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A Change of Apparel Industry will be brought by *Kansei* Interaction Technology

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Ⅰ. Introduction

Any daily newspaper or television news report will testify to the chaotic state of the world when seen from any perspective you care to choose, political, economic or spiritual to name just a few. We believe that immediate action is needed to address these issues and improve our quality of life. Some people argue for technology as a solution to these problems, but we would argue that these very technologies are partly responsible for the current situation, due to their rapid development at this point in history. The technology itself is not evil, indeed it often useful in its' specific purpose and in its' immediate environment.

We often fail to consider the broader environment and the impact such technology produces. Technology correctly applied can produce splendid results. The corollary is that technology poorly applied, can have disastrous results. Many parts of the world face serious environmental pollution caused by technological advancements poorly applied. The recent power blackout in the Northeastern part of the United States (August, 2003) was caused by the lack of mutual relationship among various technologies. The terrorism is very serious problem in the world, and there is a cause for lack of comprehension between elements constituting society. As for the technical problem, there is a problem for social science technology as well as engineering based on natural science.

It is an essential problem that all technology have been isolated from person's spiritual problems. So how do we break this cycle of crises? Many argue that advancing technology is key to ride out future crises.

As we stated above, we feel that modern technology is effective within a limited domain; their strength is in the specific purpose they were designed for, but their weakness in the way they interact with the wider community. We would argue that these technologies should be managed

from a much broader perspective than is currently the case. Technology operates closely with our work and everyday life, and therefore has a strong impact on our consciousness. If these technologies develop new functions, such as interactivity, then we believe that they can change people's concept of how they interact in and with the world around them. *Kansei* is human comprehensive ability that means sensitivity, recognition, modeling, expression and creativity and so on. *Kansei* engineering is the set of technology to make good human-relations by KANSEI. It includes hard-technology and soft-technology and makes new and good products.

This technology links different technologies together, adjusting the system for the betterment of the whole. *Kansei* engineering can be said to spin and weave everything, from the atom to the spirit, in the pursuit of *kansei* products. As a result, *Kansei* engineering can produces a society rich in culture and safety.

Ⅱ. Industrial Capitalism and Post-Industrial Capitalism

Our present society is based on capitalist economy dominated by mass-production systems. But it is found to be lacking in meeting the demands placed on it by our modern society. Therefore, we propose a new production system to replace the current status quo, with the ability to meet the demands of our society. We call this the interactive production system.

1 The Distribution based Economy Supporting Industrial Capitalism

In our industrial capitalistic economy we aim for full production and consumption within the system to maximize its' effectiveness. To this end, products are standardized so they can be more easily processed and produced. The resulting industrial product is lacking in individuality. It is one more 'thing', one of many as a result of trying to maximize capital or labor resources. In this economic model, the most efficient way to exploit the 'thing' is to circulate it through a market, with essentially a one-way flow. It is argued that this one way flow results in the 'thing' being pushed from the business onto the consumers.

For this reason, the industrial capitalist economy is maintained by this mass-production / mass-consumption economy, and is illustrated in Fig. 1.

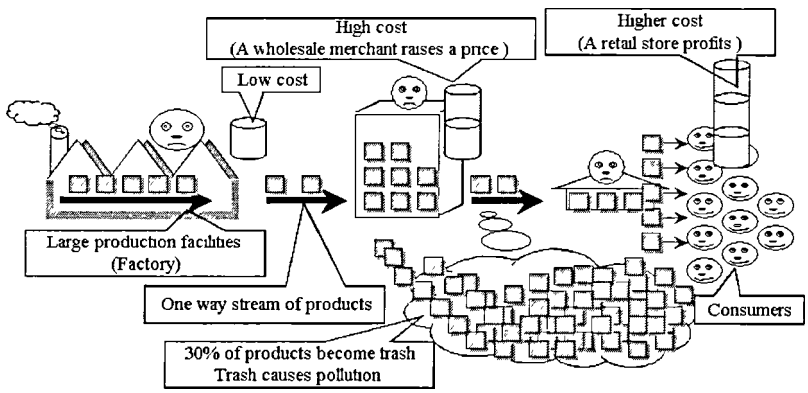

Fig 1. A mass-production and mass-consumption system with distribution of one way.

