

## A Study on Fashion Items to Prevent COVID-19 Using Wearable Technology

<sup>1</sup>Hye-Sook Park, <sup>2</sup>Phil-Joo Moon\*

<sup>1</sup>Professor, Dept. of Fashion Design and Branding, Pyeongtaek University, Korea

<sup>2</sup>Professor, Dept. of Information and Communications, Pyeongtaek University, Korea  
[hspark@ptu.ac.kr](mailto:hspark@ptu.ac.kr), [pjmoon@ptu.ac.kr](mailto:pjmoon@ptu.ac.kr)

### **Abstract**

*The generalization of social distancing due to the COVID-19 pandemic has rapidly spread non-face-to-face services, accelerating the speed of non-face-to-face digital conversion technology. The importance of telemedicine, a remote service, has been rekindled in the wearable technology including the medical industry. In a situation where it is not easy for any company to overcome the COVID-19 pandemic, it is a time when collaboration within the industry or between competitors is necessary. In addition to the digital-based online exhibition hall using AR-VR-MR technology, which is a major core technology of the future industry, virtual stores that can receive services such as actual shopping should be actively used. Paradoxically COVID-19 will provide new opportunities to reshape and reconnect the future of the textile and fashion industry. Therefore, the purpose of this study is to investigate the current status of wearable technology products being developed as fashion items for the prevention of COVID-19 and analyze their characteristics. This study results can be used as basic data for future research on the fashion industry and education.*

**Keywords:** COVID-19, Wearable Technology, Quarantine fashion item

### **1. INTRODUCTION**

On December 31, 2019, China reported an outbreak of pneumonia of unknown cause in Wuhan City, Hubei Province. On March 11, 2020, the WHO declared a global pandemic due to COVID-19. The world is realizing how much danger and damage the public health crisis can be caused by infectious diseases, both socially and nationally. Since the world has already experienced SARS, Ebola, and MERS and thus experienced infectious diseases, reviewing the response strategies of major countries and their impacts can be a valid basis for future crisis management policies [1]. As of July 2021, according to Worldometer, the cumulative number of confirmed COVID-19 cases is 194.8 million, and the total number of deaths is close to 4,174,000 [2]. Due to the instance, the world is faced with the worst situation of 'social distancing', in which human-to-human contact should be kept as far as 2 meters away from each other.

The generalization of social distancing due to the COVID-19 pandemic has rapidly spread non-face-to-face services, accelerating the speed of remote digital conversion technology. The importance of telemedicine has been rekindled in the bio-health and medical industry. In the past, telemedicine was suggested as a solution to solve the medical financial deterioration and the shortage of medical personnel and facilities, due to the entry into an aging society. However, the need for such services as a solution to prevent the spread of infectious diseases is emerging after the COVID-19 pandemic. The COVID-19 pandemic has accelerated the paradigm shift from the traditional medical industry centered on diagnosis, treatment, and hospitals to the disease,

prevention, and consumer-centered smart healthcare industry with ICT-based technology convergence [3].

Even in the fashion industry, the development of wearable technology fashion items fused with ICT-based hi tech is being developed innovatively, and ironically, these developments have been accelerated as much as 10 years due to COVID-19. Therefore, this study aims to identify the characteristics of wearable technology items that are being developed as fashion products to prevent COVID-19, and this analysis aims to become a bases for future research in the field of fashion industry and education.

## 2. THEORETICAL BACKGROUND

### 2.1 Fashion industry status according to the COVID-19 pandemic

COVID-19 caused the biggest economic contraction since the World War II and has hit every kind of fields from manufacturing to fashion industry. In particular, fashion products are relatively vulnerable to the crisis since personalities reflects the market. According to McKinsey, the average market capitalization of apparel, fashion and luxury companies worldwide fell by about 40% between early January and March 24, 2020, a steeper decline than the market capitalization of the entire stock market. In this global crisis, the domestic textile and fashion industry is also experiencing many difficulties. As a result of a fact-finding survey conducted by the Korea Textile Industry Association for the textile and fashion industry in March, 92% responded that sales decreased in the first quarter. In April 2020, the utilization rate of domestic dyeing complexes fell 32.7% compared to the previous year, and the utilization rates of chemical fiber and cotton spinning companies are also falling. Korea's textile exports also decreased by 35.3% in April compared to the previous year, which is the largest decline since 1988, when the Korea International Trade Association started providing monthly export results [4]. Wearable technology, on the other hand, flourishes due to its characteristics, that it can compensate human needs in order to break the limitations of fashion. Furthermore, aspects such as information and communication, bio-technology, and nano-tech should be reorganized in a way that challenges abilities, and emerge as a new direction to improve the human body and mind [5].

