The Design
of the Requirements and Verification
for the Sliding Door knob:
Through the Physiological Indices and Four Stance Theory

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ABSTRACT

Japan have sliding door culture since ancient times. Although the modern residential door is normal leaf door mostly, but in the hospital, welfare facilities, etc. sliding door is the mainstream. The sliding door doesn’t moving around the center of gravity forward and backward, because the action which open or close the door is very little, the burden on the body is also very small. In addition, compared with the leaf door, it is does not require space when open or close sliding door, neither cause obstruction even if keep it open. Therefore, in the hospital and welfare facilities, sliding door as the mainstream. Switches of doors and other daily actions, accompanied by people's basic applied action such as walking, standing, sitting and grasping. Such actions must be accompanied by the movement of the body. On the other hand, there is rare research on the application of motion theory in the architectural space of human life.

Keywords: design, requirements, verification, sliding door knob, physiological indices, four stance theory, grasp

1. Introduction

In this study, in 2010, Focusing on four stance theory proposed by Hiroto Satoshi, an active member of the Japan Olympic Committee (JOC), and were divided into type by brain waves, pulse wave and salivary amylase of physiological indices. Through the results, provide and verify the necessary conditions for the design of the sliding door knob.

2. Method

First, select the experiment object, classify them according to the four stance theory, sum and summarize the results. Next, the brain wave experiment, pulse wave experiment and salivary amylase experiment were carried out, and the necessary conditions for improvement of sliding door knob were put forward and verified. Finally, based on the validated experiment data and opinions which had listened, conducting re-validation experiments, summarizing the characteristics of A/B type, and creating a sliding door knob which is universal design and easy to use.

Brain wave experiment (Photo 1):
Focusing on the physiologic indicators showing the comfort of the alpha wave size, and to compare the discussion.
Pulse wave experiment (Photo 2):
The power value ratio (LF/HF) of the low frequency field (LF) and the high frequency field (HF) obtained by the heartbeat fluctuation coefficient and frequency analysis, were compared and discussed using the maximum entropy method.

Salivary amylase experiment (Photo 3):
The experimental data and the pressure level of the target data were compared and discussed.

The results of experiments with physiological indicators Results of electroencephalogram and pulse wave experiments and typing results by four stance theory are integrated and typed.

For the results of electroencephalogram experiments, the type with the largest average value of alpha wave and the type with the lowest MEM value for the result of pulse wave experiment are described. Salivary amylase is also described in 4 stages. There are 64 types in all.

Among them, focusing on four types (the same type results in all experiments: A1A1A1, A2A2A2, B1B1B1, B2B2B2) which is the standard of the four stance theory (Table 1).

| Table 1. 64 types |
|------------------|
| Four stance       | Brain wave | Pulse wave | Salivary amylase | 64 types  |
|                  | A1(subject 1) | A1          | A1              | A1A1A1    |
|                  | A2(subject 2) | A2          | A2              | A2A2A2    |
|                  | B1(subject 3) | B1          | B1              | B1B1B1    |
|                  | B2(subject 4) | B2          | B2              | B2B2B2    |

| Table 2. Results of hold the doorknob |
|--------------------------------------|
| Type       | contact position of the knob                  | palmar flexion/ dorsiflexion |
| A1         | · The root of the index finger                 | palmar flexion               |
|            | · Fingertip                                    |                            |
|            | · From the second joint of the index finger to the slash   |
|            | in which center of the little finger metacarpal  |                            |
| A2         | · Ring finger roots                            | dorsiflexion                |
|            | · Fingertip                                    |                            |
|            | · Index finger, middle finger, ring finger, root line of little finger |                            |
| B1         | · Central of index finger metacarpal           | dorsiflexion                |
|            | · Palm                                        |                            |
|            | · Index finger, middle finger, ring finger, central line in small thumb metacarpal |                            |
| B2         | · Central of ring finger metacarpal            | palmar flexion              |
|            | · Palm                                        |                            |
|            | · From the root of the index finger to the slash with the hook bone |                            |
3. Results

According to the previous experiment, the action of getting hold of the doorknob can be divided into four types (A1, A2, B1 and B2). When different main action part contacts the sliding door knob. At the situation of type A, fingertips are the main action part variables while the palms are the main action part variables of type B. Since main action portion is contact with the sliding door knob, the force becomes easy and the comfort is improved. Therefore, manufacture the hand which adding the two elements and perform verification test (Table 2).

As a result of the verification, it was found that the sliding door knob of the Universal Design produced (Photo 5) was easy to use than that of the conventional grip knob (Photo 4). When the grip was newly developed, the average value of the alpha wave of the brain wave was high, the pressure value of the pulse wave was low, salivary amylase are not in the pressure range. It is judged that the sliding door knob is easier to grip than the conventional knob. Therefore, it can be said that the newly developed knob is more comfortable than the conventional knob.

4. Conclusion

The authors designed and proposed the sliding door knob which was easy for everyone to use. It is shown through the physiological indices of brain waves, pulse waves, and salivary amylases were determined by four stance theory. The opening and closing of the sliding door is accompanied by friction. In a more practical research program, by adding the friction and other indicators, consider making a more specific design sliding door knob. In addition, it is necessary to increase the number of subjects and make comprehensive judgments in the future.

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