Adopting Calligraphy Style to Design Smart Clothing for Down Syndrome Users

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Abstract
This study utilizes smart clothing as a tool to support self-training activities for individuals with Down syndrome. It addresses issues that arise in both daily life and sports, proposing sportswear with a calligraphy style, electronic devices and mobile applications. Down Syndrome Foundation R.O.C was established by selling Tu's Calligraphy as a fund-raising effort in 1998. His illustrated artworks contained messages of love, joy and abundance, and was intended for males with Down syndrome and parents. In 2018, the author was invited to create a smart clothing design for the foundation for its 20 year anniversary celebration ceremony. The garment developed offers Down syndrome users a good fit and meaningful calligraphy to support self-training purposes. Smart clothing utilizes functional stretch fabrics and a high degree of pattern-making technology protected by patent. The 3D sculpturing garment manufacturing method and system makes smart clothing easy to wear 12 hours a day. The garments have a 22gram electronic device with multiple safety functions, which include safety controls to assess temperature, location and fall down detection, an SOS alert, connected via mobile blue tooth. The smart clothing incorporates the silhouette, line stroke, texture and meaning of calligraphy style using a laser cutting mesh, hot-melt adhesive and waterproof tape. In summary, this study focusses on developing a smart clothing designing procedure to demonstrate a good "design method" for smartly styled clothing and garment patterns. These designs not only fulfil user needs, they also provide comfort for all day wear, reliability for self-care training and mental support.

Keywords: Calligraphy Style, Smart Clothing, Down Syndrome.

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Introduction

During 8 decades, the life expectancy of patients with Down Syndrome has increased by about 46 years. From 1929, the average life expectancy was 9 years old, in 1949, 12 years old, in 1982, 35 years old and in 2007, 55 years old (Barnhart and Connolly, 2007). In Taiwan, the research in 2015 by Chiang, Yang, Hsu revealed that the total number of Down's syndrome using Taiwan National Health Insurance in 2011 was 3,684. In this data, 181 Down's syndromes were over 50 years old, which was 4.9% of the total sample. It shows Taiwan is one of the long-term care of patients with Down's syndrome over 50 years old, in the world. The study also illustrated that 1407 Down's patients were aged 19 to 49. This is 38% of the total sample and their rehabilitation is home care. Lin (2018:67) pointed out that these families, who are care for rehabbing patients with Down's syndrome, are under pressures and challenges.

In 2016, Taiwan government approved a “10-years long-term 2.0” program. This program organizes issues of long-term care, specifying long-term care categories and personnel and services of long-term care for related (Lin G.-P., 2018). This program helps family to do and to improve the quality of long-term care. So, this study is taking family as the training place, parents and caregivers of Down's syndrome mainly use self-care skills training to cultivate the ability of patients with Down's syndrome to reach self-care task(Lu, 2016). In 2018, the author was invited to create a smart clothing design for the foundation for its 20 year anniversary celebration ceremony. The garment developed offers Down syndrome users a good fit and meaningful calligraphy to support self-training purposes.

Literature Review

The literature of this study was divided into three parts: dimensional transformation of 2D and 3D design in fashion design, smart clothing and self-care training for Down Syndrome.

2-1. Dimensional transformation of 2D and 3D design in fashion design

The study about well ability of dimensional transformation in smart clothing design is important. Take a case of Professor Jun Mitani cooperates with fashion designer Issey Miyake for example, Professor Mitani establishes origami research software, which is ORI-REVO(Mitani,2011), assisting Mr. Miyake(2018) to execute his fashion brand “132.5”. The software offers designer to create garment based on three-dimensional to two-dimensional as foldable cloth.

Computer-aided software(CAD) and Computer-aided manufacture(CAM) assist garment pattern makers to pinpoint and estimate the layout of the design drawings such as Lectra, Gerber, PAD and Investronica. These softwears and its system offer design from two-dimensional idea to three-dimensional. CAD tools like Gerber, Lectra, PAD, Maya, and Syflex help designers in the process of dimensional transformation. The Parametric Pattern Generator, which was developed by TPC Limited of Hong Kong(2011), is a computer-based input interface. It offers calculates the three-dimensional shape from a three-dimensional angle and can be planarized into a layout. In Korea, CLO 3D mainly uses a flat garment pattern to simulate the virtual model of a three-dimensional garment. However, the function of CLO 3D has a way to gain garment pattern by pattern flattening from virtual averter unique pattern as users to illustrate very fit garment silhouette and slash.