In result, it is a perfect time to develop items that can make human life convenient and safe by using various wearable technologies to overcome the global economic recession and fear of contagion due to COVID-19.

### 2.2 The overview of wearable technology

Wearable technology clothing can be summarized as wearables that contains digital functions for the enhancement of human ability or convenience in the user's personal space, that can be controlled by the user, and has constancy in operation and interaction [6]. As shown in [Table 1], the development process of wearable technology clothing can be divided into three stages. The first stage is to disassemble a digital device, such as a computer, or directly connect it to the clothing so that the system can be worn. In the second stage, the system is attached to the clothes, and parts of various functions are arranged on the clothes according to the user's convenience. These days, it can be said that the second stage is to embed MP3 players, headphones, mobile phones, etc. in commercial leisure clothing. In the case of the second stage, since the electronic devices or modules were connected using a computer cable, the clothes seem to play a role of hiding the electronic devices or modules from the outside. In the last third stage, clothes are made using electrically conductive fibers and digital yarns that can be used for information and communication purposes, and appears naturally, like real clothes [7].

**Table 1. Development stages of wearable technology clothing**

Step	Form and content
First step	Disassembled and connected personal computer.
Second step	A form in which devices with various functions are selected and arranged for user convenience. The device and wiring are used for pc, so the clothes only play the role of hiding the wirings.
Third step	The stage of making clothes using electrically conductive fibers and material capable of information and communication.

Through these stages of development, wearable computers are expected to develop from accessory type to textile · clothing integrated type, body attachable type, and ultimately, bio implantable type. It is evolving in a direction closer to the body. Low-power technology for long-term use, ultra-compact to improve wearing comfort. The development of flexible/stretchable electronic technology is more urgently required [8].

### **3. COVID-19 quarantine fashion item using wearable technology**

#### **3.1 Evolution of COVID-19 Prevention Mask**

A virtual platform was held to announce the innovative wearable technology in 2021. Maskfone introduced the 'Maskfone' [Table 2], a face mask with built-in earbuds. The Maskfone is designed to reduce the need to touch or take off the mask to talk on a cell phone. This product is washable and is made of soft twill weave and fits the human face well. The fibrous tissue is dense enough to block large particles, but some ventilation is possible. Therefore, it can also be used during exercise.

Razer, a US company known for its PC game accessories, introduced an innovative mask product called 'Project Hazel' [Table 2]. It is an N95-grade mask that can block droplets, and consists a removable vent to control airflow with a UV sterilization function case that can be used when charged. Users can also personalize their masks by choosing from 16.8 million colors with various effects [9].

Recently, six Chinese designers, in collaboration with Beijing's Frank Chou Design Studios, have created a capsule collection of conceptual designs for combatting the COVID-19 [Table 2]. The series is titled Create Cures, abbreviated to CC – referencing the medical unit measurement of cubic centimeters. Portable utility is a key theme. Sun Dayong's 'Be a Bat Man' shields the wearer using UV technology– the upper-body armor also folds to a compact size when not needed. Meanwhile, the Maskerchief by Chen Min, serves as both a foldable face mask and a reusable handkerchief. In addition to protective and sanitizing features, designs also interact with and engage users. Above Studio's 'Buckle Masks' changes color from white to black to signify that the filter is ready to be replaced. Pino Wang and Frank Chou's 'Time-Changing Hand Sanitizer' reacts to oxygen, morphing from pink to purple to blue over the course of 30 seconds to ensure proper application of the product [10].










A water capsule and a test result table are attached to the outer surface of the COVID-19 diagnostic mask' jointly developed by a research team at Harvard University's Bis Research Center and MIT's Department of Biotechnology [Table 2]. Masks, the number one contributor to the prevention of COVID-19, are evolving. It is equipped with a strong virus blocking effect and a COVID-19 infection diagnosis function. In June 2021, the Bis Biomimetic Engineering Research Institute at Harvard University in the United States announced the 'COVID-19 Diagnostic Mask' jointly developed with a research team at the Massachusetts Institute of Technology (MIT) in *Nature Biotechnology*, an international scientific journal. The research team introduced that the use of this mask is simpler and faster than the 'gene amplification (PCR) test', which is mainly used to test for COVID-19. After wearing the mask, let the water in the capsule attached to the outside seep into it, and then exhale until the test result comes out. If you are infected with COVID-19, the color of the 'paper sensor' mounted on the inside of the mask changes. It takes 90 minutes to derive the test, which is very short compared to the PCR test, which takes 3 to 6 hours to get the result. In addition, there is no need to prick deep in the nose and throat to collect mucus, and only a small concentration of genetic material released during respiration can confirm the presence of infection. The accuracy of the test results also met the PCR test standards of the World Health Organization (WHO) [11].

