My work from 1989-1995 was unique and pioneering, and was selected to feature at the Supercomputing '95 conference in Washington, DC. A news item about the work was featured in Scientific American. Later, other international science magazines including GEO in German and Korean featured news about the work. The work also was published in refereed journals and presented at conferences.

16. Simultaneously, as part of my industrial extension assignment at Cornell, I worked with apparel manufacturing companies in Upstate New York. I introduced the apparel companies to apparel CAD and trained them on using the systems and software to improve pattern design, grading, marker making, and cutting in their operations. During that time, I became familiar with apparel production processes in several well-known companies such as Sara Lee and Sanyo.

I was appointed as an inaugural member of the Center for Manufacturing Enterprise at Cornell University.

17. On the hardware and automation side of apparel, I worked with companies, including Jetsew®, to develop computer and software systems to handle flexible materials like fabrics without human input. The work was published and presented at the Techtextil Conference in Atlanta, GA.

18. As part of my extension work, I assembled a consortium of textile and apparel schools from the Northeast U.S. The effort was supported by the New York State senators at that time as well as by AFL-CIO. Later, the consortium members were invited to join the National Textile Center, a Department of Commerce supported group of institutions to carry out research in textiles and apparel.

19. During my tenure at Cornell University I also developed and taught an undergraduate course in apparel production at the Department of Textile and Apparel, College of Human Ecology.

20. One of the consortium member institutions, Philadelphia College of Textiles and Science, appointed a new dean who invited me to join him in developing the programs for ABET accreditation at the institution. I joined Philadelphia College of Textiles and Science (now merged with Thomas Jefferson University) in 1995. I continued my virtual fabric drape modeling work at Philadelphia and was funded by

the National Textile Center. Progressively I improved my virtual fabric simulation software, including allowing the software to model whole garments, seams and stitches.

21. In 2002, I obtained, along with co-principal investigators from Stanford, Rice and Rutgers Universities, NSF funding for the virtual fabric simulation project. The work resulted in finding ways to model fabric and garment drape in a more precise manner, taking into consideration fabric mechanical properties. In addition to static drape, the model and software allowed users to visualize dynamic drape, the effect of friction between cloth and body or any object, and the effect of wind on the movement of a draped fabric.

22. From 2005-2008, I was funded by the Department of Defense, U.S. Army Natick Soldier Research, Development & Engineering Center Natick, Massachusetts, for using computer modeling to evaluate garment drape, fit, and pressure objectively. My other work related to fabric drape and modeling included developing a device for remotely feeling the texture of a fabric using an augmented reality computer mouse, a body-borne flexible fabric antenna for soldiers, and a digital twin of a laboratory thermal manikin to evaluate garment comfort.

23. In 2013, I served as the principal investigator for the development of outer layer garments for NASA Z2 space suits. My other research and development

work, not related to textiles, fabric and fabric drape, are in the areas of mechatronics, robotics and electric vehicles.

24. During my tenure at Thomas Jefferson University, I have taught undergraduate courses in apparel production in the School of Engineering and Textiles. I have also taught graduate courses in apparel production for textile engineering students. I currently teach (and have for many years) a computer modeling and simulation course for engineering students. The course includes the use of simulation software including Maya®, Solidworks®, and Ansys®. As part of the course, I introduce the students to the use of finite element method to model flexible materials such as fabrics and their deformation, including drape.

III. MATERIALS CONSIDERED

25. I have reviewed the '448 Patent, including the challenged claims, and its prosecution history. I have also reviewed the Petition for *inter partes* review filed by Petitioner, as well as the Exhibits attached, including:

- Ex. 1003: Declaration of Dan Perreault
- Ex. 1004: Grinspun
- Ex. 1005: Graphicextras
- Ex. 1006: Canvai
- Ex. 1007: Adobe

- Ex. 1008: Marvelous Designer-1
- Ex. 1009: Marvelous Designer-2

26. I have also reviewed various other sources cited within this Declaration.

27. In forming my opinions, I have considered the materials listed above and any documents cited in this declaration. I have also relied on my own education, knowledge, training and experience that are relevant to the '448 Patent.

28. I have also considered the understanding of a POSA around the time of the invention the '448 Patent.

IV. LEGAL PRINCIPLES

29. I am not an attorney and will not offer opinions on the law.

30. In forming the analyses and conclusions expressed in my declaration, I have applied the legal principles described in the following paragraphs, which were provided to me by counsel for the Patent Owner.

A. Priority

31. I understand that a patent may claim the benefit of the filing day of an earlier filed application if the earlier filed application provides adequate disclosure of the patent's claims. I understand that the disclosure requirement is satisfied if a POSA could clearly conclude that the inventor invented the claimed subject matter as of the earlier filing date sought. I understand that the earlier filed application does

not need to describe the claimed subject matter in precisely the same terms as found in the claims at issue.

B. Anticipation

32. I have been informed that a patent claim is invalid as anticipated under 35 U.S.C. § 102 if each and every element of a claim, as properly construed, is found either explicitly or inherently in a single prior art reference. Under the principles of inherency, if the prior art necessarily functions in accordance with, or includes the claimed elements, it anticipates.

33. I have been informed that a claim is invalid under 35 U.S.C. § 102(a) if the claimed invention was known or used by others in the U.S., or was patented or published anywhere, before the Applicant's invention. I further have been informed that a claim is invalid under 35 U.S.C. § 102(b) if the invention was patented or published anywhere, or was in public use, on sale, or offered for sale in this country, more than one year prior to the filing date of the patent application (critical date). And a claim is invalid, as I have been informed, under 35 U.S.C. § 102(e), if an invention described by that claim was described in a U.S. patent granted on an application for a patent by another that was filed in the U.S. before the date of invention for such a claim.

C. Obviousness

34. I have been informed that a patent claim is invalid as “obvious” under 35 U.S.C. § 103 in light of one or more prior art references if it would have been obvious to a person of ordinary skill in the art at the time of the alleged invention (“POSA” or “POSITA”), taking into account (1) the scope and content of the prior art, (2) the differences between the prior art and the claims, (3) the level of ordinary skill in the art, and (4) any so called “secondary considerations” of non-obviousness, which include “long felt need” for the claimed invention, commercial success attributable to the claimed invention, unexpected results of the claimed invention, skepticism of others, failure by others to achieve the claimed invention, and “copying” of the claimed invention by others.

35. I have been informed that a claim can be obvious in light of a single prior art reference or multiple prior art references. To be obvious in light of a single prior art reference or multiple prior art references, there must be a reason that would have prompted a POSA to modify the single prior art reference, or combine two or more references, in a manner that provides the elements of the claimed invention. This reason may come from a teaching, suggestion, or motivation to combine, or may come from the reference(s) themselves, the knowledge or “common sense” of a POSA, or from the nature of the problem to be solved, and this reason may be explicit or implicit from the prior art as a whole.

36. I have been informed that, under the law, the combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results. I also understand it is improper to rely on hindsight in making the obviousness determination.

37. I also understand that, under the law, there must have been a reasonable expectation of success in combining references. In other words, a party seeking to invalidate a patent based on obviousness must demonstrate that both (a) a POSITA would have been motivated to combine the teachings of the prior art references and (b) the POSITA would have had a reasonable expectation of success in doing so.

D. Claim Construction

38. I understand that claim construction is a matter that will be decided by the Board presiding over this IPR. I understand that the relevant inquiry in claim construction is the question of how a POSA would have understood the claim terms at the time of the earliest priority date, in light of the patent specification, the prosecution history, and any other relevant intrinsic and extrinsic evidence. On that note, I understand that it is permissible and sometimes helpful to use extrinsic evidence such as dictionaries, treaties, experts and the like to ascertain what a person of ordinary skill in the art would understand what a claim term means.

V. BACKGROUND OF THE TECHNOLOGY

39. The global apparel market is valued at around 1.8 trillion dollars (Ref. Statista). Almost every country in the world has some form of apparel production, although most apparel is currently produced in Asia. In the case of raw material that is fabric, the apparel production process consists of pattern design, grading (for various sizes), marker making (laying out patterns to cut fabric), fabric spreading, cutting, and sewing. The last process, sewing the garment, has mostly remained a manual process, with sewers putting the garment together. While in many industries one person would look after several machines, in garment construction it is still a one person, one machine operation.

40. The development of a garment starts with creating patterns to cut fabrics. This process of creating patterns is done in two ways. In the draping method, a surrogate fabric such as muslin, is placed on a mannequin (a form) and adjusted for drape. Once the designer achieves the look he or she wants, the muslin is taken out, spread flat and patterns are drawn on paper.

41. In the second method, pre-drawn patterns (or slopers) are available for standard garments from commercial publications in books or online. If desired, the slopers can then be modified, for example to convert a regular sleeve to a puffed one. The draping method is more commonly used in the couture and fashion garment

industry. The sloper method is used in the design of commodity garments such as blouses, pants, skirts, etc.

42. Beginning in the 1980s, computer-aided design (CAD) software was introduced to draft two-dimensional drawings based on measurements. In the beginning, CAD software was used in the engineering industry, mostly in mechanical and civil fields. In the engineering industry, there was already a well-established practice of viewing objects in three orthogonal views (plan, elevation, and end view) and, if required, an isometric view (an engineering three-dimensional view without the perspectives of realistic vision).

43. The above method of visualizing objects is not suitable for garment construction. The reason is the unique set of qualities of textiles. Fabrics are flexible materials and assume draped shapes when placed over an object. A good example is a tablecloth that gracefully folds over the corners of a table. An artist can draw the shape but cannot be represented by a draftsman using geometrical construction techniques.

44. However, flat garment patterns using the sloper or drafting method can be constructed using CAD and used for fabric cutting. Visualization of the garment in 3D was not part of the process. The early apparel CAD software was used by pattern makers purely as a drawing aid to draft garment patterns on computer screen.

45. Beginning around the 1990s, 3D CAD systems, both software and hardware, became available. The early 3D CAD systems could construct, render and real time manipulate objects in 3D on the computer screen. The systems found early adapters in the entertainment and movie industry. These 3D CAD systems were later developed to have the capability to model flexible materials such as fabrics, hair and even water, smoke, etc.

