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Automatic Pattern Setting System Reacting to Customer Design

Ying Yuan* and Jun-Ho Huh**

Abstract

With its technical development, digital printing is being universally introduced to the mass production of clothing factories. At the same time, many fashion platforms have been made for customers' participation using digital printing, and a tool is provided in platforms for customers to make designs. However, there is no sufficient solution in the production stage for automatically converting a customer's design into a file before printing other than designating a square area for the pattern designed by the customer. That is, if 30 different designs come in from customers for one shirt, designers have to do the work of reproducing the design on the clothing pattern in the same location and in the same angle, and this work requires a great deal of manpower. Therefore, it is necessary to develop a technology which can let the customer make the design and, at the same time, reflect it in the clothing pattern. This is defined in relation to the existing clothing pattern with digital printing. This study yields a clothing pattern for digital printing which reflects a customer's design in real time by matching the diagram area where a customer designs on a given clothing model and the area where a standard pattern reflects the customer's actual design information. Designers can substitute the complex mapping operation of programmers with a simple area-matching operation. As there is no limit to clothing designs, the various fashion design creations of designers and the diverse customizing demands of customers can be satisfied at low cost with high efficiency. This is not restricted to T-shirts or eco-bags but can be applied to all woven wear, including men's, women's, and children's clothing, except knitwear.

Keywords

Apparel Pattern, Application (App), Color Pattern, Customer Engaged Platform, Digital Printing, Merge Digital Apparel Pattern

1. Introduction

Digital printing production in cloth production accounts for a large portion of the current industry. Compared with existing dying techniques, digital printing does not need the process of stereotyping, which costs less and does not require mass production [1,2]. That is to say, the participation in digital printing is closely related to the service of customization.

Currently, the customizing services using digital printing are widely used for home fabrics, T-shirts, and various other types of fabrics, and what is in the background of these services is the convergence of IT technology. However, current IT technology mostly offers some conveniences in simulations or payment methods only. Even though the plate making process is not required in the digital printing

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Corresponding Author: Jun-Ho Huh (72networks@kmou.ac.kr)
* Dept. of Clothing & Textiles, Hanyang University, Seoul, Korea (yuanyingyuan@naver.com)
** Dept. of Data Informatics, Korea Maritime and Ocean University, Busan, Korea (72networks@kmou.ac.kr)

process, a design process prior to printing is necessary. Nevertheless, if customers design their own designs expressing their individuality, the design of each product will become different so that they will have to be re-designed with a computer. For fabrics or customized T-shirts, it is convenient to create image(s) for automatic printing as the simulation is performed within a rectangular domain and only the image in the same domain will be printed automatically. However, for the clothes actually traded, the cloth patches do not fit in the rectangular domain when printing is performed for the patches in advance and they are sewn together afterward. The digital textile printing (DTP) customizing service has the same problem and that is why it is difficult for this service to be used for other clothes, especially for women's clothing. In order to solve such a problem and implement a digital customizing service for various types of clothes, it is necessary to develop the technology with which the designer can directly set a flexible domain that automatically fits all the patterns of the patches of a clothing style that changes constantly (i.e., the domains with more complex shapes or following the outline of a piece of clothing, etc.). In this research, an input system that matches the domains with which the customer will perform simulations with patterns in advance has been developed using the concept of machine learning. The system allows the producer to set the domain as he/she wishes and then the design elements are reproduced on a pattern according to the predetermined domain. The automated reproduction process does not simply enlarge or reduce the mapped image but reproduces each element one by one so that, in the final product, the defects such as image juddering, voids, low resolution, etc. can be substantially reduced. Such a computing technology offers unparalleled efficiency to the existing technique of reproducing each element on a pattern by the designer. Also, this technology can be a key solution that can rapidly produce and provide customized-design clothing.

2. Digital Textile Printing & Service

The emergence of digital printing has created many new services in the fashion market. The plate making process has been simplified compared to the conventional dyeing process, and small-quantity production has become possible while saving water in the production process. That is, the characteristic of being able to produce products in small quantities can be widely applied to the fashion market. Additionally, the DTP process has become indispensable to the fashion customizing service or the clothing factory networking.

2.1 Background of DTP Study

Digital printing in current clothing production occupies a great deal of the current industry. Unlike traditional dying methods, digital printing does not need drawing or stereotyping, and its delivery is quick. Accordingly, the preparation cost is inexpensive and it is optimized for small quantity batch production [3-6]. Digital printing in cloth production is closely related to the customizing service. In this paper, Digital Printing is expressed in the abbreviated form DTP. DTP is digitalized from design to printing process. The system on digital equipment is as in Fig. 1.

Compared with traditional printing, the DTP process is as in Fig. 2. The existing process requires about 15 days from original copy to the output. However, current DTP takes only 1–2 days, which helps reduce the cost significantly, and it is optimized for a small quantity batch production system. As shown here, regardless of the complexity of the drawing, the current DTP method can concentrate on original design and can produce a more creative output.

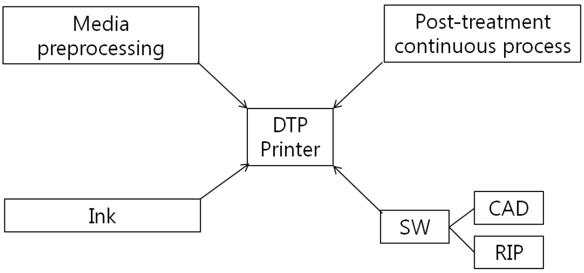

Fig. 1. Composition of the DTP system.