This is also known as the physical distribution economy. The core of this approach relies on standardized products, manufactured at cheap price through economies of scale, and shipped off to consumers through a maze of intermediate layers such as wholesalers, retailers and a number of transportation handlers. The cost to the consumer is not so cheap because along the way, each intermediate party is required to secure an appropriate profit for handling the product. Because the 'thing' is produced in large quantities, they often remain unsold. This surplus supply to the actual demand results in dead stock. Not only does this dead stock produce inefficiencies in the system by gathering dust, it can lead to a further burden on the environment by first consuming valuable resources in its production, only to be returned in the form of pollution or part of the ever growing waste dumps, which blight our communities. Another result of this system is the over-production of certain products, causing excessive supply and causing prices to plummet in order to stimulate demand.

As businesses are forced to cut costs to win competition, they remain on an endless cycle of diminishing profits. It is often difficult for entrepreneurs to escape this make-to-stock production because the lack of a viable alternative.

2. The Interactive Production System Supporting Post-Industrial Capitalism

We think few would object to a new improved system of capitalism, which accents the positive aspects of the current system, while minimizing the negative aspects. In our modern age society dominated by science and technology, we argue for a post-industrial form of capitalism, which offers stability and wealth for the many, not just the few. We think such a system should be collaboration between the producer and the consumer. In a physical distribution economy, the focus is often on the planning, design, manufacture, distribution and marketing with little direct contact between the consumer and those beyond the retail level. We believe that workers involved in the manufacturing process require an active meaning to their labor, which does not currently exist.

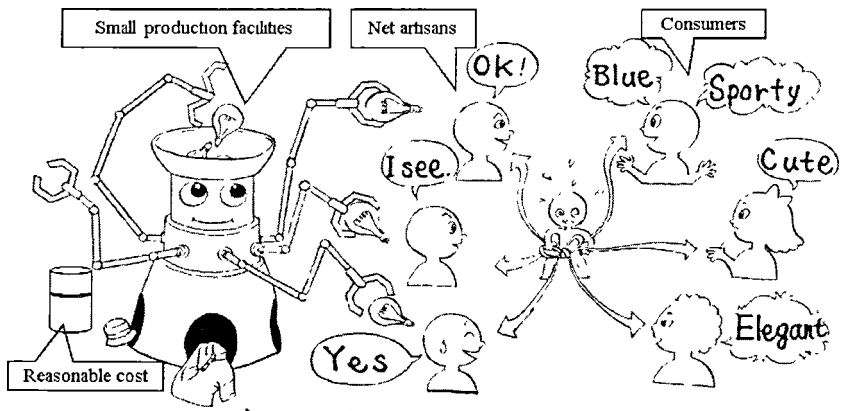

Fig 2. A interactive production system of apparel (IPSA).

Instead the workers are marginalized as small cog in the greater economic machine. We would argue that if producers and consumers could collaborate on the design and production of a product, the mutual opinion would produce a more creative and superior product. We call this end result an interactive product in recognition of the collaboration that takes place, from the two-way flow of information. We broaden the perspective of the product to include the interaction itself as part of the product, not simply a by-product.

The resulting distribution economy can be called Kansei distribution, meaning, the joint design production system between producer and consumer. More precisely, we have decided to call this system 'The Interactive Production System'. For a concrete example of how this theory can be expressed in practical terms, we will explain in more detail the Interactive Production System Apparel, as shown in Fig. 2.

Ⅲ. Technology Elements for Interactive Production System Apparel (IPSA)

1 Evaluation of Materials for Clothes

1) Circular Multi-Axes Testing Machine

A circular multi-axes testing machine was developed to measurement the tensile anisotropy of fabrics.

Fabric is typically an anisotropic material in tensile property. In conventional tensile tests, warp, weft and bias direction or shear tests are required. Tensile property of fabrics without structural orthogonality, such as twill, is not well known. We developed the testing machine that could measure the tensile property of multi-directional fabric at one time.

2) Transverse Compression Testing Machine for Single Fibers and Yarns

Transverse compression characteristics of yarns and fibers affect the tactile felling of textiles. But there is no commercially appropriate testing machine. We developed a transverse compression testing machine which utilized a piezo-stack and microscope.