The research of Huang (2012) is the only fashion design method, which is the Sculptural Form Giving Method, from 3D to 2D perspective. In 2018, this research gains Taiwan's invention patent technology and won a price of future tech by Taiwan Ministry of Science and technology (2018). This unique fashion design methods helps to illustrate customized clothing design by introducing 3D virtual modelling before constructing a first garment sample. This patent method also offers 21 times efficacy to illustrate garment pattern in compared with the method in 2012. (Huang, Guo, Hou, 2017).

2-2. Smart Clothing：

The development of smart clothing in 1990s was mainly researching and developing by military use such as U.S.A and European Union (Ariyatum, Holland, Harrison and Kazi, 2010). These Institutes investigates on Smart clothing develops innovation research and development (R&D). Since 2001, many international sports brands are developing their produce with sensor and device, such as Adidas' self-adapting shoes, Gapkid's FM radio shirt, Burton's MD & AMP jacket, North Face's self-heating jacket, Sensatex Smartshirt. In 2005, more smart apparel products were developed in fashion, such as Levis's iPod jeans, Zegna's Bluetooth jacket and Thai solar jacket, and Oakley's solar clothing. In 2010, Suh, Carroll and Cassill's journal papers at the University of North Carolina were published using different stages of design research, product development, and product development. Process and functional clothing product development process, they divide the smart clothing product design steps into five stages: design concept generation, design, prototype development, sample clothing Evaluation and design refinement, product planning.

2-3. self-care training for Down Syndrome

Self-care training for intelligently disabled people: Brolin (1995) mentioned the following nine daily life skills in the life career education. It including ability to handle personal belongings, to choose and handle home matters, to care for personal needs, to raise children and face marriage, to purchase, to prepare and consume food, to purchase clothing, to demonstrate civic responsibility, to use recreational facilities for leisure activities and to engage in activities in the community.

Smart clothing is monitored the health care of users. It provids monitor the physiological and emotional index of autistic patients (Taj-Eldin, Ryan, O'Flynn and Galvin, 2018). Kara, Güleç and Çağıltay, 2018) used wearable clothing and animation to help the four children with intellectual disabilities in Turkey. They were taught to recognise five organs of the human body. In 2002, Carmeli, Kessel, Coleman and Avalon's study studied adults with Down's syndrome to exercise for 3 times for 30 weeks and to tracking during the 25 weeks. The result shows significantly improve of lower limb muscle endurance of adults with Down's syndrome. Rimmer, Heller, Wang and Valerio (2004) studied that improving the muscle strength and endurance exercise training programs for patients with Down's syndrome. Although there is no significant change in body weight, the important effect is to reduce the health risks of Down's patients and delay Down's Functional deterioration of muscle strength and muscular endurance in adults and maintenance of independent body function. In 2008, Shields, Taylor and Dodd found that treadmill activity training for children with Down's syndrome for ten

weeks and three times a week improved their cardiopulmonary function, physical fitness, and body fat ratio.

Research on the use of smart wearables in Down's syndrome: In 2018, Lazar, Woglom, Chung, Schwartz, Hsieh, Moor, Crowley and Skotko developed mobile application software for patients with Down's syndrome to address Down's patients' meals. Nutritional decision-making, their interface is user-centered, and the software is revised with feedback from doctors, geneticists, psychologists, dietitians. Semjonova, Vetra, Oks, and Katashev (2019) designed a smart T-Shirt worn by Down's patients and placed a sensor on the shoulder.

Methodology

This study used the authors' patent, the Sculptural Form Giving Method (Huang, 2018). Vertical and horizontal patterns are the two patterns to illustrate. The research utilises Microsoft Excel to calculate garment variation. This design method offers garment a high degree of accuracy in pattern-making. It also benefits fashion design team to do design communication. The map of Sculptural Form Giving Method is illustrated as squall. Body shape is defined as oval shape. $\frac{b1}{a}$ and $\frac{b2}{a}$ are experimental parameter, such as waist line $\frac{b1}{a}=\frac{17}{9.5}$, $\frac{b2}{a}=\frac{6}{9.5}$: .

3-1. The calculation of horizontal pattern：four quadrants and its formula are listed below.