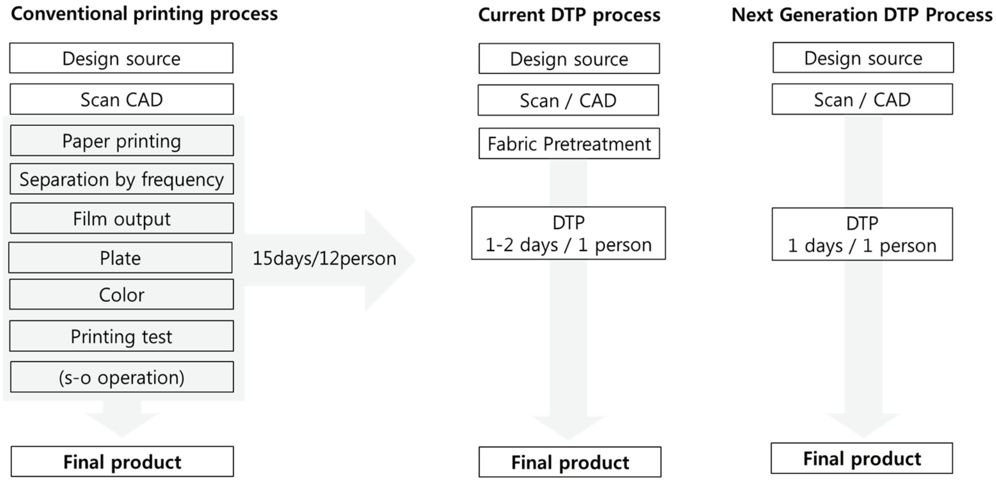

Fig. 2. Comparison of the DTP process with traditional printing.

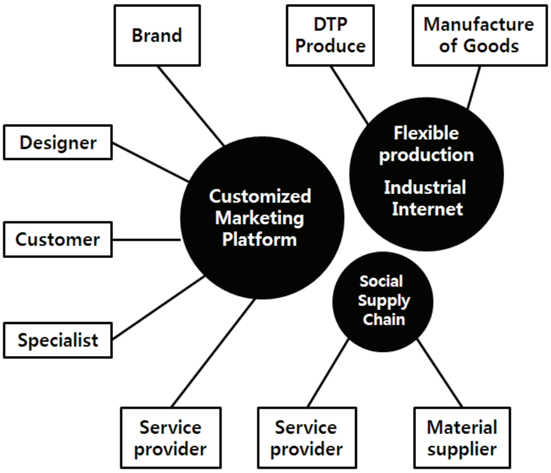

Fig. 3. C2B framework of textile mass customization.

In 2015, Lin and Jin [8] designed a customizing B2C service frame using DTP as follows Fig. 3. He divided the design in three parts including the customizing platform, factory production networking, and supply chain, and he marked linked areas with each cloth-related business. Among them, the part with the largest connection point is the customizing platform [7,8]. The example of the specific implementation of such a platform is half design platform in existing studies. That platform needs more than a simple payment function for selling goods. As a customizing platform is the point of applying customers' customizing information to the production method, it requires technology as a platform to make customizing information available as a file for final production. As a preliminary study, there was a study on customer design interacting with the user interface. This paper attempts to find the method of rear part technically [7-12].

2.2 DTP Fabric Customization and Online Clothing Service

Customizing using current DTP is divided into two parts as follows. One is a simple fabric printing customized production. The other is a cloth printing customized production that lines to clothes. A specific description is as in Fig. 4. The figure expresses DTP mass customizing services. Also, it analyzes the service process and means used per process. No. 1 is a process sold in Taobao as a digital printing customized production fabric. In this customized method, in Step 1, customers send their requests through chat or text and receive a quote. In Step 2, they send a printing file via email. In Step 3, the payment is made according to the quote. In this process, the internet is a media that simply displays contact details and shows printing effects in a photo. Personalized service requires a high labor cost as it serves customers, but it produces a quick and accurate product [13-16].

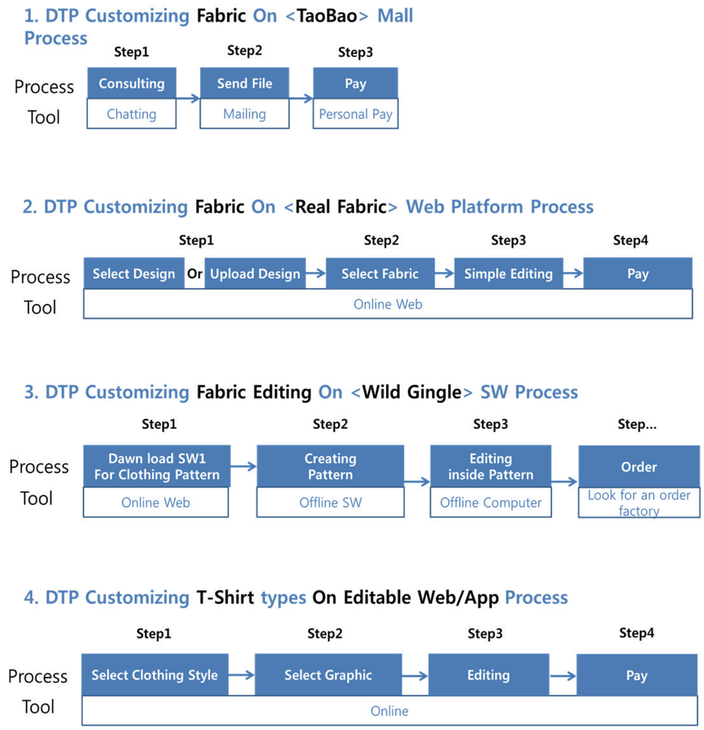

Fig. 4. DTP customizing fabric & the clothing-service process.