3) Bending Testing Machine for Single Fiber/Yarn

We can only measure dynamic minute deformation bending by the vibration method. In pure bending we cannot measure single fiber. We developed novel flexural-rigidity measuring machine for the single fiber/yarn, which utilizes centrifugal forces.

4) Trellis Shear Tester for Fabrics

We developed a trellis shear tester which gives uniform shear deformation under small tension to obtain the initial shear modulus under small tension.

2. *Kansei* Retrieval System for Interactive Design Selection

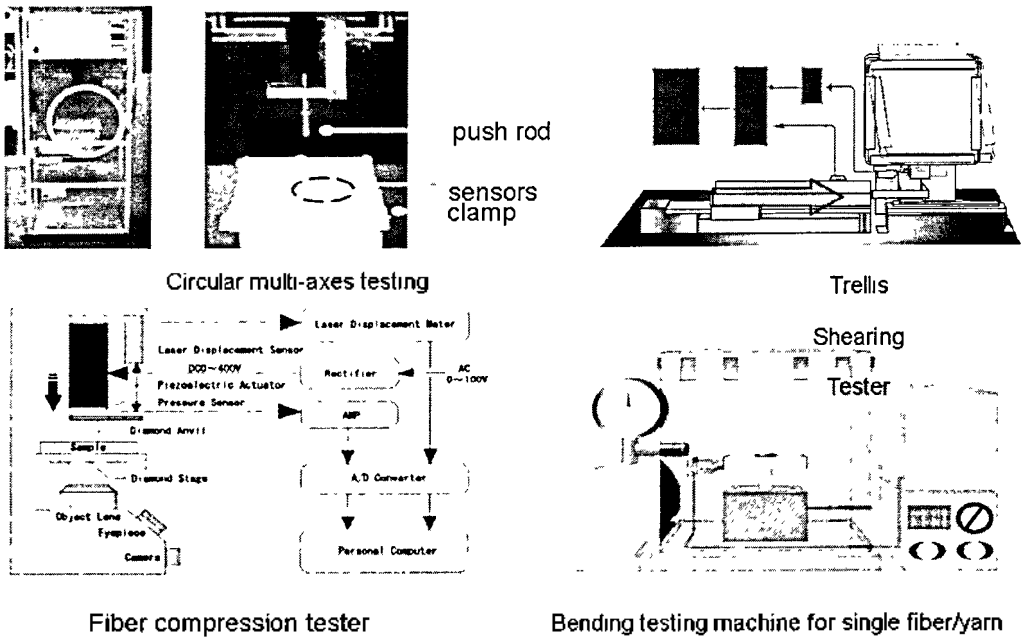

Fig 3. Apparates for valuation of materials for clothes.

As for an on-demand apparel production, selected product items can be enormous, depending on such differences as the kinds, colors, forms and the material. Differences of product evaluation between individual customers also vary according to their society reversion, self-representation, greed, and physiological body characteristics. Accordingly, some proposals of products corresponding to individuals are required.