46. The 3D CAD models visualized by the above-mentioned systems were not exact, but were sufficient to realistically represent flexible materials for movies and video games. Later, physics based animation principles were applied to make the visualization more realistic. The apparel industry did not adopt the early 3D CAD systems as they were not helpful in pattern development.

47. Around 1995, researchers in academic institutions succeeded in developing fabric drape models that were based on finite element method (FEM) principles. The FEM based models precisely represented the fabric mechanical properties and collision detection algorithms to render the draping of cloth. However, FEM based models are computationally intensive and require qualified people to work with the computer programs.

48. The main mechanical characteristics of textile fabrics are the tensile, shear and bending rigidities and also the thickness and density. These characteristics

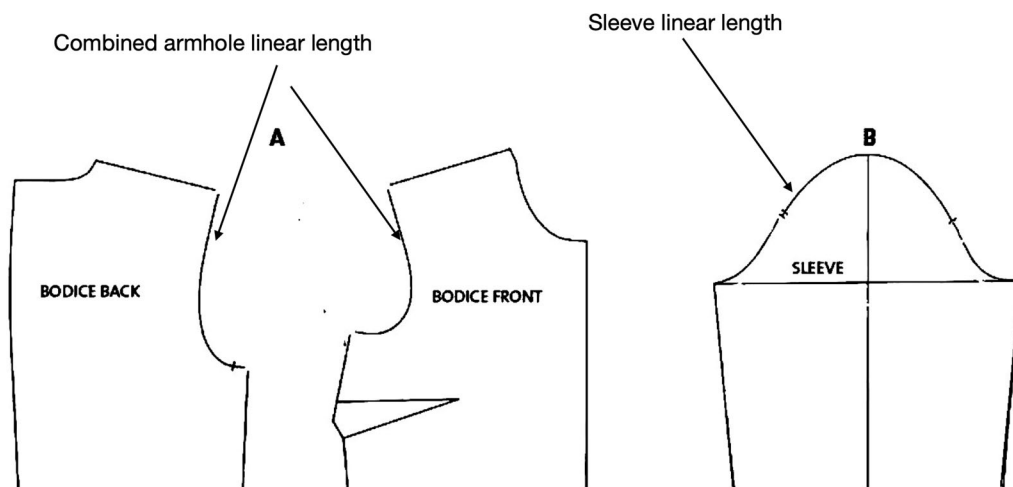
can be exactly represented in FEM models of fabric drape. However, in graphics models, based chiefly on particle cloud-based systems, it is not possible to represent precise mechanical characteristics. Therefore, certain simplified relations representing the mechanical characteristics were adopted. Most currently available apparel 3D CAD systems use the graphics models described above.

49. Using the graphics 3D apparel CAD systems, one can construct flat patterns and place them on a virtual mannequin to obtain the draped look. Conversely, it is also possible to manipulate pieces of fabric in 3D space on a virtual mannequin and then flatten the pieces to obtain flat patterns.

50. Flat patterns are used to construct a 3D garment in apparel construction. This process is different from, say, creating the body of a car from flat steel sheets. There is a difference in, among other things, ‘drape’ and ‘fit’. A good example is a tennis ball with a fabric fitted’ over a sphere. On the other hand, a T shirt is ‘draped’ over a human body.

51. The ability of a fabric to conform to the shape of the object it is laid on, that is ‘drape’, needs to be modeled to create computer models of 3D garments. Modern apparel CAD systems have been developed in continuing to address the problem of virtually draping garments on virtual mannequins. The figure below is an example. The combined linear length of the armhole in a flat pattern and the

linear length of sleeve are identified by the arrows. The sleeve is fitted to the front and back bodice pieces by a sewer using a sewing machine. The two lengths are not exactly equal. The sleeve linear length is slightly longer than the combined bodice armhole length. This difference in length is introduced to give the sleeve a three-dimensional shape to drape over the shoulder. When the sewer sews the sleeve with the bodice front and back armhole, they feed the two fabric pieces to the sewing machine at different stretch, so that the pieces match after sewing. This type of nuances occurs in other parts of garment flat pattern design.



52. Thus, there must be an ability in CAD pattern design software to match two segments on two different patterns or pieces that may not have the same shape or have exactly the same linear segment length.

53. In certain situations, a user may need to measure a length between two points of a 3D garment. However, measuring an accurate length may not be easy for

various reasons. For example, it may not be easy to measure an accurate length between these two points because polygons of a mesh forming the 3D virtual clothing are affected by gravity with material and physical laws of the source fabric being applied, and are thus stretched to some extent. EX1001, 1:37-47. Moreover, when editing the size or shape of fabric pieces before they are sewn together, it may be beneficial to arrange the pattern pieces such that they do not overlap one another. “However, in such a case, a gap between the pattern pieces may need to be considered, and thus it may not be easy to intuitively measure a distance between two points in different pattern pieces.” EX1001, 9:17-20.

VI. PERSON OF ORDINARY SKILL IN THE ART

54. I understand that Petitioner argues that a POSA would have had “a minimum of a bachelor’s degree in an engineering, computer science, graphic design, or a related field plus 2-3 years of work and/or research experience in the field of computer aided design (CAD) software.”

55. I disagree with this characterization of a POSA because it does not adequately account for the nature of 3D clothing design which general CAD knowledge would not teach, as I have described above. General CAD software is not suitable to solve the intricacies of virtual clothing design, such as converting a 2D fabric into a “draped” 3D clothing article. The types of problems encountered in the art would include creating seams and sew lines, understanding flexible material

properties such that when the clothing is draped no wrinkles are created, and determining distances between points taking into consideration gaps between the pattern pieces and the effect of gravity and material choice of the fabric. As I explained above, a good example of this a tablecloth that gracefully folds over the corners of a table; an artist can draw the shape of the 2D tablecloth, but cannot accurately represent how it would look draped over the table using geometrical construction techniques. This is because the draping of the tablecloth depends on the material used (e.g., type, thickness, etc.), gravity's impact on the tablecloth, the amount of material that hangs over the table, and other issues. These are all types of factors that are taken into consideration by 3D clothing design software, but not general CAD software. The conversion of 2D fabric into 3D clothing (i.e., draping) is a specialized process that static, generic CAD software is not suited for.

56. Therefore, a POSA to which the '448 Patent pertains would have had a minimum of a bachelor's degree in mechanical engineering, textile engineering, computer engineering, computer science, graphic design, or an equivalent degree, with at least 2-3 years of experience in software design for the creation of digital or virtual clothing.

VII. OVERVIEW OF THE '448 PATENT

57. The '448 Patent discloses a method and apparatus for taking measurements of 2D digital fabric patterns corresponding to 3D virtual clothing.

EX1001, Title, Abstract. A user defines a series of points, or points of measurement, in the 2D patterns, determines attributes of the areas in which those points of measurement are selected, measures the length of the line segments between the selected points, and outputs those lengths to a table or other list of the points of measurement to allow clothing designers and garment manufacturers to have accurate, precise measurement data for the design and manufacture of actual clothing based on virtual 3D clothing. These measurements must be accurate.

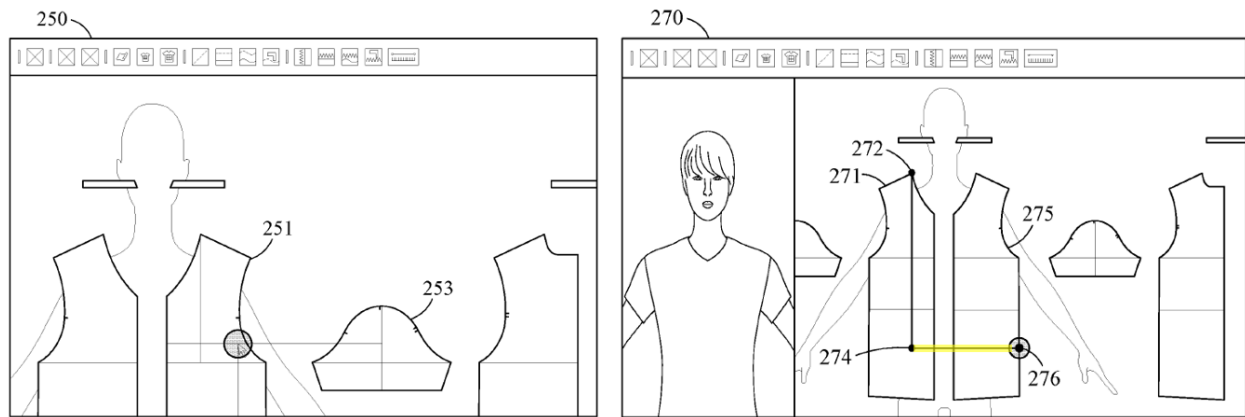
58. The '448 Patent recognized difficulties in trying to measure a length between two points of three-dimensional (3D) virtual clothing. EX1001, 1:37-47; 9:17-20. The '448 Patent explains that when measuring a distance of length between two points from simulated 3D virtual clothing, the fabric mesh is made up of polygons, which are affected by several variables such as gravity, material, physical laws of the source fabric, and fabric properties such as stretch, ease or stiffness. *Id.*

59. The '448 Patent's digital clothing program allows a user to set points of measurement anywhere in or on two or more 2D patterns and more accurately measure the lengths between two or more points on those patterns that correspond to the 3D virtual clothing. The '448 Patent allows a user to account for space between patterns by changing the length of line segments that span two 2D patterns to account for that space. This happens frequently. For example, a garment manufacturer may

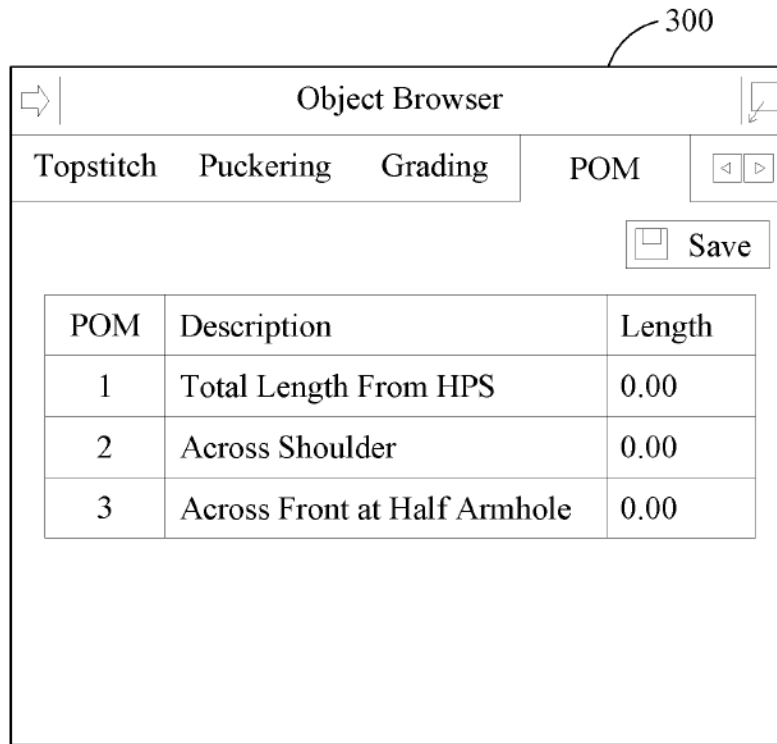
need to check a dimension of a fabric that would span two 2D patterns per the virtual 3D clothing design. But at that point, the garment is a single 3D piece of clothing. The '448 Patent allows a designer to include, as a point of measurement, a distance spanning from one 2D pattern to another 2D pattern, for use in both the 3D virtual rendering and the actual 3D garment.