However, some customers receive counseling but do not buy. This causes the loss of labor costs. The second is a Real Fabric service currently provided in Korea. This service handles natural cotton fabric only. In the selection of fabric type by customers, it limits the kinds of selection to simplify the decision process. In addition, it links cotton and eco-friendliness while producing a good image. The overall purchase process service of Real Fabric is an online type at the relevant site. The steps are as follows. In Step 1, a customer selects their favorite pattern on the site or uploads their own image. In Step 2, the customer selects the thickness and width of the fabric [17-19]. In Step 3, customers can make various edits to the pattern as there is an editing function provided inside the site. Size editing is also available. In Step 4, it is possible for payment and payment point accumulation. With an internal automatic discount system, the more you order fabric, the more of a discount you receive. It is possible to pay with accumulated points. This service is popular in Japan as an innovative service that realized automation in an online system [20-23]. However, customers must have professional fabric technology and some degree of production in order to use this service. The third is a fabric editing service for DTP customizing printing. This service is a software produced by Wild Gingle. This company handles various pieces of software for designing clothes. One of them is to produce adjective-combination-type clothing patterns. It is possible to create a pattern image for DTP within the cloth pattern images. If a customer wants a cloth with different colors and patterns for the arms, body, front, and back, it can produce fabric saving and creates personality. That is a unique point from other simple pattern repetition software. It should be noted that an online system that provides a customized service for fabric images does not exist. However, editing for immediate output in a figure type with pattern is widely used by many designers privately. It may be a significant innovation for customizing production in the future. If a DTP image is made with this software, a user needs to download software that produces cloth patterns (at cost). In Step 2, using the downloaded software, it produces patterns as an adjective-selection item for the desired design. Step 3 moves to the fabric editing site of Wild Gingle where customers upload an extracted pattern for internal editing. In Step 4, the complete DTP image can be ordered through another printing company. Overall service is based on the knowledge of customers regarding clothes. Those who lack this knowledge cannot find and distinguish the location of the input pattern even if they wanted to insert a specific pattern on a sleeve, for example. The fourth is a digital printing online/ app service for T-shirts; this has become popular recently. With this service, the purchasing process is as follows. In Step 1, customers select the cloth style. In Step 2, they select the pattern for the cloth. In Step 3, they edit the pattern in a limited selection area. In Step 4, they make a payment. All processes are conducted online. There are three similar T-shirt production applications in Korea. They are not limited to fabric production of digital printing, but they link to clothes so that those without professional knowledge can easily participate in the design process. While this is positive, quasi-service providers are not fashion designers. However, DTP factories have printing equipment to produce clothes. So, there is no advanced silhouette design or style development. Also, customers are restricted to create their own customized design in the design participation process. The DTP cloth service is a service that goes one step closer to customers than DTP fabric. If it is used well, the DTP cloth service can be an important advancement in the cloth customizing service industry.

2.3 DTP Mass Customizing Service and Manufacturing

The DTP customizing service is based on fabric printing, and in the second process, DTP using a cloth customizing service is conducted [24-26]. Fabric DTP prints a regular width. However, the cloth DTP service has many production methods, which are as follows in Fig. 5. While DTP fabric and DTP cloth form a vertical relation in the production process, they form a horizontal relation in terms of business. Fig. 5 is a customer online service and production method to realize a customizing service using DTP. As for fabric, if the customer edits it in the editing screen, it is possible to convert it to printing. Besides, customers simply need to provide accurate fabric information. However, DTP cloth customizing is rather complicated. Firstly, as for app services for the simplest T-shirts, the customer is limited to selecting patterns, and only some colors can be selected. This service is often based on prior production and post-printing.

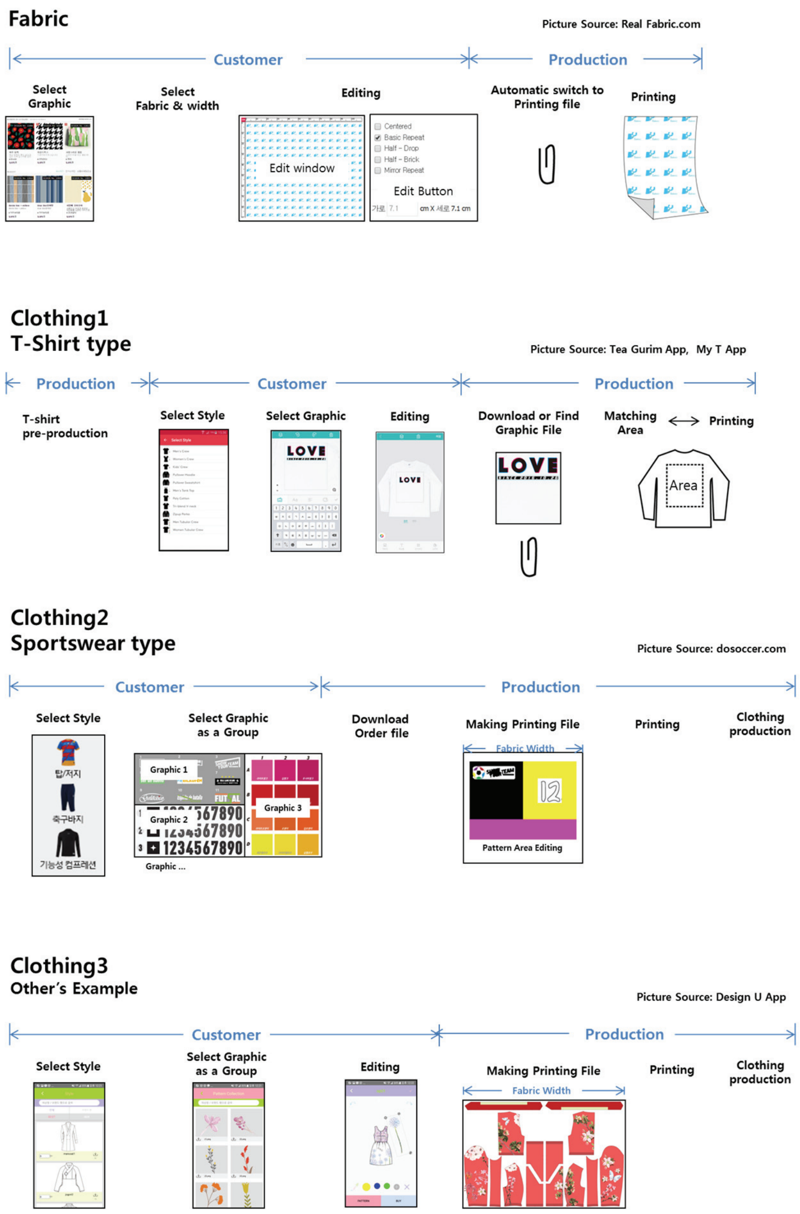

Fig. 5. DTP clothing mass customizing service and manufacture.