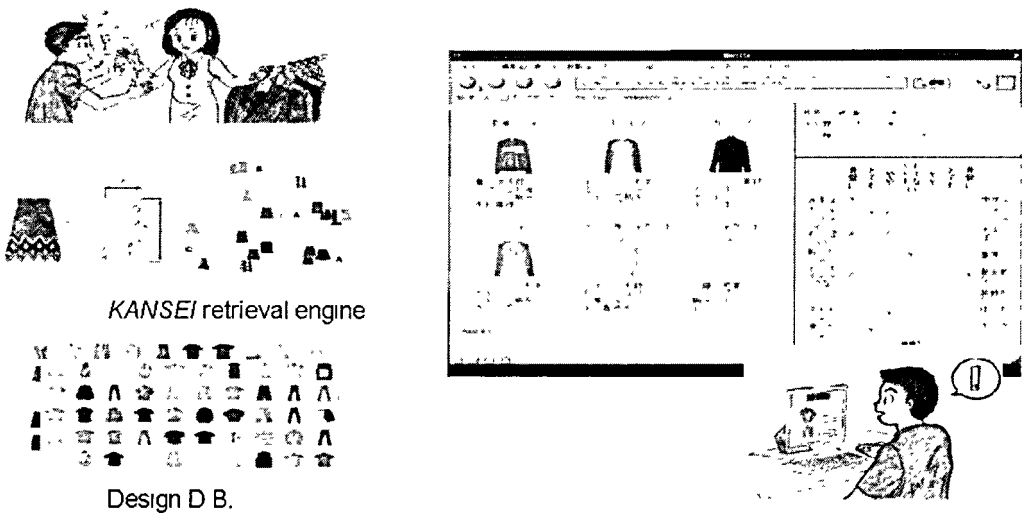

Fig 4. *Kansei* Retrieval System.

We have proposed a *Kansei* retrieval system, in which customer users can search apparel products through several stores. In this system, the user can search the products by inputting category information and/or other *Kansei* measurement values. A unified format of category information of apparel products suited for the search was developed. In the search, some methods to reflect the differences in the use of Kansei terms between individuals were also investigated.

3 Individualized Clothes' Pattern Making

Apparel manufacturers have been struggling to meet the needs and wants of their customers without sacrificing the efficiencies and profits gained through mass production. While conventional order-made clothes are ideal, they are also expensive because the processes involved are complicated and far from automatic. In order to an establish interactive apparel pattern making using CAD at a reasonable cost for customizing clothes, it is essential to employ three-dimensional pattern. We focus on the development of a clothes measurement system using a three-dimensional digitization of the shape when clothes are worn. Moreover we attempted to develop a pattern-making system that is three-dimensionally interactive, using measurement data from a given model to provide accurate information for individual pattern design. The three-dimensional measurement data was converted by coordinate column to build a cross section line model. We created a human body model with ten control points, which were capable of

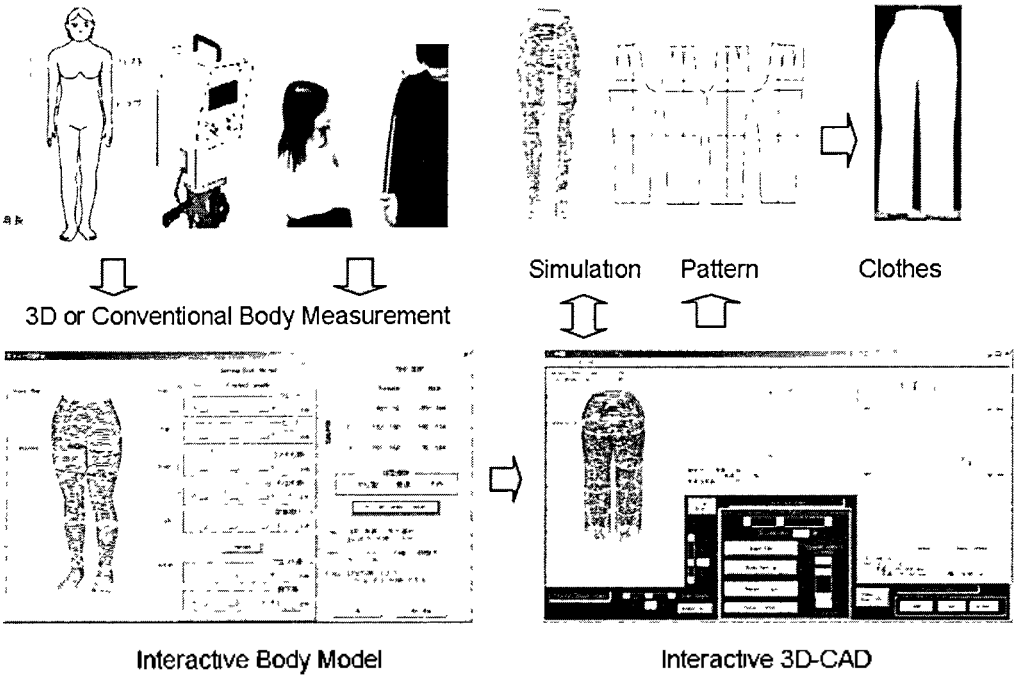

Fig. 5. Individualized Clothes' Pattern making.

being modified by scaling magnification. A clothes model can be modified interactively and suitably with a body model. Pattern fitted size information from the three dimension shape was created, thus allowing us to simulate clothes pattern fitting for individual body shapes.