60. Taking a measurement using the '448 Patent's digital clothing program starts with the user inputting two or more points in a space in which a 2D pattern of clothing is displayed, *e.g.* a starting point and an ending point. EX1001, 6:43-48; 7:25-30. The computer program determines certain attributes of areas in which the points are located, and then determines a length of a line segment between those points based on the determined attributes. EX1001, 6:55-67; 7:26-40; 8:1-58. The attributes include whether the points are located in a same pattern piece of the clothing or different pattern pieces of the clothing. *Id.*, 7:5-12; 8:4-27. The length of the line segment between the points can be different depending on whether the points are determined to be on the same pattern piece, or different pattern pieces. When the points are located in different pattern pieces, the determined length of the line segment is changed to account for separation between the pattern pieces in the 2D display space. *Id.*, 8:4-27.

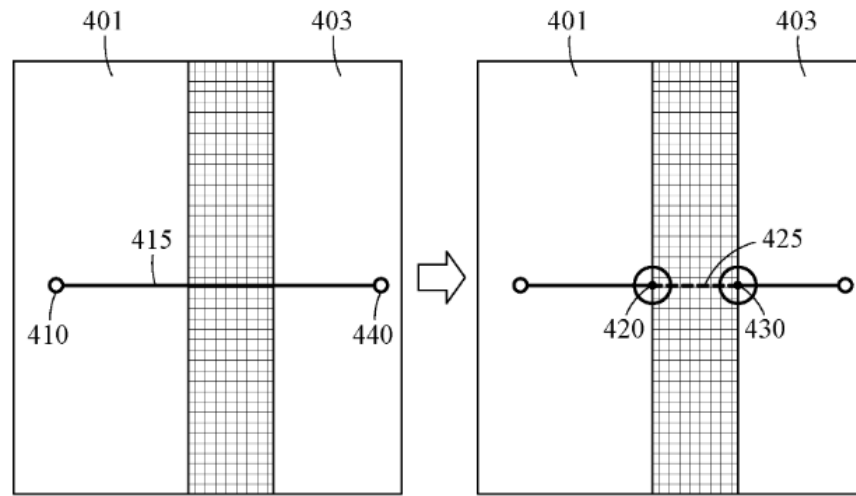
61. As illustrated in Fig. 2A, a user may view 2D digital clothing patterns in a 2D window 210. A pattern 235 is shown as the right side of a shirt. *Id.* The user can select a “point of measurement” or a “tape measure” tab 215 at the top of the screen. As illustrated in Fig. 2B below, a user may set starting point 272 on first pattern 271, ending point 276 on second pattern 275, and an intermediate point 274 on first pattern 271. *Id.* at 11:19-21. The ‘448 Patent’s program measures the length of the first segment between points 272 and 274, and the length of the second segment between points 274 and 276. *Id.* at 11:22-26. There is a “connection line” (no reference numeral, highlighted in yellow below) that spans the space between the first and second patterns. Depending on what lengths are important to a user, the program can output the total length of the segment from points 272 to 276, and/or the lengths of the first and second segments. *Id.* at 11:27-39. The length of the total segment and/or just the second segment is calculated by removing the length of “connection line” from the length of the second segment spanning from point 274 to point 276. *Id.*



62. As shown in Fig. 3 below, the program includes a user interface that displays the list of points of measurement and the measurements between those points. *Id.* at 11:40-45. The points of measurement may be labelled to assist with subsequent use, and the segments assigned names so they are easily identifiable. *Id.* at 11:56-66. The line segments lengths may be automatically updated based on modifications to the size or configuration of the 2D patterns.



63. In the example shown in FIG. 4, the '448 Patent's digital clothing program measures a length of a line segment 415 that connects the start point 410 from one pattern piece 401 to the end point 440 of another pattern piece 403. EX1001, 12:20-23. The points may be set inside of the 2D patterns, depending on what points of measurement are important or necessary to garment design and manufacturing.

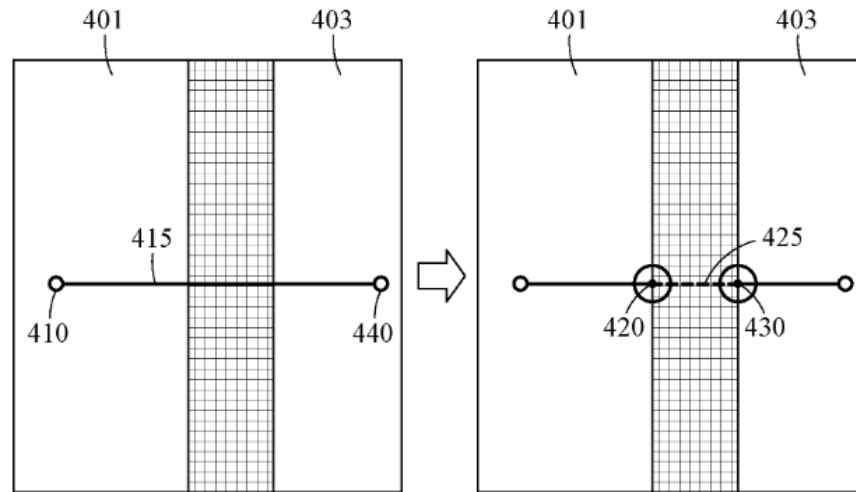


EX1001, FIG. 4

64. The program “may measure a length of a connection line 425 (indicated by a broken line) that connects an intersection point 420 at which the line segment 415 crosses an outer line of the pattern piece 401 and an intersection point 430 at which the line segment 415 crosses an outer line of the pattern piece 403.” *Id.*, 12:23-29. The determined length between the start point 410 and the end point 440 may be determined “by subtracting the length of the connection line 425 from the length of the line segment 415.” *Id.*, 12:29-31. “[T]he length of the connection line 425 may be changed as a user deforms or changes a position or size of a pattern piece or changes positions of points selected from the pattern piece.” *Id.*, 12:31-34. But the length of the connection line can still be determined after a user adjusts the pattern piece. That length is of the fixed line segment, not the difference between the old connection line and the new connection line. It is important that the point of

measurement data be accurate to reflect the dimensions of the current 2D patterns.

Id.



EX1001, FIG. 4

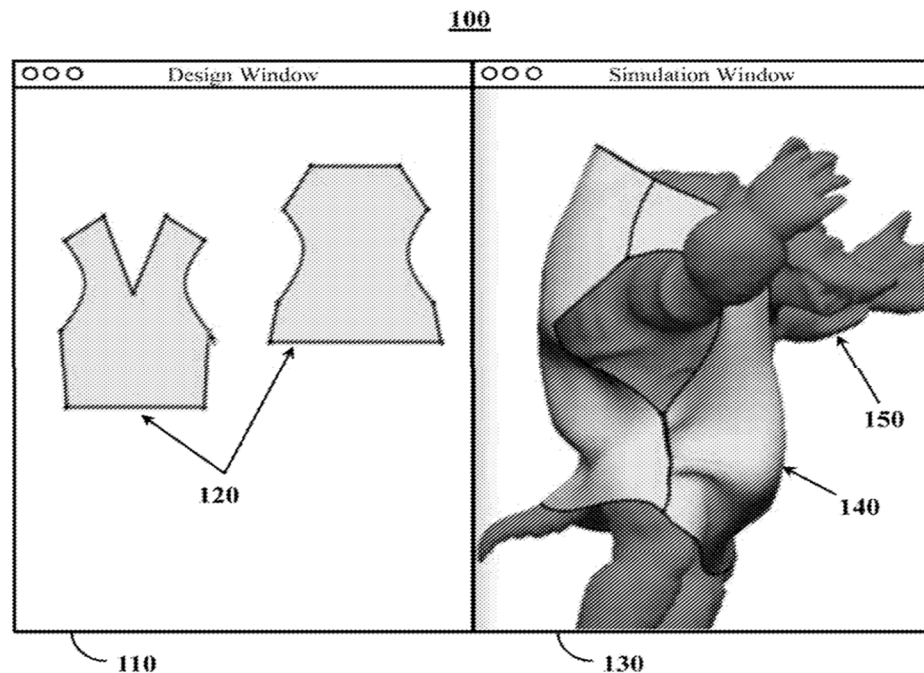
65. The '448 Patent likewise describes setting points of measurement and calculating line segment lengths when the points in the two 2D patterns are offset, or don't match. See Figs. 5A and 5B.

VIII. OVERVIEW OF THE PRIOR ART

66. The IPR Petition sets forth various Grounds for why the claims of the '448 Patent would have been obvious in view of the various prior art references that I overviewed above. I disagree with these proposed Grounds for at least the reasons set forth below.

A. Grinspun

67. Grinspun is a patent application publication that describes CAD software enabling “interactive garment modeling and editing.” EX1004, [0010]-[0013], FIGS. 1-4 and 14-19. The CAD software provides an “interactive garment designing application that simultaneously and synchronously models a two-dimensional garment pattern and its corresponding three-dimensional draped representation.” *Id.*, [0003].