3. Research and Development Topics

In the analysis of current DTP services, it is more promising in the DTP product service market to sell clothes instead of selling fabric itself. However, the current cloth service does not pay attention to the designs of cloth styles. As service providers are not designers, they just simply seek efficiency in terms of DTP. However, the real problem is technical issues. For example, if applying it to women's cloth, which has complicated and quick changes in trends, more items are selectable and customers need to participate in the design. Moreover, there is a functional service for the online implementation in this setting. Due to such technical limits, a DTP customizing service for T-shirts is introduced most. If such technically completed cloth items can be set conveniently, it may be possible to easily register as new product photos are posted in shopping malls. If registered designs are transmitted in a DTP output image to a factory, like Wild Gingle services, after immediate pattern edition inside, as shown in Fig. 5, it can save labor costs that require the reproduction of customer designs one by one. That is to say, as in Fig. 6, if the pattern inside the image editing function is Back end and the customer design participation part is Front end, combining the technology of the two services it will be possible to flexibly apply more diverse items. Based on the research model in this paper, the front end makes flat design contents of cloth for customer editing. Furthermore, in the Back end, the pattern is made contents and the automated DTP image, including the pattern, is developed. Secondly, to use such technology widely in the clothing industry, it develops the user interface to set original design more easily.

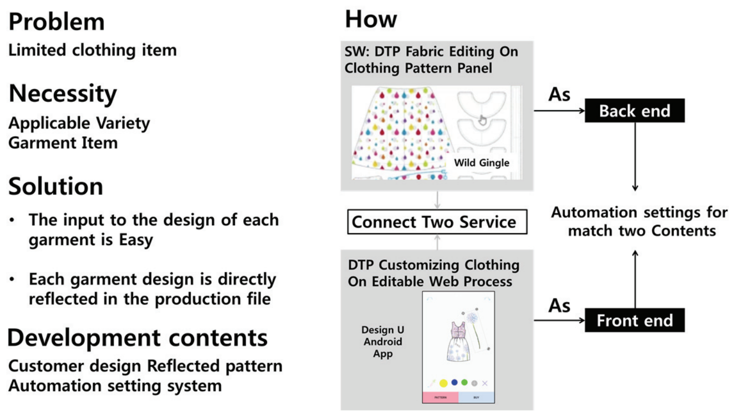

Fig. 6. Development model.

3.1 Basic Knowledge on Clothing Design

Fig. 7 is an expression of clothing before production by a designer. It is called a flat design. Designers express design elements and details through flat design. A pattern designer prints a pattern based on a flat design. Moreover, as normal people can see information on such a design, it is a good figure for design communication. Fig. 8 is a pattern. It is a pattern on the front end based on front end information of Fig. 7. Pattern designers print drawn patterns as in Fig. 8 when they receive a design order as in Fig. 7. A cloth pattern is used to draw a shape on fabric so real cloth can be cut. The cut and paste fabric becomes a 3D cloth in Fig. 7. Those without knowledge of cloth do not understand cloth patterns, which is normal. They have difficulties distinguishing the different parts of a piece of clothing while they are simultaneously looking at patterns. As for Wild Gingle, it is a method for customers to edit patterns directly as in Fig. 8. Therefore, in the design communication of cloth that is not yet production, it is effective to communicate with a flat design. To the contrary, when communicating with a factory, it is better to give a pattern directly to the manufacturer in order to reduce production time.

Fig. 7. Clothing flat design.

Fig. 8. Clothing pattern.

3.2 Area Matching

Fig. 9 is a figure that shows which pattern piece is applied to the area of flat cloth design. That is to say, it is an area matching as a user behavior to form a relation between flat design and pattern.

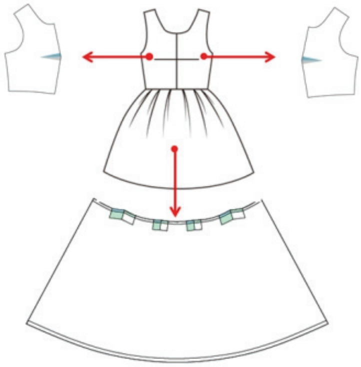

Fig. 9. Flat cloth design displays pattern matching.

3.3 Matching Method and Reproduction Information

Each area of flat cloth design is relevant to a piece of pattern used in actual production. More than one area of flat design can share 1 pattern piece. Matching is conducted in order to reproduce customer design elements in flat design on the real pattern. Fig. 10. The reason why performing reproduction is necessary is that there are many errors if the image is mapped on one area that is designed by a customer. It is a phenomenon caused by different design areas and pattern areas. Therefore, it is necessary to reproduce customer information into the pattern one by one. The customer design element to be reproduced on the pattern is as in Fig. 11. Customer elements are divided into image and color. Color indicates the background color of the relevant design area. When the customer selects an original color, the relevant pattern is changed to that color. The image uses a method of reproduction of link. The information owned by a customer edited image includes size, rotation, and position of the image's center in the figure area.

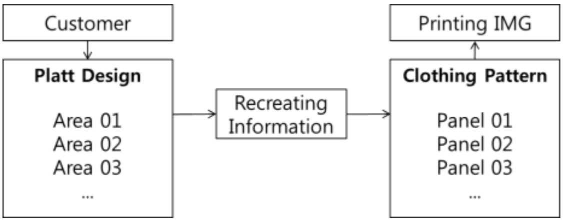

Fig. 10. Customer design reflected pattern process.