4. Evaluation of Comfortability and Health

1) *Kansei* Measurement

The purpose of our study is to construct an evaluation method for clothing comfort by measuring the multiple relationships between human and clothes. In order to design comfortable clothes, we should measure the physiological and psychological effects of clothes on the wearer. Clothes and human have multiple relationships. For conscious consideration, clothing comfort can be evaluated by sensory tests. For subconscious considerations, the measurement of physiological response is the only method of evaluating clothing comfort. Actual evaluation of clothing comfort is achieved by both a physiological evaluation and a psychological evaluation. We call the evaluation of the comfort by measuring a multiple relation a Kansei measurement.

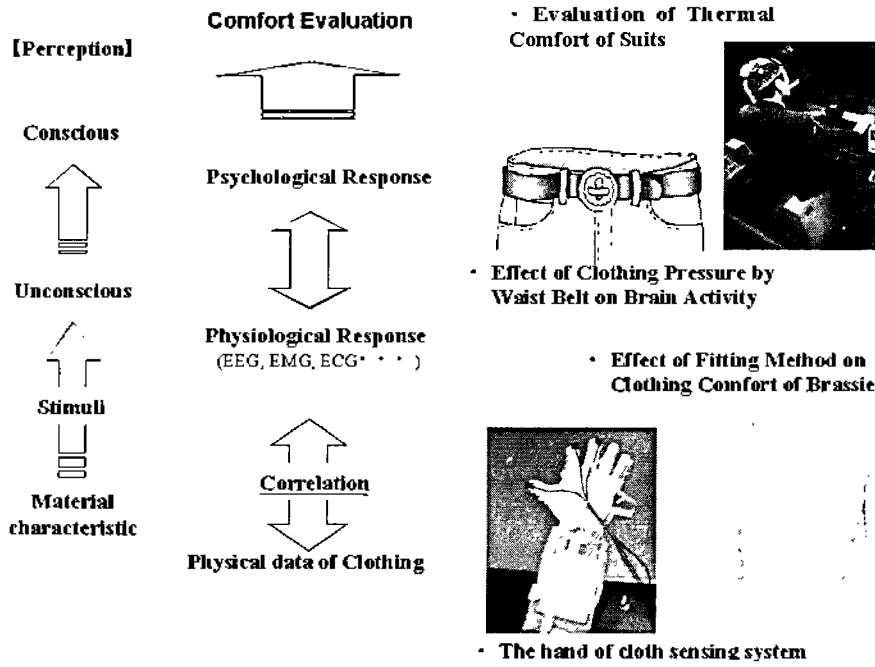

Fig 6 *Kansei* measurement.

2) Effect of Clothing Pressure by Waist Belt on Brain Activity

The condition of brain in brain activity resulting from the pressure exerted on the abdomen by waist belts was evaluated using an Electroencephalogram(EEG) measurement We investigated the possibility of estimating psychological and physiological stress arising from waist belts in

clothing based on EEG measurements. Waist belts are often daily attire for both men and women.

In this study, electrodes were fixed to the scalp and EEG was measured for states of abdomen pressure and non-pressure as exerted by the waist belts. Additionally, sensory tests for sensations of tightness, arousal, and feelings of comfort were carried out. Frequency analysis of the measured EEG data was carried out and brain activity as reflected in the intensity of alpha waves under the conditions of pressure exerted by waist belts was evaluated. The intensity of alpha waves decreased significantly under waist-belt pressure in comparison with the intensity of waves in non-pressure conditions.