68. Grinspun also explains that the user can “generally create and/or edit patterns” in the design window 110. EX1004, [0042]-[0044]. For example, the user can use mouse movements for “sketching and creation of the flat patterns” and “altering the shape or position”. EX1004, [0042]-[0044], [0057], [0069].

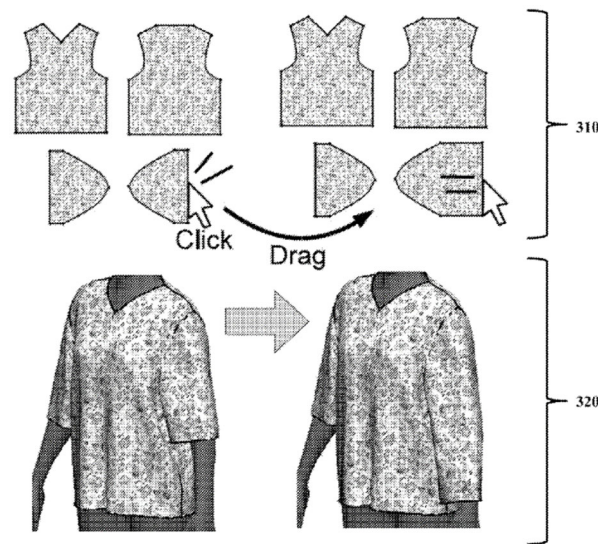


FIG. 3

EX1004, FIG. 3

69. However, Grinspun has no disclosure or teaching of the following: (1) selecting points of measurement in the 2D window, (2) determining attributes of the areas in which those points exist, or (3) measuring the lengths of the segments defined by those points. Instead, Grinspun is directed to ensuring that changes made to the patterns in the 2D window are carried over to the 3D window, and that changes made to the 3D clothing in the 3D window are carried over to the patterns in in the 2D window. Grinspun was focused on the math that allowed the bidirectional adjustments, not on key virtual measurements that assist with actual garment manufacturing.

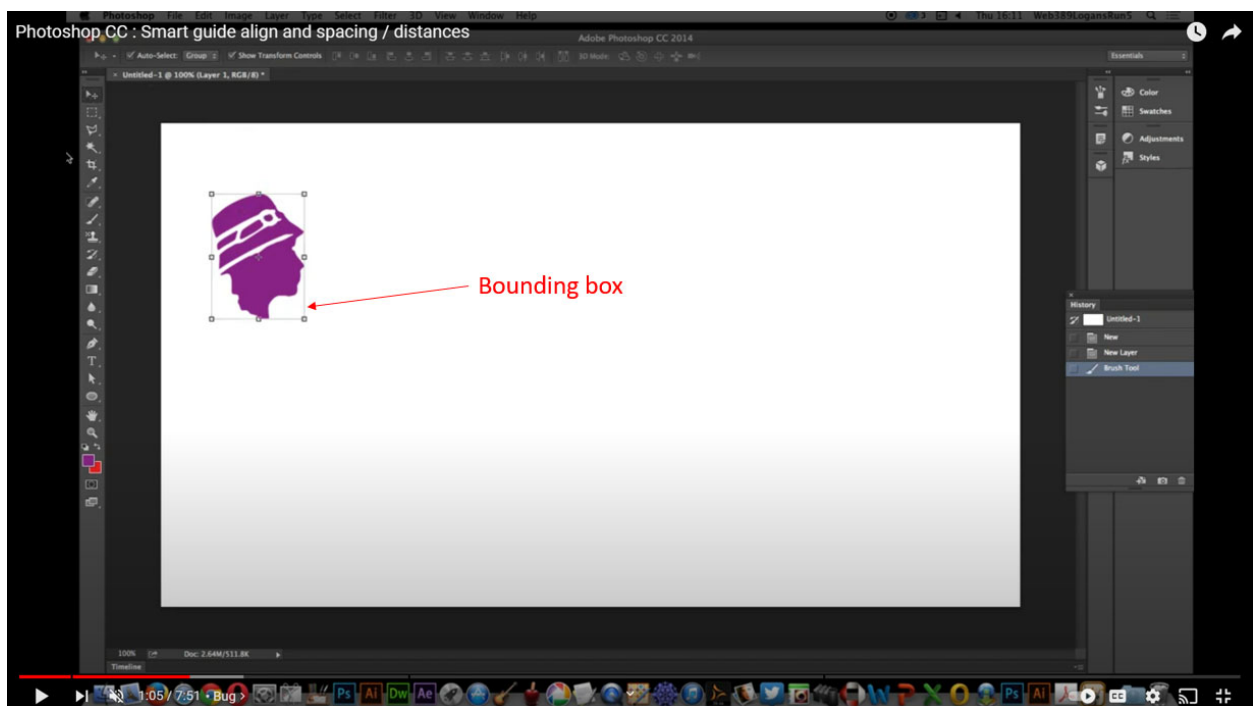
70. Additionally, to create the 3D rendering from the 2D patterns, the user must select seam lines on each pattern and virtually sew them together. The relative positions and arrangement of the two 2D patterns in Grinspun’s 2D window has *no effect* on the 3D display or the bidirectional editing. A user is free to move and arrange the two 2D patterns in the 2D window without any effect on the 3D rendering in 3D window. If the user were to move the 2D patterns closer or further away from one another, it would *not* alter the appearance of the 3D rendering at all. This is because the seam lines is what matters – if you move the length or location of the seam lines, the 3D rendering will change. But movement of the 2D patterns would do nothing to the 3D rendering.

B. Graphicextras

71. Graphicextras is a short YouTube video showing the use of a basic image-editing feature in Adobe Photoshop CC 2014. It has nothing to do with virtual clothing design. Graphicxtas describes its “Smart Guide” feature which determines and displays distances between objects.

72. The video depicts introducing an object (in this case, a pink icon of a person wearing a hat), with distance information being displayed as the first object is placed. The Photoshop software automatically generates a “bounding box” around the object. This bounding box is essentially a rectilinear or rectangular area that defines the two-dimensional spatial extent of the object (*i.e.*, width and height).

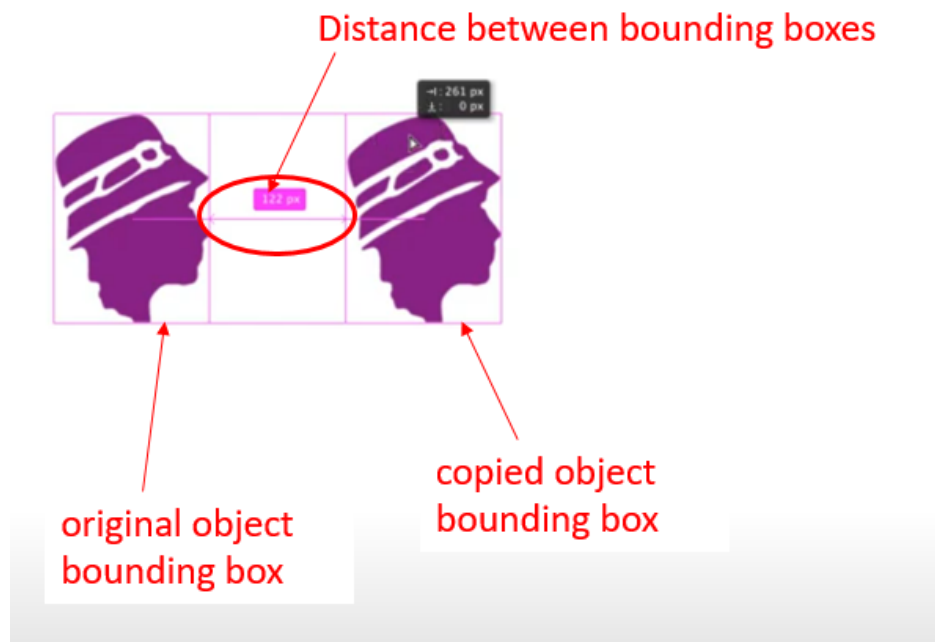
Basically, each of the four edges of the bounding box intersects (or is extremely close to) the extreme furthest-out point of the object that the box surrounds. It defines a rectangular border of the object, with no part of the object extending outside of the border. As shown below Photoshop adds eight defined points: four at the corners, and four at the midpoints of the horizontal and vertical border lines.



EX1005, 1:06 (annotated)

73. The video continues with copying the object, and moving the copied object to a new location. Both the original object and the copied object are provided with a respective bounding box. The software displays a “Smart Guide,” showing a distance between the bounding box of the original object and the bounding box of the copied object. Notably, this distance (and all measurements in the video) are