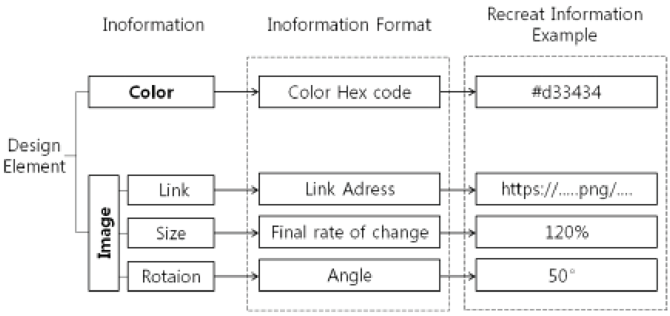

Fig. 11. Information of customer design recreating.

3.4 User interface for Automation Setting

While area matching and information reproduction are easy for those who can handle coding, it is difficult for cloth designers. Therefore, it is necessary to research and develop an easy setting system for cloth designers. This system aims to produce a coded effect created by developers only with a simple operation of selfie image editing. The step by a designer for system use is as in Fig. 12. Step 1 is preparation design source and this requires the front and back image of a Flat Design. All sizes are required for cloth patterns and all sizes are needed. In Step 2, the matching step, performs matching of figure are and pattern piece, expansion and reduction rotation. In Step 3, array performs pattern pixel unit selection (Adobe Illustrator standard, international standard), patched pattern upload, fabric width numeric input, automatic array button and manual complementation to save fabric more. It can perform copy, reflex rotation by need.

Fig. 12. User setting steps.

4. Development Result

4.1 Pattern Information Reproduction Process by Figure Area and Pattern Matching

Fig. 13 shows the process of reproducing the pattern information on a domain by matching the pattern with it. The sky-blue part (the color can be different) at the bottom layer is a clothing pattern and the one in the next layer (the white image) shows every domain of the flat design. The present structure, where the flat design domain has been arranged on the pattern, resulted from the overlapped mapping by the garment provider who had enlarged, reduced, or rotated the images. The image at the top is one that the customer designed. These images are the final deployment results obtained through the tasks of a customer who has chosen the design sources directly and then enlarged, reduced, rotated, and shifted them. Such a method was used because the buyer did not have a sufficient knowledge of the pattern (the sky-blue part) so that the design was applied to the flat image domain (the white part) directly. What the garment provider would require finally is the information of the buyer's design to be deployed on the pattern. Therefore, the white flat design domain will disappear in the final output. Also, as the images exceeding the sky blue domain will overlap with other patterns, these images should be cut. Fig. 13 is one that reproduced the image elements used by the customer from the design representation elements in Fig. 11. All the images, figures, and characters called in are considered the image elements. The deployment of the images prior to cutting them, according to the outlines of the pattern, is shown in Fig. 13. If one of them was turned 180˚ or its position was shifted, the image designed on the flat design domain would also do the same when it was reproduced. The reproduced pattern will be enlarged or reduced to scale according to the size of the clothing. In the reproduction process, the user matched area is mapped on the user arranged pattern. The figure area, except for the pattern, is removed. The relevant pattern is masked according to the outline of that pattern.

Fig. 13. Reproduction process of pattern information by figure area and pattern matching.

4.2 User Interface

4.2.1 User interface: importing and matching

Fig. 14 shows the part where the garment provider input the information to register the template that can be designed for the customer. This is also where the garment provider can receive technical service where the information will be reflected automatically on a pattern. ① and ② show the image uploading and matching, respectively. In ①, there are two separate uploading sections: a flat design image and the corresponding images. In ③, a flat design is uploaded. The flat design that can be designed by the customer by gathering the files with separated domains is then produced in ⑤. Here, the images corresponding to the front face form one group and the images corresponding to the back face form the other group. That is, when performing an 'Import' task, import all the former images and import the latter images. These images will be displayed on a separate canvas. A similar design service can be provided for front and back, or for the front, back, and side. By pressing button ⑧, it is possible to check how many canvases have been created and whether there are any errors in the images. If the customer wishes to design on a pattern, it would be much easier in the production process but as the buyers of clothes usually do not have any expert knowledge in clothing design and patterns, it will be difficult for them to read the patterns. Thus, it is more convenient to deal with designs through flat designs. In ⑥, all the images corresponding to ⑤ are being displayed and, by pressing ⑧ to display the information on the back face, all the corresponding sub-images will be displayed. The reason for doing this is because each image corresponds to a single domain of an area and this domain is related to the patterns to be imported. Also, the connecting task should be performed at the last stage. ⑫ shows the pattern importing. As the patterns are saved as images, this, after all, is image importing. The imported patterns are of actual sizes and they appear in ⑦ side by side. The next task to be performed after importing all the images to be processed is matching/mapping each domain of a flat design with patterns. First, when a pattern in ⑦ is clicked, the corresponding pattern image fixed to the pattern selected will appear. Next, a selection of the domain corresponding to this pattern is made, after which the selected domain image will appear on the