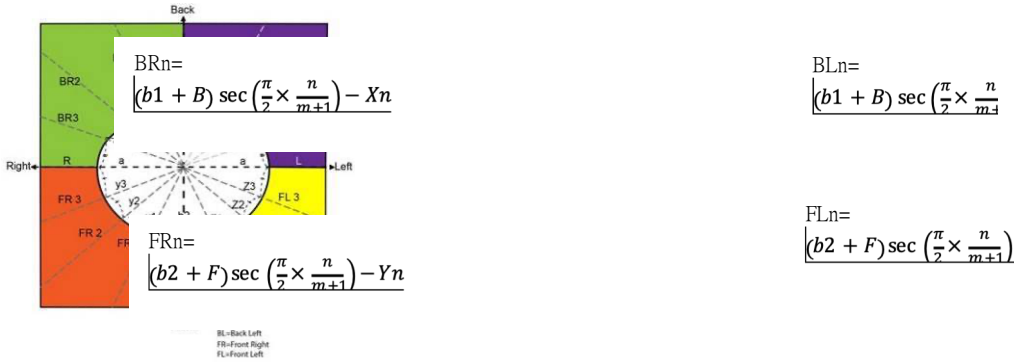


Figure 1 Four quadrants and its formula.

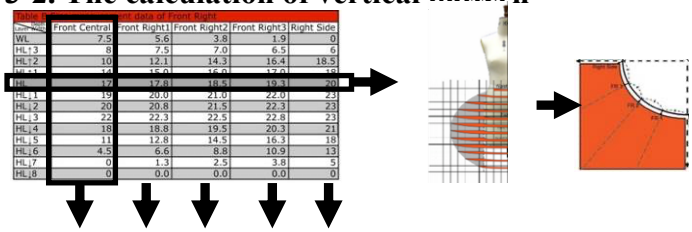
m: Number of nodes. n: Node order.
3≦n≦m. The number of nodes is more than 3, due to the silhouete getting smooth. This improves comfort of wearing. Taking the Sculptural Form Giving Method for example.

$$Wn= b2+\frac{1}{m}(a-b)\times n$$

$$BLn=(b1+B)\sec\left(\frac{\pi}{2}\times\frac{n}{m+1}\right)-Wn$$

After entering in Excel, pattern-maker is able to follow data set to draw vertical and horizontal variation.

3-2. The calculation of vertical pattern



	Front Central	Front Right1	Front Right2	Front Right3	Right Side
WL	7.5	5.6	3.8	1.9	0
HL13	8	7.5	7.0	6.5	6
HL12	10	12.1	14.3	16.4	18.5
HL11	17	17.8	18.5	19.3	20
HL1	19	20.0	21.0	22.0	23
HL2	20	20.8	21.5	22.3	23
HL3	22	22.3	22.5	22.8	23
HL4	18	18.8	19.5	20.3	21
HL5	11	12.8	14.5	16.3	18
HL6	4.5	6.6	8.8	10.9	13
HL7	0	1.3	2.5	3.8	5
HL8	0	0.0	0.0	0.0	0

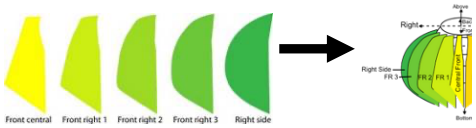


Figure 2 Vertical and horizontal pattern are display on mannequin in order.

3-3. The calculating variation by Excel

Figure 3 The interface to calculate variation by Excel.

Experimental Work

The experimental work was divided into three parts, including electronic module, fashion design and fashion show.

4.1. Electronic module and its application

The electronic module includes safety controls to assess temperature, location and fall down detection, an SOS alert, connected via mobile blue tooth.

Figure 4 Three ways to adjust heating pad temperature.

Figure 5 Pedometer screen. Figure 6 S.O.S SMS

4.2. Fashion Design

The smart clothing design includes design theme, design concept and garment design details.

4.2.1.Design theme：Love is able cross limitation and we have confidence together forever.