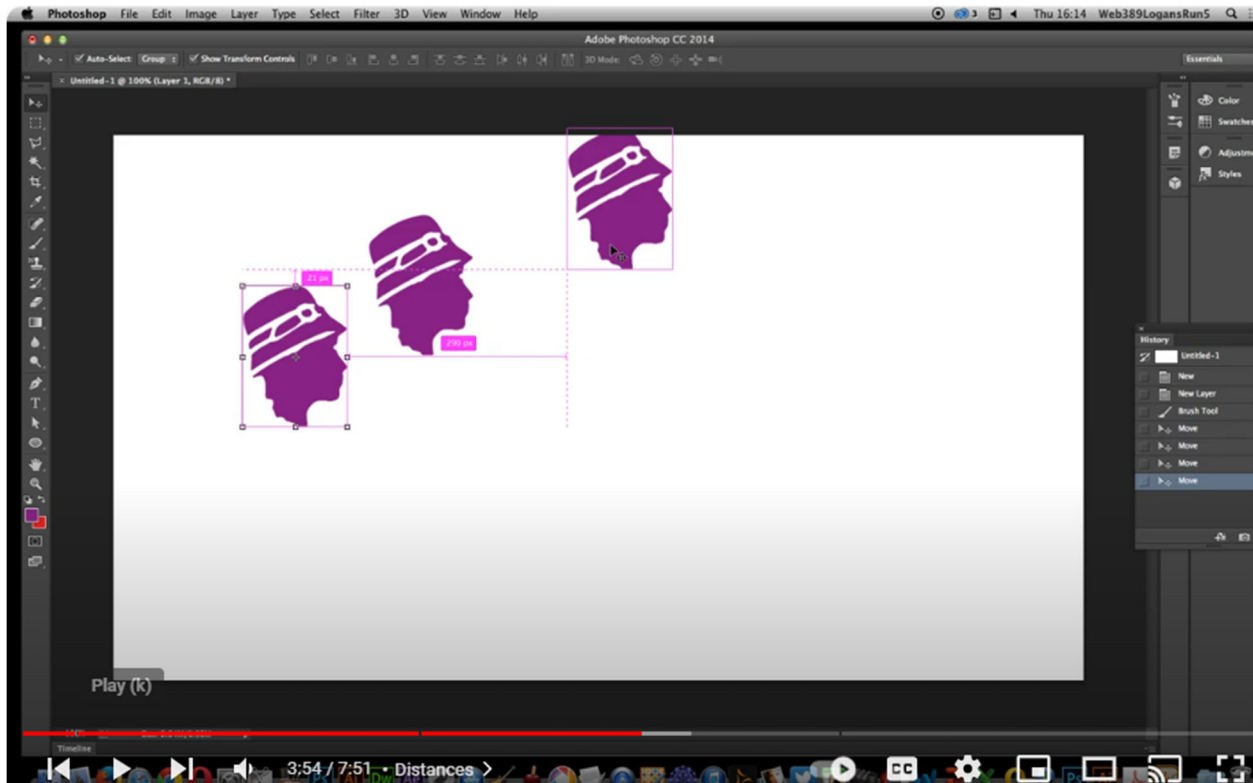
always taken relative to the ***bounding boxes***, and not the objects themselves. Graphicextras ***cannot*** (i) set any points of measurement inside the bounding boxes (they are fixed images), (ii) measure any line segments between points within a bounding box, or (iii) measure any line segments originating from a point within the bounding box. This is not surprising, because Graphicextras does not contemplate (and is not concerned with) providing accurate measurements between points of measurement set in 2D patterns for the design of 3D virtual clothing. Graphicextras simply shows equal spacing between what amounts to digital stencils of images.



EX1005, 1:25 (annotated)

74. Since the function of the Smart Guide feature is to provide distances between bounding boxes for spacing purposes, only horizontal and/or vertical

distances are computed and displayed. As shown in the screenshot below, both horizontal and vertical distances between two objects are displayed when the objects are both horizontally and vertically offset.



EX1005, 3:54 (annotated)

IX. ANALYSIS OF THE IPR GROUNDS

75. The IPR Petition sets forth reasons for why the claims of the '448 Patent would have been obvious in view of the various prior art references that I overviewed above. I disagree with these reasons for at least the reasons set forth below.

A. Even if Grinspun is modified by Graphicxtras in the manner proposed by Petitioner, the combination fails to disclose several claim elements

1. Element [1.pre]

76. Neither Grinspun nor Graphicxtras teach taking a measurement *of a 2D pattern*, which is the foundation of claim 1 and found specifically in the preamble.

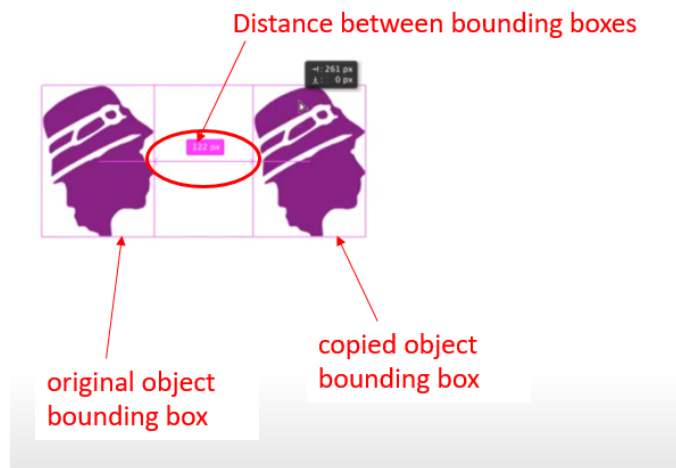
77. Grinspun certainly provides a 2D pattern in its Design Window 110, but no measurements are taken of the 2D pattern.

78. Thus, Petitioner turns to Graphicxtras's so-called "suggested improvements" such that the Grinspun-Graphicxtras combined system would "enabl[es] presentation of onscreen measurement information associated with 2D patterns within Grinspun's design window 110" and "display[s] an onscreen measurement that changes to account for a separation distance between two objections." Petition, p.32. According to Petitioner, the user would have received a "measurement of a line segment appearing between garment patterns 120 in the design window 110" of Grinspun. *Id.*

79. However, as noted above, Graphicxtras does not teach taking measurements of a 2D pattern or object. Rather, Graphicxtras teaches creating a "bounding box" around the object, shown below, for purposes of taking measurements *between* those bounding boxes:

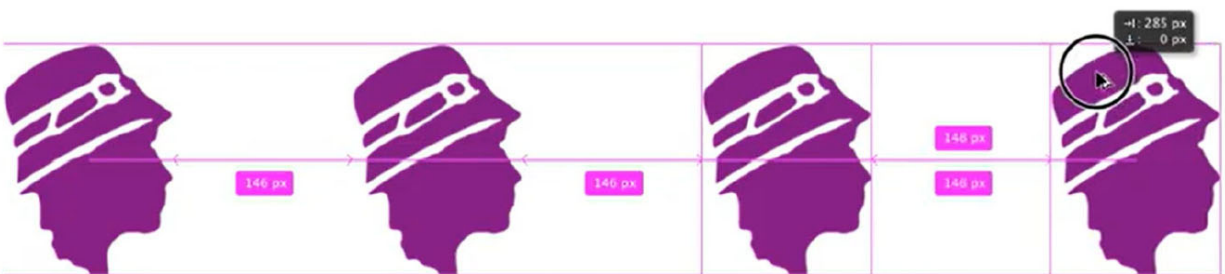


EX1005, 1:06 (annotated)



EX1005, 1:25 (annotated)

80. For example, Petitioner argues that Graphicxtras’ “measurement guide” function displays various horizontal distance measurements. Petition, p.22-23. But these are horizontal distance measurements between the bounding boxes of objects, and are *not* measurements of points within the bounding boxes.



EX1005, 6:00; Petition, p.23

81. Petitioner even admits that the “displayed length” in Graphicextras’ “measurement guide” is a “horizontal distance measurement (*from the adjacent 2D object*)”. Petition, p.23 (emphasis added). Measuring distances *between* objects or bounding boxes is not measurements *of* an object.

82. Even if determining a distance *between* objects would be a measurement *of* an object, Petitioner’s concocted Grinspun-Graphicextras combination that is relied upon throughout the Petition is completely contrary to the teachings of Graphicextras. Petitioner proposes an illustration of the Grinspun-Graphicextras combination that would look like the following:

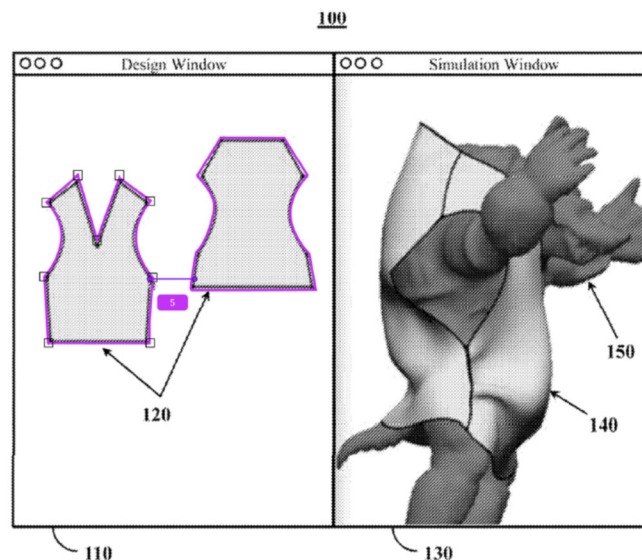
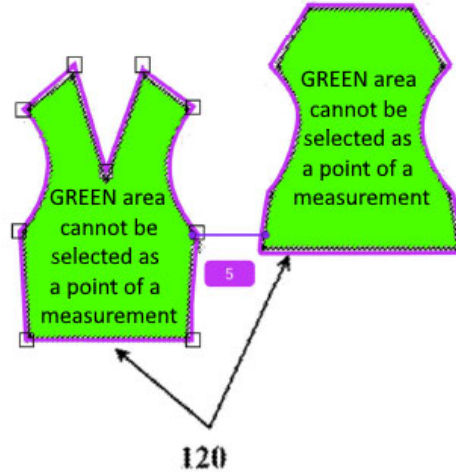


FIG. 1

Petition, p.29

83. According to Petitioner, this combination would have a line (shown in purple) that traces all edges of the 2D patterns such that distance information (represented by the number “5”) between these 2D patterns can be displayed. But nothing in Graphicextras teaches drawing or tracing the outline of the pattern itself, or determining the distances between the patterns themselves. Rather, once again, bounding boxes are used. Petitioner appears to create this purple outline out of thin air with no explanation in a creation of what measuring distance between the patterns would look like in the Grinspun-Graphicextras combination. This is pure hindsight, and is self-serving to the Petition’s argument. In short, nothing in Graphicextras would lead a POSA to determine a difference between outer edges of 2D patterns.

84. Finally, even if one assumes the Petitioner’s Grinspun-Graphicextras combination is valid, the combined system would not allow a user to select points inside of the 2D objects, *i.e.* within the 2D pattern piece, as illustrated by this annotated portion of Fig. 1 of Grinspun:



EX1004, FIG. 1 (annotated)

85. This again highlights the fact that the Grinspun-Graphicextras combination does not take any measurements *of* a 2D pattern, which is required by claim 1.

86. The '448 Patent overcomes the difficulties of taking a measurement of two or more points of 3D clothing by measuring a length on the 2D pattern that accounts for separation between pattern pieces. The Grinspun-Graphicextras combination simply does not accomplish this. At best, the combination only results in measurements of the spacing *between* bounding boxes of two 2D pattern pieces, and does not provide measurements *of* a 2D pattern.