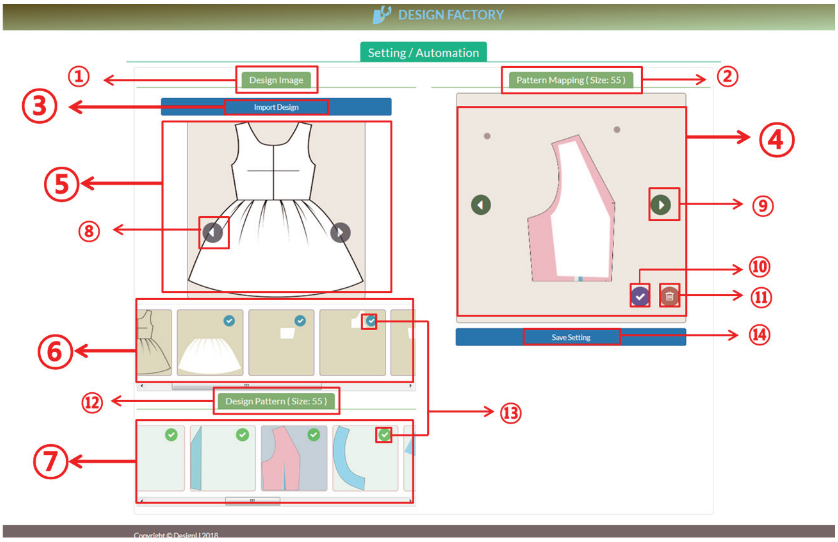

Fig. 14. User setting interface – matching.

pattern selected in area ④. The selected domain image can be enlarged, reduced, moved, and rotated so that the provider overlaps the two images in the same position by using this editing function. The matching will be completed by clicking ⑩. The check marks appear on the domain image and the pattern image being matched as in ⑬. By pressing the left or right button in ⑨, mapping can be performed more conveniently as the patterns displayed in ⑦ will be selected in sequence to find respective corresponding patterns. If the two elements to be matched were mistakenly selected, the corresponding image in ④ should be clicked and deleted by pressing ⑪. The image and the matching history will then disappear together. ⑭ is a save button which saves the import and matching contents in data format.

4.2.2 User interface: pattern array

Fig. 15 shows the pattern arrangement stage. After completing the import and matching tasks in Fig. 14, they need to be arranged. This pattern arrangement task is performed by inputting the actual width and breadth of the fabric on which the pattern(s) will be printed in advance. In the simulation window where the actual fabric and pattern size have been applied, the designer decides how to arrange and print the pattern. The provider performs the pattern arrangement task just once in a way to best save the fabric by moving the pattern freely. In this way, the image will be generated automatically based on a previously planned arrangement even if there are repeated orders. ① shows the pattern is loading. The patterns entered in Fig. 14, the previous stage, carry all the mapping information and the corresponding matched patterns will appear on the screen by pressing ① in the arranging stage shown in Fig. 15. ⑤ is the size of the fabric, and the size of the fabric to be actually used should be entered. ⑥ shows the size information of the current pattern being processed, and the arrangement is usually performed based on the largest size. This is because small-sized patterns may not overlap when they are in the same position. ⑦ is the tools related to pattern shifting, rotating, binding, and reflecting. ⑧ is a simulation window on which

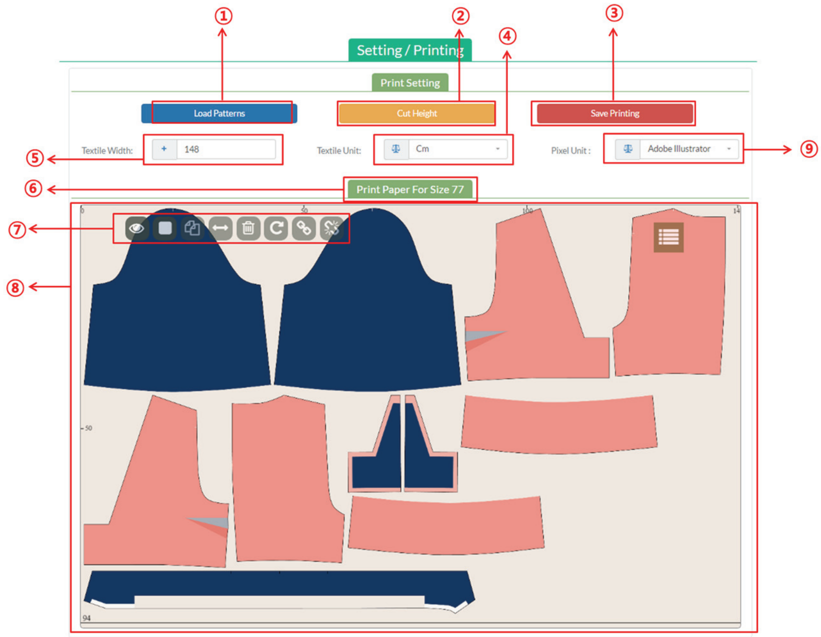

Fig. 15. User setting interface: array printing pattern position.

actual pattern and fabric sizes have been reflected. Button ② is for cutting the length. After all the patterns have been arranged, perform a cutting task for unnecessary parts (lengths) to save the fabric. That is, when generating the final automatic image, an image proportional to screen size ⑧ is created after completing the cutting process. ④ is for selecting the unit of the length between cm and inch. ⑨ is for the selection of the pixel unit. The patterns are the ones that have been already edited with Adobe Illustrator. These images are simulated on the screen when actual proportional sizes have been taken into consideration. An accurate image can be generated by using pixel/cm in Adobe Illustrator. The pixel of international standards should be used for images edited with CAD or Photoshop as they have different pixel values. Finally, the pattern arrangement contents, including all the mapping information, will be saved by pressing button ③.

The saved contents are stored in Project Management and will be displayed as sellable products on a relevant site for the customers to select and apply their own designs. Owing to the automated function of the system, the providers are able to acquire the full images of different design orders without doing much even if many customers order different types of clothes.

4.2.3 Test result

As a result of the test, the customer pattern is created on the relevant area and the pattern color is changed based on customer selection. If Fig. 16 is printed and output, the cloth in Fig. 17 design can be produced.

Fig. 17 shows an example of a design applied to the customer-provided dress form. Brown was selected for the background and several flowers were included.

Fig. 16. Auto-created DTP result.