- **Design concept**：

This research collaborates with the Down Syndrome Foundation Republic of China and Professor Lee, to design smart clothing for age of 12, 22 and 32 Down syndrome male users. This study takes smart clothing as an intermediate tool to monitor the Down syndromes' actives ether life and sports issues, via sportswear, electronic devices, and its mobile application. This study establishes smart sportswear for Down users to improve 21% garment fitting for users' body via pattern-making technology of the

Sculptural Form Giving Method. It adopts 22gram electronic module to establish a smart clothing collection. The Down users intend to wear for a long time and improve the users' willingness to visualize and to monitor their daily sports activity. The technology of pattern-making of the Sculptural Form Giving Method is able to create unique garment silhouette, slash and details to improve users' life quality via clothing. This customized garment is a foundation for collecting big data and further data analysis. It also can be used to design for various users, such as athlete, baby, children, elderly and patients.

4.2.2. Smart clothing details：

The body size, calligraphy, garment technical design and photoshoot are the four major issues of fashion collection.

A.No.1 Down Syndrome male user

Figure 7 Down Syndrome user, who is age 12.

Figure 8 artworks contained messages of love by Calligrapher Tu.

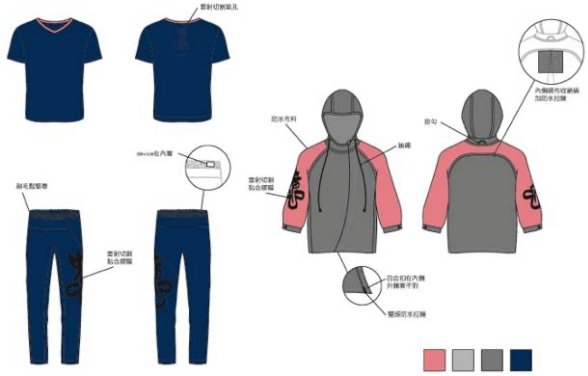


Figure 9 Garment details of mart clothing construction.

Figure 10 The electronic device in wait line and laser cutting mesh.

Figure 11 Front view and side view of smart clothing for age 12 Down Syndrome.

B.No.2 Down Syndrome male user

Figure 12 Down Syndrome user, who is age 22.

Figure 13 artworks contained messages of joy by Calligrapher Tu

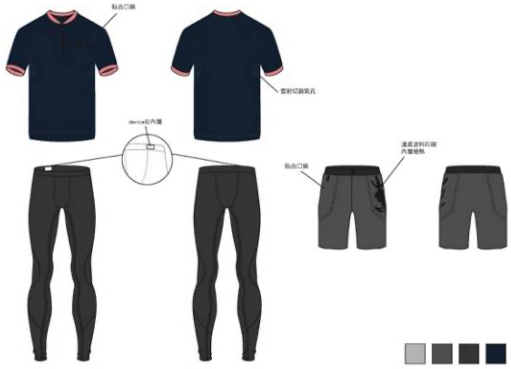


Figure 14 Garment details of mart clothing construction.

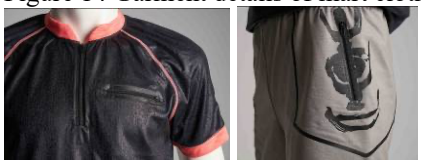


Figure 15 The garment details of pockets.

Figure 16 Front view and side view of smart clothing for age 22 Down Syndrome.

C.No.3 Down Syndrome male user

Figure 17Down Syndrome user, who is age 32.

Figure 18artworks contained messages of abundance by Calligrapher Tu.

Figure 19 Garment details of mart clothing construction.

Figure 20 Laser cutting reflective material, mesh of Calligraphy and power bank pocket.

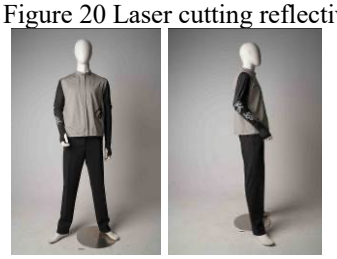


Figure 21Front view and side view of smart clothing for age 32 Down Syndrome.

4.3. Fashion Show

Figure 22 Down Syndrome Foundation R.O.C 20th for its 20 year anniversary celebration ceremony in Taipei Songshan Cultural and Creative Park, 2018.03.16

Figure 23 Fashion Collection in Taipei Songshan Cultural and Creative Park, 2018.03.16。

Conclusion

In summary, the Sculptural Form Giving Method and procedure is reliably to form smart clothing to fulfil user needs. They also provide comfort for all day wear, reliability for self-care training and mental support. This research utilized smart electronic module, which only 22gram, to form ether an easy wear garment to do self-care training and activities. The research result shows that taking the design skill from cross-disciplines is able to design smart garment offer users need.

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