2. Elements [1.2]-[1.3] [15.2], [16.2]

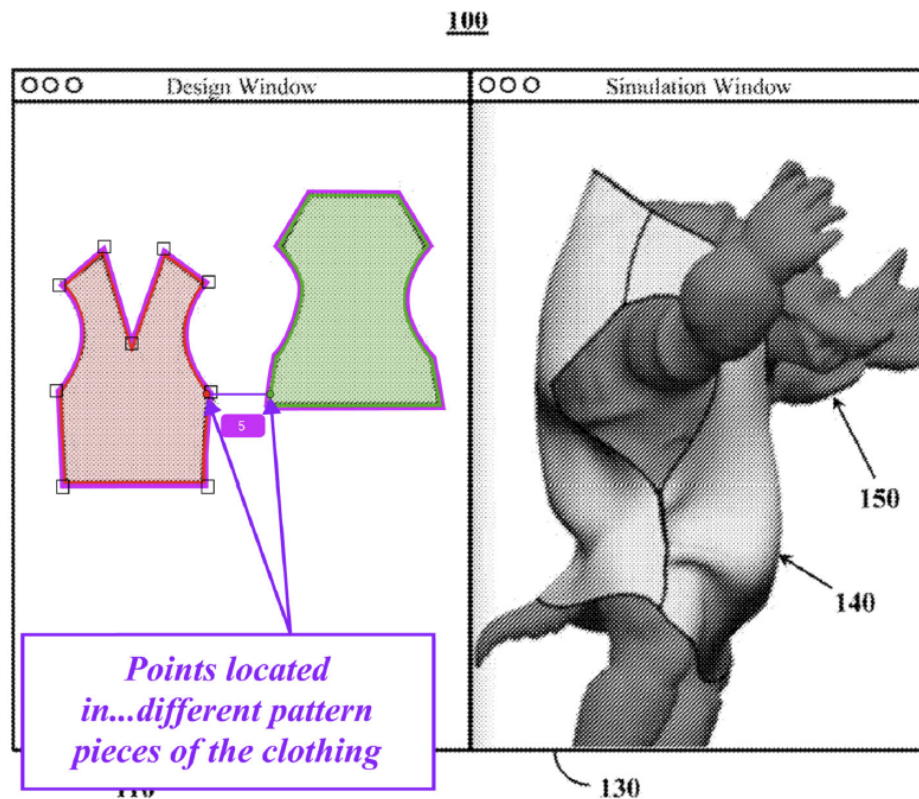
87. Elements [1.2]-[1.3]¹, [15.2], and [16.2] require determining attributes of areas in which the points are located, wherein the attributes indicate at least whether the points are located in a *same* pattern piece of the clothing or *different* pattern pieces of the clothing. For example, the system's "measuring apparatus may determine that areas to which the two points A and B belong correspond to different pattern pieces based on the data structure corresponding to each of the two points A and B." EX1001, 7:25-40. The data structure corresponding to each point that allows the system to determine whether the points are on the same or different pattern pieces may include "a link, information associated with at least one of a pattern piece in which each of the points is positioned, a line in a pattern piece on which each of the points is positioned, or a point on a line in a pattern piece." EX1001, 2:20-25; 6:58-62. As another example:

The data structure corresponding to each of the points may store information corresponding to each of the points in the form of a linked list, a tree, or a table, for example. The information corresponding to

¹ In Petitioner's "Listing of Challenged Claims" on page iv. of the Petition, Elements [1.2] and [1.3] are separated, however both are combined as Element [1.2] in pages 34-35 of the Petition. For purposes of this Reply, I am referring to the arrangement of the Elements as set forth in the Listing of Challenged Claims.

each of the points may include, for example, identification information of a pattern piece in which each of the points is positioned, identification of a line in a pattern piece in which each of the points is positioned, a coordinate of a point on a line of a pattern piece, and the like. EX1001, 6:63-7:4.

88. The Petitioner's Grinspun-Graphicxtras does nothing of the sort in order to determine whether two points are on the same pattern piece or different pattern pieces. Petitioner's entire analysis for these limitations can be summarized as follows: "[T]he Grinspun-Graphicxtras system would have determined that two points (plurality of points) associated with a line segment are each associated with distinct 2D patterns 120" and "[t]hus... a POSITA would have recognized from Graphicxtras' demonstration that the process of establishing points for distance measurement by the system would have involved determining attributes of areas in which the points are located." Petition, pp.34-35.



Petition, p.35

89. But the Grinspun-Graphicxtras combination does not make any affirmative determination that the points are on the same or different pattern pieces. For example, I don't see any explanation of what the system would look to in order to determine if the points are on the same pattern piece or different pattern pieces. The illustration above merely shows that the two points selected by the user are on two different pattern pieces, but the system makes no affirmative determination of such a fact by looking at "attributes of areas" in which the points are located.

90. Moreover, in the Petitioner's Grinspun-Graphicxtras combination, the borders of the 2D pattern pieces and all of its points are *always* on two different pattern pieces. There is therefore never any use for an affirmative determination that *the points are located in a same or different pattern pieces*. There is no disclosure that Graphicxtras's Smart Guide function or any related software in the Grinspun-Graphicxtras combination actually and affirmatively determines whether or not these points are located in the same or different pattern pieces. That decision would be of no consequence in the Grinspun-Graphicxtras combination.

3. Elements [1.4], [15.3], [16.3]

91. Elements [1.4], [15.3] and [16.3] require determining a length of a line segment using the points *based on the determined attributes of the areas, the determined length of the line segment changed to account for separation between the pattern pieces responsive to determining that the points are located in different pattern pieces*. For the same reasons given above in the preceding section, the Grinspun-Graphicxtras combination does not receive points or determine attributes of areas where the points are located in order to determine whether those points are on the same or different pattern pieces. Because of this, the length of a line segment generated by the proposed combination is not determined *based on determined attributes* of the areas associated with those points.

92. Additionally on this point, the '448 Patent teaches determining “a length of a first line segment between two points 272 and 274 present in the same pattern piece 271, and a length of a second line segment between the point 274 in the pattern piece 271 and the point 276 in the pattern piece 275.” EX1001, 11:22-26. In such a scenario, “the length of the second line segment may include a length of a connection line between the point 274 in the pattern piece 271 and the point 276 in the pattern piece 275.” EX1001, 11:32-34. Thus the determined length of the second segment is different than the determined length of the first segment because the “total length” of the second segment can be “obtained by subtracting the length of the connection line from the length of the second line segment.” EX1001, 11:35-39. In other words, the distance of the second segment is determined differently than the distance of the first segment, *depending on whether the points are located in different pattern pieces or the same pattern piece*, which is something the Grinspun-Graphicxtras combination does not do as explained above.

93. For these reasons, the Grinspun-Graphicxtras combination also does not teach the determined length of the line segment being changed “*responsive to* determining that the points are located in different pattern pieces” which I understand is required by the claims.

94. Further, regarding the claimed “length of the line segment changed to account for separation between the pattern pieces,” Petitioner proposes a specific user operation where the user moves one pattern piece relative to another in order to achieve this feature. *See* Petition, pages 37-43. Petitioner argues that the Grinspun-Graphicextras system provides that the determined length of the line segment is changed to account for separation between distinct two-dimensional flat patterns 120, because a user would have “generally create[d] and/or **edit[ed]** patterns and draped forms using mouse movements” within the 2D design window 110. Petition, pgs. 37, citing to EX1003, ¶77. Petitioner further explains that the user would have performed an initial measurement at a first time point (T_1) using a first instance of the “measurement guide” function, and then performed a positioning adjustment by dragging one two-dimensional flat pattern (green) and moving its position within the design window 100 relative to the position of the other two-dimensional flat pattern (red). EX1003, ¶80; *see* EX1005, 5:47-6:00.

