The Design Process of Wearable Computers for Extending the Performer's Expression

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Abstract. This research proposes a new process of designing wearable computers, which combines interaction design methodology and actual stage costume design processes. The performing arts have achieved an extension of space and time on stage and the enhancement in expressivity by introducing a new technology to theater, resulting in the strengthened "liveness" of performance. Performers, considered as the primary medium of performance communication by showing their characters, lively on stage, are the most important factor in achieving "presence", which is the key aesthetic concept in performing arts. From this perspective, liveness is re-mediated and strengthened by the performer's capabilities of expression, and wearable computer technology can further extend the performer's expression, thereby creating a new media effect on stage. However, literature on performing arts lacks an adequate study of the design processes of wearable computers to help actual performers understand them. This study provides artists an understanding of this process and presents a new method of design that integrates interaction design and stage costume design. This new process is applied to the design and construction process of costumes using wearable computer technology in a live performance work, 『The *Pieces of Me*』. Through this case study, artists can understand the concept of wearable computer technology more easily and potentially engage with wearable computers with a deeper understanding.

Keywords: Wearable computer, interaction design, performer's expression, design process, performing arts.

1 Introduction

"Presence", the aesthetic concept representing the key value of performing arts may consist of the existence of performers, the key members, and above all, liveness is understood as the most important feature forming presence. Thus, the performer's lively expression of characters or specific and clear revelation of interactive actions taken among them can be a standard that strengthens liveness of the performance and forms presence.

Theater has always used the cutting-edge technology of the time to enhance the "spectacle" of productions [1]. But this has been used as a form of visual images presenting a spectacle on the stage. Yet, as mentioned above, since performing arts mediate contents of production through performers, extension of their expression

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using wearable computer technology can be closely related to the strengthening of liveness of the performance.

A wearable computer is a computer that is subsumed into the personal space of the user, controlled by the user, and has both operational and interactional constancy, i.e. is always on and always accessible [2]. This can get the intention to use and the context of the surrounding environment in a place closest to the user's body and allows him or her to carry out computing capabilities in any kinds of environments, which can double the intimacy among human, computer and environment. When a computer is worn, the user's surroundings and state can be recognized. Context-sensitive applications can then be designed to exploit the intimacy among them [3]. Wearable devices are a new way to manage information. In addition, they can extend human cognitive and physical functions. Therefore, introducing wearable computers to performing arts in particular performers are put up as major representation media can extend their bodies, which may have great impacts on the development of new representations and methods of interactions, and it is expected that they will dramatically change the ways of communications between objects on the stage and help create effects of new media.

However, in the field of wearable computer, preceding studies have mostly dealt with special fields such as military, medicine and aerospace or have been carried out from the perspective of costume studies related to wearability, and their focuses have been brought to the development of smart devices that can directly be involved in the user's real life. In contrast, there is a lack of studies on the method of introducing wearable computers to performing arts, the method of optimizing the technology or the effectiveness of the new media.

Thus, this study seeks to propose a methodology of introducing wearable computers for the extension of performers' expression through the convergence of the actual stage costume design process and interaction design methodology. Through this, it will discuss what roles a wearable computer can play in strengthening vividness of performance by mediating performers' bodies and bringing about changes in the method of interaction, and aims to help artists understand the processes of application of the technology.

2 Methodology

This study aims to extend performer's expressiveness through the introduction of a new process of designing wearable computer. Thus, it will introduce wearable computer technology to stage costumes to help creative expression of characters and interactions among them by mediating performer's movements with a new form, and for this, it will propose a design process reflecting interaction design methodology and stage costume production process that facilitate the interaction between human and services, and characteristics of performing arts and the technology.

2.1 Process of Stage Costume Design

Stage costume design process, requiring close consultation with the production crew, unlike the general fashion design process: 'Determining a concept - Design –

Production' necessitates a study on the process of the overall performance production, which was summed up in Youngsam Kim [4] as the following five stages: 'Pre-production, Rehearsal, Production Week and Preview, Run and Post-production'. In addition, Suh, Ji-Sung [5] classified the process into seven steps, focusing on the original costume design process, and Lee, Ji-Seon [6] summarized the stage costume work process based on three steps of 'Preparation, Production and Performance' and summarized tasks by each process.

Stage costume design should be completed through the analysis on the work, participation in practice process and discussions with the production crew and go through several processes of modifications considering performers' activities. Thus, stage costume design process can be summarized and proposed combining three perspectives in the above cases as follows.