Fig. 16 shows the result of an exact reproduction of the customer-designed image source on the pattern. This is not the enlargement of an area in Fig. 17. For the color, the pattern's pixel corresponding to each flat design domain has been converted into the color information selected by the customer. For the image, each image element's position on the pattern and the size information of the image used at the end were both memorized to recreate the original pattern. Thus, even if the pattern has become reduced or blurred while drawing it, as in Fig. 17, it will neatly reappear in the final output. The position on which the pieces of patterns being placed in Fig. 16 shows the resulting image created by the producer or the provider who has entered the actual fabric size to be printed. Each pattern was arranged one by one such that the customer's image information will be reproduced in the same position as in his/her arrangement.

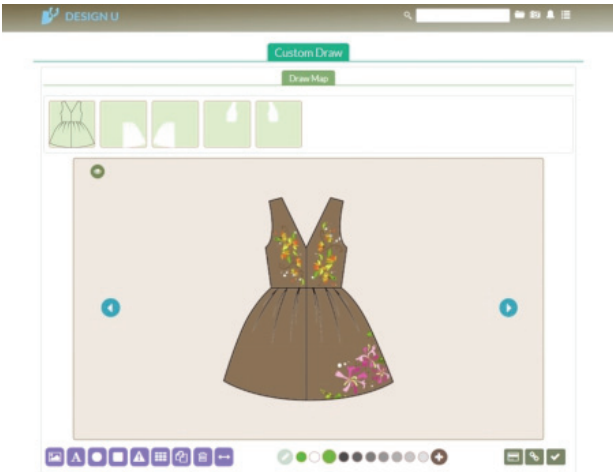

Fig. 17. Customer design.

5. Performance Evaluation

To perform an objective performance test, a football uniform company's design was registered on the developed platform. The result of the automated image generation based on the applied uniform design together with the customer's design is shown in Fig. 18. First, after selecting the design to be customized, relevant information was entered in the setting system developed for automation. The customer then freely input his/her own color along with a logo and pattern on the uniform. Then, the product automatically generated as soon as the placed order had been checked.

The company's service and production method was comprehended through the interview conducted in advance. Although they were implementing their own DTP-based customizing service, they did not have a user interface for simulations or editing. First, the symbols were attached to all the design sources provided by the company. Second, the customer downloaded the excel file format from the website. Third, the customer input the source symbols he/she wanted. Finally, it was sent by e-mail. In this case, the customer could not fully anticipate the final output of his/her order. However, such a problem was solved with the user interface described in the second part of Fig. 18. The other requirements and the production method for the image to be printed were as follows: Adopting the method of printing first, and then producing after. Also, assign a rectangular box that can amply cover the rim of the cloth pattern. After printing the pattern in the rectangular domain, start cutting it according to the shape of the pattern. This is shown in the left picture of Fig. 19. Based on customer information, it is the final product to which customizing was applied for production. The one on the right of Fig. 19 is an image generated on the platform through customizing. By comparison, the pattern in the rectangular box was reproduced as it was before, showing a reproduction rate of approximately 99%. The system developed in this study is also an application software which has the benefit of allowing creativity to be used for the DTP customizing service. This is due to the fact that it offers a variety of additional editing functions for representation according to various existing production methods pertaining to simple/partial customizing, color assignment, and other production processes.

Fig. 18. Auto-created DTP result.

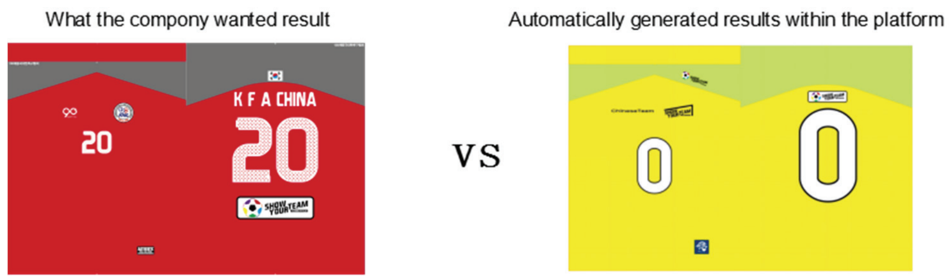

Fig. 19. Hand work vs. automation.

For performance evaluation, efficiency levels of the existing manual method and the platform automation method were compared. The results are shown in Fig. 20. The company's designers were spending an average of two minutes to reproduce the customizing design sources on a clothing pattern. However, it will take less than nine seconds per customized image to be automatically generated in the platform. This means, supposing that a designer works eight hours a day, he/she will be able to achieve 240 manual customizing tasks. However, if customizing is performed on the platform developed, it will take from nine seconds to 36 minutes. That is, if 240 orders have been placed simultaneously, it would take about nine seconds. If the orders were taken sequentially, the total production time would not exceed 36 minutes. Since a large amount of manpower cost can be saved with the developed method, the evaluation clearly validates its high efficiency.

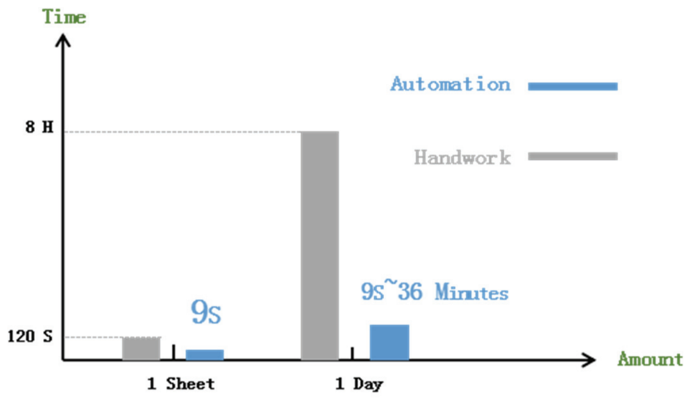

Fig. 20. Performance evaluation.