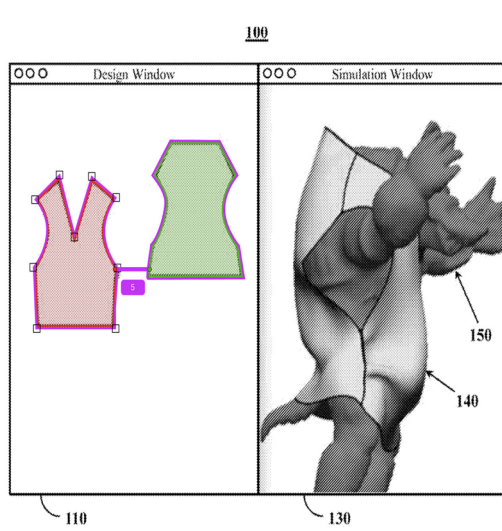


FIG. 1

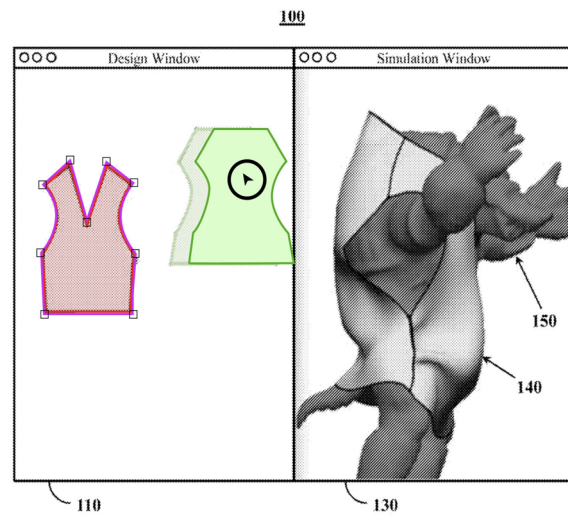


FIG. 1

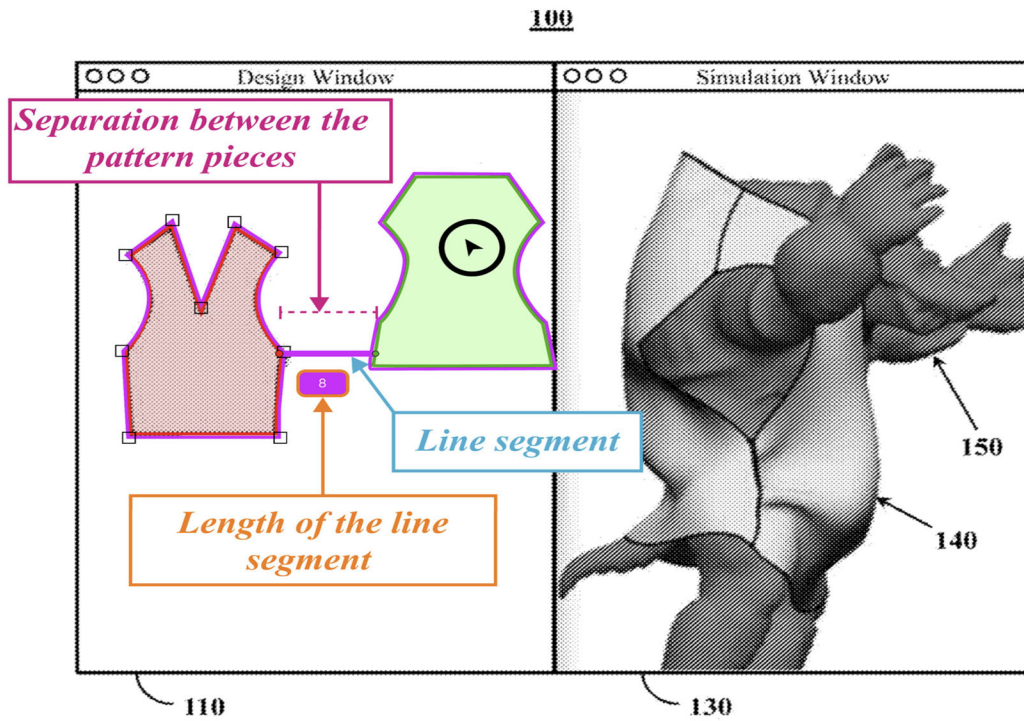


FIG. 1

Petition, pp.38-42

95. But the “changed” does not mean moving the second pattern to a new position, or a comparison of the length of a line segment between first and second patterns before and after the second pattern is moved. Rather, the ‘448 teaches repeatedly and the claims require that the patterns are fixed relative to one another, that the selected points are fixed, and that the line segments are fixed. The entire purpose of the claimed invention is to measure the length of a line segment in response to determining that the points are located in different pattern pieces, and then accounting for the “white space” or “separation between” the two patterns. The “changed” in the claims refers to modifying the length of the line segment to account for the space between the patterns. This concept is clearly described in the ‘448 patent, and illustrated in Figures such as 2B, 4, 5A and 5B. This feature is important because when a user or ultimately a garment manufacturer is attempting to determine the measurement of a portion of the 3D clothing, that length must be accurate – no matter whether the length was determined by measuring the distance between two points on the same 2D pattern, or two points on different 2D patterns.

96. The Grinspun-Graphicextras combination does not and cannot disclose this limitation. In the Grinspun-Graphicextras combination, the claimed “points” can never be inside or within the pattern pieces. The points can only be along their edges. Because there can be no portion of the line segment extending into either

2D pattern piece, there can be no change in the length of the line segment to account for the separation between the patterns pieces. The line segment is always “0.” And one cannot move the second pattern piece to generate an artificial change. The claimed measurement of the new line would still be “0” every time. This just illustrates the problem with Petitioner’s argument and interpretation of this claim language - the distance is not changed *to account for* separation between the pattern pieces, the distance *is* the separation between two pattern pieces.

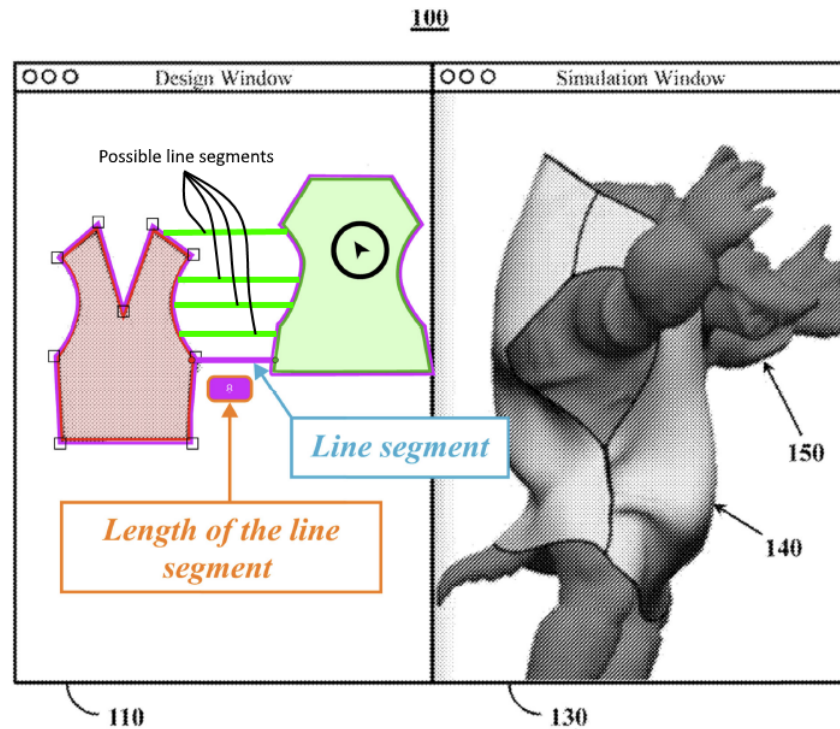
97. Further, since the “points” are always on different pattern pieces in the Grinspun-Graphicxtras combination, the determined length of the line segment is thus in not changed *in response to* determining that the points are located in different pattern pieces – the displayed length is only changed by a manual operation performed by a user. That is, the software and system of the Grinspun-Graphicxtras combination does not determine a length of a line segment, and then change the length based on a determination of the points being in different pattern pieces.

B. A POSA would not modify Grinspun based on Graphicxtras as proposed by Petitioner, further distinguishing Claims 1, 15 and 16

98. POSA would not have been motivated to combine Graphicxtras with Grinspun.

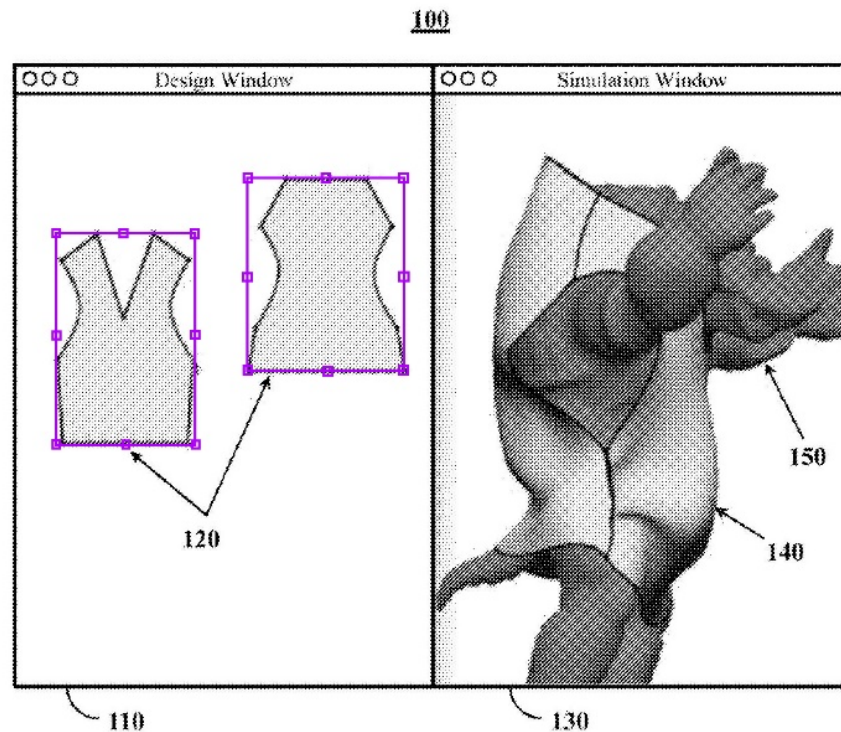
99. Petitioner contorted Graphicxtras’s bounding boxes in such a way that they trace the edges of the 2D pattern pieces in Grinspun. This proposal is supported

only by the Declaration of Dan Perrault (EX1003, ¶67), which provides no explanation for why the Grinspun-Graphicxtras combination does not include Graphicxtras's bounding boxes. However, Nothing in either Grinspun or Graphicxtras teach tracing the outer edges of the 2D fabric to determine the distance of a line segment between those outer edges. The use of bounding boxes would make a length measurement between two bounding boxes simple, which is why it is used in Graphicxtras – the length measurement between the bounding boxes is the same no matter which points on the edges of the bounding boxes are selected. (In other words, the vertical edges of two adjacent bounding boxes have a length between them that is the same no matter where the length is measured from on the those vertical edges). However, since the bounding boxes are not included in the Grinspun-Graphicxtras combination, the proposed combination would need to identify a start point and an end point for a length measurement. For example, referring to Petitioner's annotated FIG. 1 of Grinspun below, there are many possible line segments (shown in green below) that each represent different distances between the patterns. Nowhere does the proposed combination identify how to select a line segment (or its start/end points) for the display of a length of the spacing:



EX1004, FIG. 1 (annotated)

100. A POSA would have instead incorporated the Graphicextras's bounding boxes into Grinspun, shown in purple in the following annotated Fig. 1. Here, I have drawn a purple bounding box about each of the two pattern pieces such the entire pattern piece is inside (or at most, intersecting) with the bounding box.



