

# 쾌적성과 사용성에 기반한 군복의 레이어링 시스템 개발

## Development of Layering System for Military Jacket based on the Factors of Comfort and Usability

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### ABSTRACT

The aim of this study is to develop a model of layering system for future soldier system. Future soldier has been supposed to carry various digital devices embedded into the combat uniform. The combat uniform must be developed to be fit to soldier's body and movement, and can be felt comfortable to soldier. The Uniform must be studied in ergonomic and physiological component because it is different from the present one. It has many devices inside, so there are some unknown barriers to set the devices on to the body. For making the ergonomic aspect of future combat suits clear, the movement of the body was researched. The size of arms(3 parts), torsos(4 parts), and legs(3 parts) of people were measured by movement. Many dots were drawn on the testees' bodies every 3cm. Each time they made compulsory poses, the distances between dots be measured and analyzed. For making the physiological aspect of future combat suits clear, the thermo-map and sweating map of body were made. The 3 maps - movement, thermo and sweating- were overlapped. The devices for future soldier were arranged on the overlapped map considering relations between devices. The final layering system developed on the arrangement of devices.

*Keyword: Combat Uniform, Future Soldier System, Ergonomics, Physiology, Smart Wear*

### 1. INTRODUCTION

'Smart Wear' is the clothes that has digital devices inside and it has very different elements to be used by people from normal clothes or electronic goods. It must have

both the wearability and the usability, means comfort as clothes and convenience as functional devices.

'Future soldier combat uniform' is a kind of 'Smart Wear'. It is the jacket for the 'Future Soldier System' that has many future soldier components and digital devices.

There are many needs to be considered in designing soldier combat uniform for future soldier system. It will have not only some digital devices like radio systems, CPUs, keypads, etc. but also biological and environmental sensors. The 'Future soldier combat uniform' is to be designed by considering the ergonomic aspects and physiological aspects.

The purpose of this study is to develop of layering system of combat uniform for future soldier based on ergonomic and physiological factors.

## 2. METHODS

### 2.1 Define the attachable body map by ergonomic factors

To define sectors attached devices on combat uniform, the measuring data of body movements were needed.

4 gestures for measuring torso, 5 gesture for measuring arms, and 5 gesture for measuring legs were chosen for comparing the sizes between movements, and the gesture were chosen for measuring the extreme stretching each part on body. And 3 specific sectors were measured on arms, 3 on legs and 4 on torsos. Dots wear marked on body every 3cm, and by measuring the distance between dots accompanying gesture's variations(Fig.1).

By analyzing the data of size variations, the attachable body map is defined.



Fig. 1 measuring the distances

### 2.2 Define the physiological comport map

By investigating the physiological papers and books, the thermo-sensitive body map was found. The map was adapted with the attachable body map, the final sector were defined.

### 2.3 Define the devices for future soldiers

There's many digital devices for future soldiers. Fig.2 shows us the devices for US FFW(Future Force Warrior) project. By referring the source of ADD and US FFW, we define the devices for future soldier system.



Fig. 2 Devices for FFW (US)

## 3. RESULTS

### 3.1 Attachable body map

By analyzing the data of measuring body surface, the attachable body map was founded(Fig.3). The sectors extended over 20% were defined not attachable area, and under 20% were attachable area on body. Attachable area is the sector for attaching devices and sensors on body. Especially sensors were very sensitive to the movement of body surface. So the



Fig. 3 attachable body map



Fig. 5 power-up body map

### 3.2 Thermo body map

By referring the sources about physiology, the thermo body map was defined(Fig.4). The thermo body map is very important for the future soldier because of a lot of devices in it.

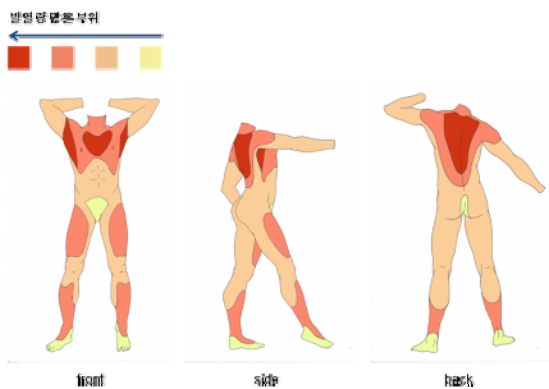


Fig. 4 thermo body map

### 3.3 Power-up body map

The muscles of body can be power-up by using proper materials on each sector on body. So many sport wear designs have adapted this point inside themselves. Future combat uniform must meet the expectations for these kinds of functions. So the power-up body map was defined.