According to Bluetooth SIG, the certification body, LG Electronics recently received certification for the 'AP551AWFA' model of home appliances [Table 2]. The product was described as 'Face Mask Type Air Purifier with Bluetooth LE'. It is believed to be a successor product to the electronic mask (model name: AP300AWFA) first released by LG Electronics in November 2020. In fact, the AP551AWFA model is already being introduced as the 'LG Puri-Care wearable air purifier 2nd generation' in some online shopping malls such as Indonesia's Tokopedia [12].

The 'AIR helmet' [Table 2] is a creation of former automotive engineer Michael Hall's Micro Climate company. The USB-rechargeable, battery-powered piece of kit totes two HEPA air filters, and continuously

pumps fresh air throughout the chamber that surrounds your noggin'. Aimed primarily at travelers who change environments at jet speed, the AIR creates a stable microclimate inside the helmet that offers consistent air quality regardless of your surroundings. A fan-powered ventilation system pulls new air in through the HEPA filter even as it channels old air out the back, keeping the panoramic acrylic face mask fog-free. The reusable padded lining forms a seal at the base of your neck, and it's intended to be removed, washed, and put right back into action. And if you're planning on spending time outdoors, there's even room to comfortably wear a pair of sunglasses inside [13].

**Table 2. COVID-19 quarantine mask and helmet**

Title	Image	Characteristics	Title	Image	Characteristics
Maskfone		Maskfone offers interchangeable PM2.5 and N95/FFP2 filters, built-in microphones and earphones.	Buckle masks		Sun Dayong's Be a Bat Man shields the wearer using UV technology– the upper-body armour also folds to a compact size when not needed.
Project Hazel		N95 grade mask that can block water splashes and fine dust	Maskerchief		The Maskerchief by Chen Min serves as both a foldable face mask and a reusable handkerchief.
COVID-19 diagnostic mask		Color change when a corona infected person wears it	LG Puricare Mask		An electronic mask is linked with a mobile phone via Bluetooth to notify whether the air purifier filter needs to be replaced or not.
Micro Climate Air - Helmet					Aimed primarily at travelers who change environments at jet speed, the AIR creates a stable microclimate inside the helmet

### 3.2 COVID-19 quarantine costume

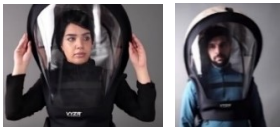



While the wearing of face masks to halt the spread of COVID-19 is now mandatory on most flights, a Canadian company has taken disease prevention further by inventing a “haute hazmat” suit for wearing in public and on airplanes. VYZR Technologies, a personal protective gear company based in Toronto, launched the futuristic product, called the BioVYZR, in April via crowdfunding site Indiegogo [Table 3]. Coming in a \$250, the gear's outer layer resembles the top half of an astronaut's suit, and even contains its own anti-fogging “windows” and a built-in hospital-grade air-purifying device. It's made from silicone, neoprene, and vinyl, weighs less than three pounds, and is easy to disinfect and pack away between uses, reports say. The customers have already pre-ordered some 50,000 units of the suit, raising \$400,000 for the company, with doctors, dentists, hairstylists, and long-haul travelers being the top customers so far. The deliveries are expected to be complete by the end of July, Bloomberg reports [14].

Design firm Production Club created the wearable-technology suit, named Micrashell, with clubbing and concerts in mind, news station KNTV reported [Table 3]. “Micrashell is a solution for bringing people together safely,” Miguel Risueno, the company's head of inventions, told the outlet. “It's a half suit that kind of takes your safety and your security in terms of being close to airborne particles or viruses to the next level.” Described as an offshoot of a hazmat suit, the airtight gear has app-controlled speakers, a microphone and most importantly, an N95 filtration system. Through a rear vent on the helmet, outside air is suctioned through the filtering system and directed at the wearer's face, the company said. It is then filtered a second time before being expelled out into the room. Drinking and vaping are still possible while wearing the suit through nozzles attached to snap-in canisters, Risueno said. Though a patent is pending, Risueno said the firm hopes to have a prototype soon so people can return to partying in crowds again [15].