This study examined DTP services and compatible technical cases while examining the digital printing production method that has gradually settled in the customized cloth market. Also, this study developed the automatic pattern system and user interface for that setting for DTP customizing on the basis of various cases. As a result, four pattern sizes reflecting customer design elements can be obtained within 30 seconds. If there is a specific size, it is expected to take about less than nine seconds. In the past, when a customer customizing service was performed with Design Android App, it took four to eight hours for one pattern to be reproduced. In addition, it took a significant amount of time for the retrieval and array of the file. Of course, other items than T-shirts cannot be attempted in the current DTP customizing cloth market due to the above reason. However, such innovative development can be a huge turning point for various cloth item services in the DTP customizing service market beyond simply T-shirts. Accordingly, it is expected that existing, ready-made cloth brands may provide customizing special services on one to two items per season by sharing technologies in this study. This technology is a service at the website. If a brand is registered on the website, it can be accompanied by technical use and sales in the shopping mall. Besides, area matching is the most difficult in terms of user difficulty, but it is not a difficult action. It requires matching by someone with special knowledge in cloth for a complicated cloth that has more than six pieces. The matching area can be conducted more quickly if cloth pattern specialists perform it. If there is in-depth professional knowledge on cloth composition, it can quickly determine the attribution of the image area's panel and it can determine the attributed panel of the relevant image area. It is more convenient as it is performed by those using 3D cloth-related CAD. If a professional with in-depth understanding of cloth performs sewing in 3D cloth via CAD, it is possible to find a sewing line quickly. It is similar to this. This system is also conducted in the same manner. As matching is conducted by an expert, it is suggested to perform matching by an expert in cloth or design. Also, to allow this platform technology to be widely used by the clothing industry, researchers, and specialists, the relevant application methodologies should also be developed in the future to promote and activate the customizing service based on this platform.

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Ying Yuan https://orcid.org/0000-0002-4027-540X

She was born in Jilin province, People's Republic of China. In August 2014, she graduated from Hanyang University at Seoul, Department of Clothing and Textiles in Korea and received his bachelor's degree. She graduated (Ph.D. Candidate) from Hanyang University at Seoul, Department of Clothing and Textiles in currently enrolled in research. She started his career as a clothing-related platform in 2017, and she was selected as an innovative idea to support Korean commercialization. Currently she is CEO of "Design U" Republic of Korea and People's Republic of China. Her research interests are new automation technologies, and technology in the clothing industry.

Jun-Ho Huh https://orcid.org/0000-0001-6735-6456

He was born in Kyoto, Japan. He was finished the Cooperative Marine Science and Engineering Program, Texas A&M University at Galveston, United States of America in Aug. 2006. Received B.S. in Science degree from Department of Major of Applied Marine Sciences (Currently Faculty of Marine Biomedical Sciences), B.S. in Engineering degree (Double Major) from Department of Major of Computer Engineering from Jeju National University at Ara, Jeju, Republic of Korea in Aug. 2007. And completion of the Secondary School (Middle and High schools) Teacher Training Curriculum in accordance with Republic of Korea Secondary Education Act (Aug. 2007). Received M.A. in Education degree from Department of Major of Computer Science Education, Graduate School of Education, Pukyoug National University at Daeyeon, Busan, Republic of Korea in Aug. 2012. And completion of the Secondary School (Middle and

High schools) Teacher Training Curriculum in accordance with Republic of Korea Secondary Education Act (Aug. 2012). Received the Ph.D. in Engineering degree from Department of Major of Computer Engineering, Graduate School, Pukyoug National University at Daeyeon, Busan, Republic of Korea in Feb. 2016. He received the Best Paper Award from Korea Multimedia Society twelve times (November 2014, May 2015, November 2015, May 2016, October 2016, May, 2017; three times, October 2017, October 2018, November 2019), the Undergraduate Student Paper Bronze Medal (Corresponding Author) Awarded, Korea Information Processing Society, in April 2017, the Best Paper Award the 10th 2016 International Interdisciplinary Workshop Series from HSST, in August 2016, the Best Paper Award the 16th International Conference on Control, Automation and Systems October 2016, ICROS with IEEE Xplore, and the Springer Nature Journal Award, Human-centric Computing and Information Sciences most cited paper award 2019 (Research published in the journal, from 2016 to 2018; SCIE IF=3.212). In addition, he received the Best Paper Award (Two times) from the 15th International Conference on Multimedia Information Technology and Applications (MITA 2019), and the Best Poster Award (First Place) from the 7th International Conference on Big Data Applications and Services (BIGDAS 2019). He has been serving as chairs in some conferences and workshops; MUE 2017, BIC 2017, CUTE 2017, WITC 2018, MUE 2018, PDCAT 2018, BIC 2018, CUTE 2018, WITC 2019, MUE 2019, MIMI 2019, MIMA 2019, MITA 2019, BIC 2019, and CUTE/CSA 2019, He is Technical Committee at IFAC (International Federation of Automatic Control), CC 1 (Systems and Signals), TC 1.5. (Networked Systems). And, Technical Committee at IFAC, CC 3 (Computers, Cognition and Communication), TC 3.2 (Computational Intelligence in Control). Technical Committee at IFAC, CC 7 (Transportation and Vehicle Systems), TC 7.2. (Marine Systems). He is an Associate Editor with *Human-centric Computing and Information Sciences* (HCIS), Springer Berlin Heidelberg (SCIE/SCOPUS indexed). He is an Associate Editor with the *Journal of Information Processing Systems* (JIPS), Korea Information Processing Society (SCOPUS/ESCI indexed). Research Professor of Dankook University at Jukjeon, Yongin, Republic of Korea (July. 2016- Sep. 2016). He was an Assistant Professor with the Department of Software, Catholic University of Pusan, Republic of Korea, from December 2016 to August 2019. Since September 2019, he has been an Assistant Professor (Tenure Track) with the Department of Data Informatics, (National) Korea Maritime and Ocean University, Republic of Korea. His research interests include green IT, smart grid, edge computing, network security, the IoT, AI, big data, and system architecture.