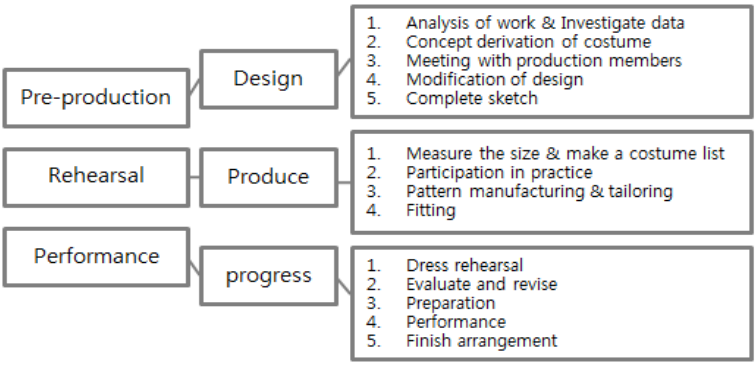

Fig. 1. Process of stage costume design

2.2 Interaction Design Methodology

Since interaction design comprehensively includes all activities that take place between men and the environment surrounding them, it is important to understand the user's needs accurately. Among interactive design techniques, crucial are a method of focusing on understanding of design context and discovering needs through a user survey and a method of evaluating the proposed design and improving it [7]. In particular, contextual design methodology [8], which collects and analyzes data to understand the users' real needs and is helpful for agreement on effective design method, is appropriate for understanding the users' needs and the structure of experience, which is summarized as seven steps: Contextual inquiry / Interpretation / Data Consolidation/ Visioning / Story boarding / User environment design / Prototyping.

On the other hand, since introducing wearable computers to stage costumes requires actual production, it is necessary to look into the prototype production design process that integrates interactive elements as well. This study refers to 'interactive design process and prototype method' proposed by Steve Gill [9] to form a design methodology that can quickly respond to the demands for correction by the director or performers.

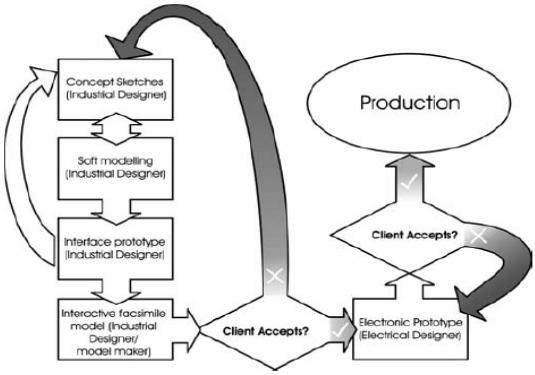

Fig. 2. Steve Gill's design methodology

2.3 Design Process of Wearable Computer to Extend Performer's Expressions

The wearable computer design process combining the preceding stage costume design process with the interaction design methodology is as follows:

Production progress		Stage costume design process	Wearable computer design process
Pre-production	Design	1. Analysis of work & Investigate data 2. Concept derivation of costume 3. Meeting with production members 4. Modification of design 5. Complete sketch	1. Director meeting 2. Analysis of work & Investigate data 3. Explore the tools 4. Concept sketch based on costume design 5. Soft modeling 6. Design meeting 7. Modification and complete 1st prototype
Rehearsal	Produce	1. Measure the size & make a costume list 2. Participation in practice 3. Pattern manufacturing & tailoring 4. Fitting	1. Performer's study level 2. Contextual inquiry & Interpretation 3. User environment design 4. 2nd Prototype & apply to costume design 5. User evaluation 6. Sewing
Performance	progress	1. Dress rehearsal 2. Evaluate and revise 3. Preparation 4. Performance 5. Finish arrangement	1. Evaluate and revise 2. Packaging and finish

Fig. 3. New process of designing wearable computers

In the design step, as costume design sketch has been accomplished, the final agreement should be made among the staff members regarding that, so this is a step that requires intimate and ongoing consultation between the wearable computer designer and the costume designer. At this time, a technology that stimulates the performers' expression can be designed if a lucid interpretation of the producer's intent to introduce the technology precedes.

Second, the production step provides performers with a time to learn the technology that gives them the opportunity to apply that in various forms and find a method to extend their expressions. Then, they should understand the form of the use by asking contextual questions and should come up with the best method of representation by modifying and supplementing the work. Then, based on the newly arranged scenarios, the second prototype is completed and applied to the costumes, and the performers wear them and have a rehearsal so that the errors occurring in the actual application are corrected to complete the finished costumes.

Lastly, correction of errors that might occur during the performance and final completion of the work are included in the wearable computer design process in performing arts.

3 Application and Conclusion

The wearable computer design process for the extension of performer's expressions proposed in this study has been actually applied to the process of designing wearable costumes in a performance, 『The *Pieces of Me*』. Performers who had learned the prototype produced according to the design process provided the following feedback: "There are several interactive motions in the work, and all motions and times of approach differ, so it is difficult to reflect the intention of the proposed technology." Accordingly, choreography were analyzed and the numbers, times and angles of the interactive motions were analyzed to complete wearable costumes through the steps like modifying the Codes to increase the LED output speed of the wearable costumes.

Fig. 4. Wearable costumes in 『*The Pieces of Me*』

Consequently, the performer could variously explore patterns of movement and relation with objects, audiences and space using wearable technology, and they show their purpose of movement more clearly and intuitionally.

Since the proposed design process was organized to reflect unique situations according to the production step of performing arts, it would be able to help artists who work on the boundaries between art and technology understand the methodology and procedure of both sides, when they would design wearable computer technology to the performing arts.

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