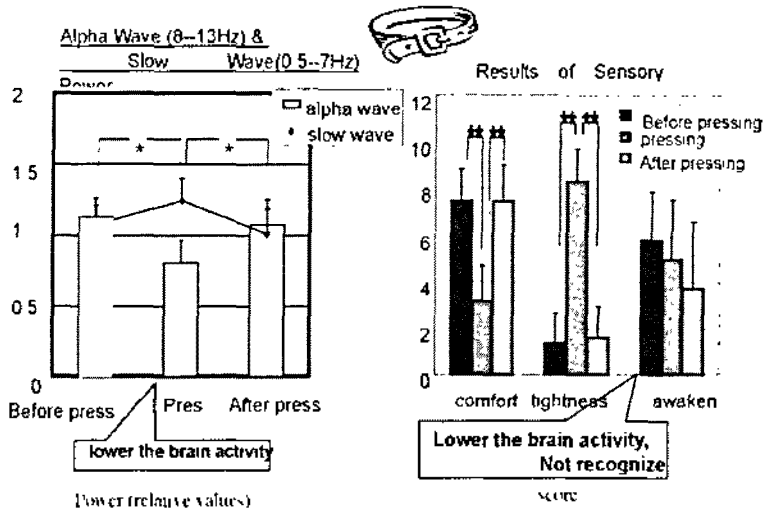

Fig 7. Effect of Clothing Pressure by Waist Belt on Brain.

The slow wave intensity increased as a result of pressure, and it decreased after the pressure was released. Therefore, it seemed to be generating the slight blood circulation disorder in the pressure. This means that the subjects could not evaluate the lowering degree of the arousal of the brain by sensory tests. The pressure on the body exerted by clothes has been seen to be a problem not only from the standpoint of sensuous comfort but also in terms of its effects on physiological functioning and health caused by oppressiveness.

5. Development of Products

1) Kenaf Blended Shirt

We developed the Kenaf blended shirt in cooperation with Flex Japan Co. Ltd. Kenaf is an annual plant, and we evaluated its comfort on the user. We demonstrated that Kenaf shirts feel cooler, prevent sweatiness and possess a comfortable feel. We also proved that the warmth stress

of Kenaf shirt is smaller than that of conventional shirts.

2) Comfortable Sockes

We developed "RL" type socks. Comfort of that new type and normal type socks was evaluated by physiological reaction and subjective evaluation. The following were measured: Muscular activities of the lower leg in the walking, sole pressure, electrocardiogram in the wear, clothes pressure by the socks.

From this analysis, the clothes pressure of the socks affected muscular activities and heart rate variability under walking, and it became clear that the comfort was influenced as a result. In the future, plane shape of the foot and solid shape must be considered the clothes pressure in the index in order to design the socks that suit Japanese people.

Fig 8 Kenaf shirts.

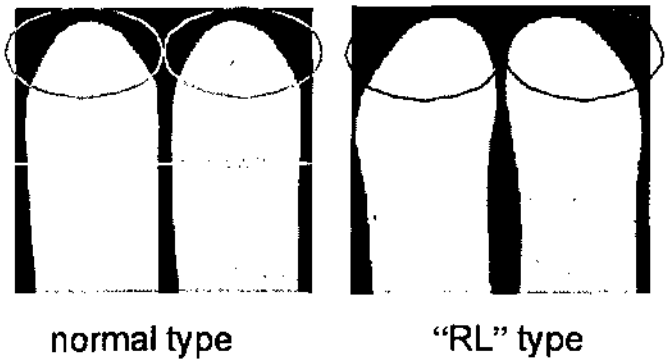

Fig 9 "RL" socks.

3) Conservation Cover

A conservation cover was developed. For example, for people whose breast were damaged by cancer operations. They could ware it when they took a bath in public spa without feeling to too self-conscious because of any scarring.

Ⅳ. Conclusion

In this paper we started by identifying concerns we have in society at large from the poorly implemented use of technology. We argued for a new paradigm of tackling these problems using *Kansei*. We demonstrated how this would affect a post industrial capitalism to replace the current system. And then we showed several concrete examples of how this can be achieved at a practical level through the Interactive Production System Apparel (IPSA). This impacts every stage from individual fibers, fabric and textiles through to apparel design and production. In terms of the broad application of Kansei, the IPSA is only one practical outcome. We believe

Fig 10. A conservation cover after breast cancer.

there are many other areas of daily life where these concepts can be introduced in such broad areas as physical products (design, manufacture and retail), computer software (user interface, education, database) and urban planning and control. These are just some of the projects being conducted through our department. We feel that this is a field rich in possibility and worthy of further investigation.