### 3.4 Materials for 3-layering system

By merging the three body map, the final device on body map was defined. And 3-layering system for future combat uniform was designed based on the maps.

The first layer is the inner layer. It has electrodes for sensors on it. The material for inner layer must have the ability to evaporate sweat off the body. The proper materials for inner layer were supposed absorbable and quick dryable materials like Cool max.

The second layer is middle layer. It has various devices in it. The material for middle layer must let the air from inner layer get through to out layer and outside. The proper materials for middle layer were supposed to be porous and breathable like mesh.

The final layer is outer layer. There must be ventilations on it for letting the air go outside. The proper locations for ventilations were the armpits, the chest, the center of the back. The materials for outer layer must have the micro pour for keeping from water and letting the vapor out like GoreTex.

### 3.5 Arranging the devices

By considering the sizes and weight of devices, they were arranged on the body(Fig.6). The usability of devices and wire length were also considered.

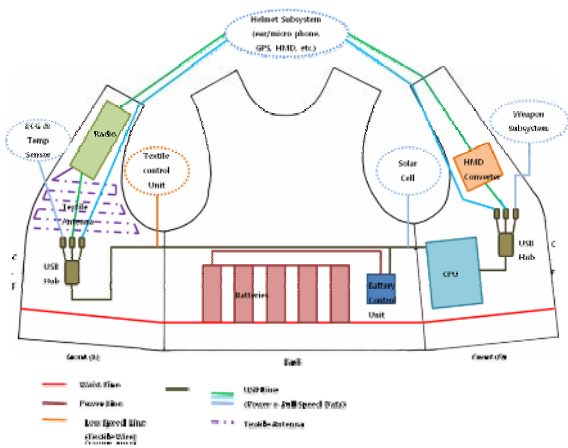


Fig. 6 arrange of devices

### 3.6 Designing 3-layering system

Layering system was design based on the body maps and materials. There were 3 draft of design and the final draft was adapted(Fig.7, 8, 9).

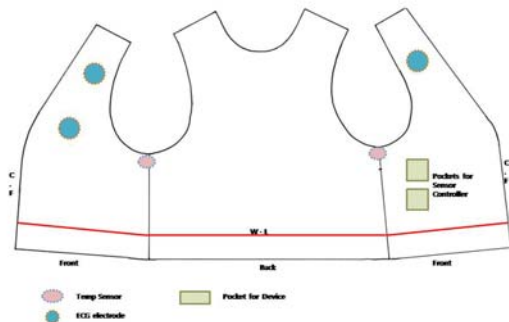


Fig. 7 inner layer design

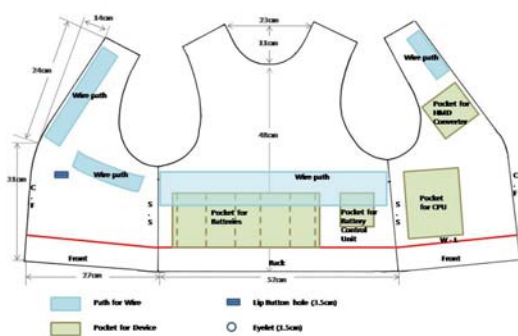


Fig. 8 middle layer design

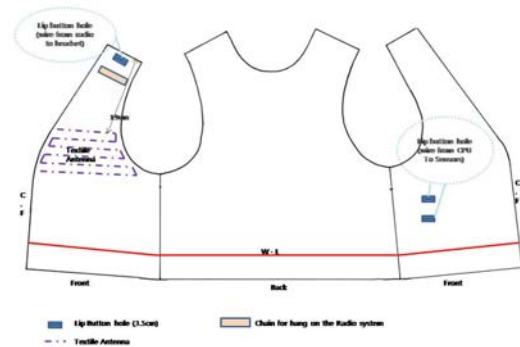


Fig. 9 outer layer design

## 4 CONCLUSIONS

The design of 'Future Combat Uniform' was designed considering ergonomic and physiological factors. Finally the 3 layering system was developed and the usability and comfort was supposed to be better.

The 3 layering system was to be tested by the real users. The user test was supposed to be tested with the 'Smart wear usability test tool' established.

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