Peter Nguyen, a researcher at Harvard University, developed it as a 'wearable (mountable) biosensor' for "a COVID-19 test method that combines the high accuracy of PCR test, the fast speed of rapid antigen test, and low cost." According to MIT News, the researchers first extracted protein molecules that respond only to the Corona 19 virus using cell freeze-drying (FDCF) and then freeze-dried them [Table 3]. This was buried in paper to make a 'paper sensor', a test strip. It was then combined with polyester fibers to develop a wearable (wearable) biosensor. Clothes made from textiles that incorporate wearable biosensors alert the wearer through a smartphone app when pathogens and toxic substances are detected [16].

Chinese architect Sun Dayong has created a conceptual design for a body shield that would protect a wearer during a coronavirus outbreak by using UV light to sterilize itself. Named 'Be a Bat Man' [Table 3], the mobile safety device would be for "people who are exposed to the dangerous situation during the coronavirus emergency", said Sun Dayong, who co-founded architecture studio Penda. The shield would be made from carbon fiber supports shaped like batwings that would be worn like a backpack. A PVC film would stretch between these supports, like the membrane of a bat's wing. Wires embedded in the plastic would heat up to a temperature high enough to kill any pathogens on them, creating a sterile environment inside for the wearer. "The coronavirus will be killed by temperatures of 56 degrees Celsius," said Sun Dayong, who is a judge for Dezeen Awards 2020 [17].

**Table 3. COVID-19 quarantine costume**

Title	Images	Characteristics
BioVYZR		The outer layer resembles the top half of an astronaut suit, with its own anti-fog "window" and built-in hospital-grade air purifier.
Micrashell suit		The hazmat suit's hermetic equipment includes an app-controlled speaker, microphone and, most importantly, an N95 filtration system.
Clothes made from textiles that incorporate wearable biosensors		Clothes made from textiles that incorporate wearable biosensors. The garment alerts the wearer through a smartphone app when pathogens and toxic substances are detected.
COVID- 19 Shield Suit		Wires embedded in plastic are heated to a temperature high enough to kill pathogens, creating a sterile environment inside for the wearer.

#### 4. CONCLUSION

After Covid-19, each country is making various efforts to overcome the serious situation. The corona virus is not over yet, but fortunately, social distancing due to vaccination is gradually easing. Recently, the UK has even declared with Corona. The textile and fashion industry is one of the industries most affected by the COVID-19 crisis. The textile and fashion industry, which has a face-to-face consumption feature that places importance on direct purchases, is an industry with a relatively large decline in sales. Therefore, the damage to the small-scale textile and fashion industry in Korea was severe, and several companies went bankrupt. As such, the domestic textile and fashion industry is in danger of losing its leadership to emerging countries such as China if it fails to overcome the current crisis even though it possesses strengths such as technical know-how accumulated over a long period of time and a balanced infrastructure for each stream.

Therefore, textile and fashion companies must set a new direction according to the degree of damage and establish a recovery plan. COVID-19 will provide new opportunities to reshape and reconnect the future of textile and fashion industries, and IT industry, including non-face-to-face services, should be able to secure national competitiveness. The COVID-19 pandemic items reviewed in this study are products that will lead the future industry, and if the domestic IT industry infrastructure is utilized, it is expected to be a change in the

direction of the textile and fashion industry. For this preparation, the results of this study are as follows.

First, it is urgent to establish an online trading platform that can trade textiles and fashion products for small and medium-sized enterprises. It is necessary to develop a digital-based online exhibition hall based on AR-VR-MR technology, which is being developed in advanced fashion countries, or a virtual store where consumers can receive services such as actual shopping without time and place restrictions.

Second, in order to cope with global regulations introduced after the COVID-19 pandemic and to quickly adapt to consumer changes, a strategy based on digital technology must be introduced. For example, there is a need to develop systems that can transform brands into demand-based models using the use of 3D technology, virtual sampling, and artificial intelligence.

Third, major advanced countries such as the United States and Europe are actively promoting industry-university joint research based on partnerships between textile-related companies, universities, and research institutes with the support of each government. In Korea, there are many limitations to simply conducting research at the corporate or private level. Therefore, to improve national competitiveness, the government's active support, expansion of the RND business scale, and technology development support for small businesses are urgently needed.

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