EX1004, FIG. 1 (annotated)

101. This proposed application of Graphicextras to Grinspun obviates potential difficulties, for both a user of the feature and in the programming the feature, that stem from using an irregular border and programmatically selecting among an infinite number of different line segment lengths representing the spacing of the two patterns or objects. Notably, when a bounding box is created around the 2D pattern pieces in Grinspun, the points along the four lines forming the border may, or may not, coincide with an area of the pattern piece. This leads to further distinctions between the claim

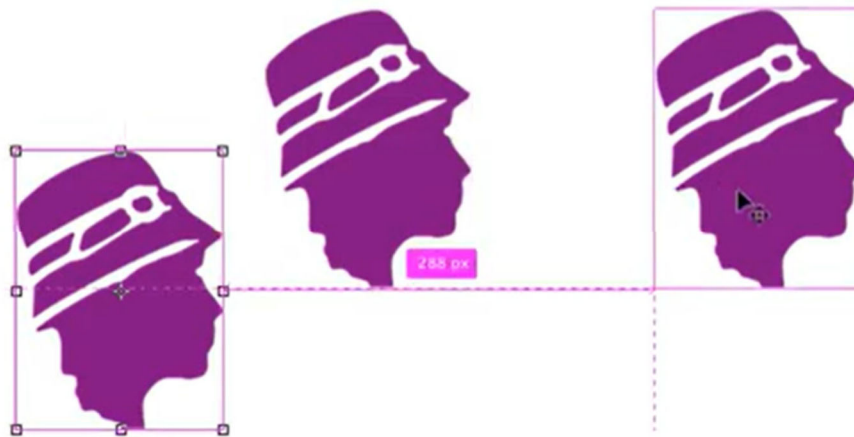
1. Elements [1.2]-[1.3], [15.2], and [16.2]

102. Petitioner argues that in the Grinspun-Graphicxtras system, upon the user providing an initiating command for the “measurement guide” function, the Grinspun-Graphicxtras system would have *determined* that two points (*plurality of points*) associated with a line segment are each associated with distinct 2D patterns 120 (the attributes being that the points are located in different pieces of clothing). Petition, pgs. 34-35.

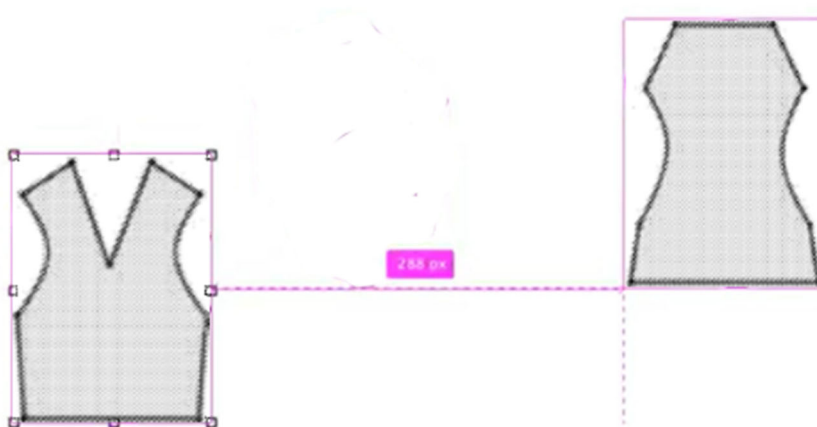
103. However, when the bounding boxes from Graphicxtras are used around each 2D pattern piece, a particular point along these bounding boxes may or may not lie within the confines of a 2D pattern piece. In other words, a portion of the bounding boxes may intersect the corresponding 2D pattern piece, while an overwhelming majority of the bounding boxes does not intersect the corresponding 2D pattern piece. Nothing in either Grinspun or Graphicxtras teaches actively “determining” whether any of these points would be within, or outside of, the 2D pattern piece. Hence, the Grinspun-Graphicxtras combination does not determine whether the two points are in an area located in the same or different pattern pieces, and the user does not actually select specific points.

104. Moreover, the points along the bounding boxes can never be “located *in* a same pattern piece” or be “located *in* different pattern pieces of the clothing” because the points will always be on the bounding box which is never

inside of the 2D shape. This can be seen in the image taken from Graphicxtras appearing on page 20 of the Petition, which has also been edited as applied to the pattern pieces of Grinspun:



(Petition, pg. 20)



105. The Grinspun-Graphicxtras combination, with a rectilinear bounding box around each pattern piece, also does not actively *determine* attributes of areas in which the points are located, where the attributes indicate at least whether the

points are located in a same pattern piece of the clothing or different pattern pieces of the clothing. This step and feature is entirely missing when the rectilinear border of Graphicxtras is applied to Grinspun.

2. Elements [1.4], [15.3], and [16.3]

106. Petitioner argues that the Grinspun-Graphicxtras system provides that the determined length of the line segment is *changed to account for separation between* distinct two-dimensional flat patterns 120, because a user would have “generally create[d] and/or edit[ed] patterns and draped forms using mouse movements” within the 2D design window 110. Petition, pgs. 37, citing to EX1003, ¶77.

107. Unlike the proposed Grinspun-Graphicxtras system, the ’448 patent describes how a user selects to points anywhere on the 2D screen, determines at least if they are on the same pattern piece or different patent pieces, and when on different pieces it accounts for separation between the pattern pieces – namely because when sewn together (as is depicted in the 3D window) this separation is not present. The patented system thus provides a distance measurement as would be actually found in the 3D clothing when the patterns are sewn or otherwise connected to form the clothing. This length change to account for separation between the pattern pieces is clearly shown in Fig. 4 of the ’448 patent:

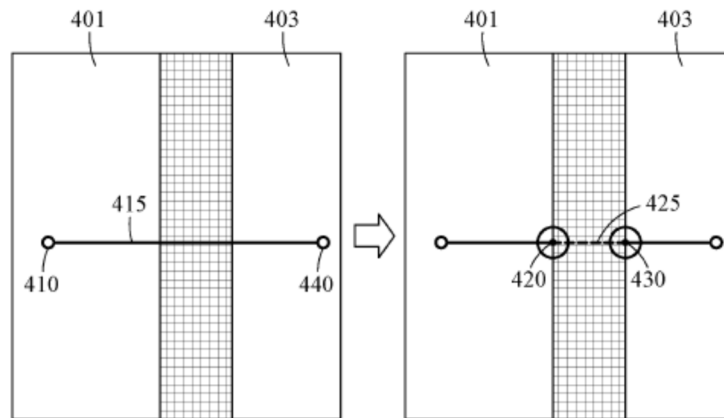


FIG. 4

108. Unlike the '448 patent, the measurements in the proposed Grinspun-Graphicxtras system are not “responsive to determining that the points are located in different pattern pieces” as is required by claims 1, 15 and 16.

C. Petitioner’s enumerated reasons for combining Graphicxtras with Grinspun are improper, and in fact a POSA would not have been motivated to make the proposed combination

109. Petitioner acknowledges that Grinspun does not expressly disclose a method of taking a measurement of a two-dimensional (2D) pattern. Petitioner proposes to modify Grinspun with Graphicxtras to provide measurement functionality to the system and method of Grinspun. However, for the reasons set forth below, a POSA would *not* have been motivated to modify Grinspun based on Graphicxtras.

1. Determining a distance between the two 2D patterns in Grinspun's Design Window would provide no benefit

110. Petitioner first argues that “a POSITA would have modified Grinspun's onscreen interface of the CAD software to include Graphicextras' suggestion for a ‘measurement guide’ so as to provide the user with real-time measurement information within Grinspun's design window 110 and thereby facilitate rapid organization/positioning of multiple garment pieces within the window 110.” Petition, pp.25-26. Several problems exist with this rationale.

111. First, the preciseness of the relative positions of the 2D patterns in Grinspun's Design Window 110 has *no effect* on the 3D display or the bidirectional editing that is the focus of the Grinspun patent publication. In other words, movement of one 2D clothing pattern within the Design Window 110 relative to the other 2D clothing pattern would not change the 3D rendering or draping of the clothing. The 2D patterns are virtually sewn together along seam lines, no matter where the patterns are located relative to one another. The Petitioner is simply wrong to state that it would have been obvious to “facilitate rapid organization/positioning of multiple garment pieces within the window 110” because movement of those garment pieces in the window 110 does *nothing* to affect the 3D draping of the clothing.

112. The simple fact that the user in Grinspun can move and edit the 2D clothing patterns does not render it obvious that the user would like to have the distance between those objects visualized on the screen. Petitioner argues that a “POSITA would have recognized that incorporation of the ‘measurement’ function within the Grinspun system would have allowed a user to achieve greater precision” in moving the 2D clothing patterns. Petition, p.26. But this reasoning falls apart because movement of the 2D clothing patterns has no impact on the resulting 3D draped clothing article.

113. Determining and displaying the distance between (boundary boxes of) objects in Graphicextra may be beneficial in Graphicextra itself because the user is evenly spacing objects on the screen – a display of that distance between objects allows the user to confirm that the objects are evenly spaced. The same is not true in Grinspun, where the user only sees two 2D patterns, and the distance between those two 2D objects is not compared to any other distance.

114. Regardless, this entire rationale for obviousness merely restates the “result” of the Grinspun-Graphicextras combination as a “reason” to make the combination in the first place. The fact that Graphicextras has a “measurement guide” is not a reason to include it in Grinspun. Grinspun is absolutely silent about the organization of multiple patterns in the 2D windows.

2. There is no ‘known’ problem with onscreen displays of garment design applications

115. Third, Petitioner argues that “a POSITA would have been further motivated to combine the teachings of Grinspun and Graphicxtras because the combination would have involved using known user interface improvement (suggested in Graphicxtras) to address a known problem within onscreen displays of garment design applications like that of Grinspun.” Petition, pp.27-28.

116. However, the Petitioner fails to explain how this alleged “problem” was known in the field, or how the prior art suggested a “solution” to this problem. Regarding the alleged “known problem with onscreen displays,” the Petition never explains exactly what the “problem” is. The Petition eludes to the fact that Grinspun’s Design Window 110 may “begin with a blank screen” which can create “spacing issues.” Petition, p.28. Neither the Petition nor Mr. Perrault (EX1003) explain what exactly these “spacing issues” are, or why they are problematic. Moreover, the only evidence that Petitioner cites to support the notion that this problem was “known” is ¶66 of the Declaration of Mr. Perreault (EX1003), but that paragraph merely parrots the text of the Petition. It provides no additional insight or discussion whatsoever as to how this problem was allegedly “known.”

X. CONCLUSION

117. I currently hold the opinions that I have expressed in this declaration. However, my analysis may continue, and I may acquire or receive additional information or insights that may result in revised or supplemental observations or opinions.

118. I declare that all statements made herein on my own knowledge are true and that all statements made on information and belief are believed to be true, and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 or Title 18 of the United State Code, and that such willful false statements may jeopardize the validity of the '448 Patent.

Executed: September 16, 2024.


Dr. Muthu Govindaraj