User-Centered Intelligent Interface of Vending Machines Modeling

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Abstract: Convenience and speed of service makes vending machines popular world-wide.However, the developmentand use of vending machines in China have not kept pace with globalmarkets. In this paper, in order to determine the key design factors, interface elements andparameters which affect the convenience of user-machine interaction, the author analyzes theinteraction problems in current vending machine design and finds out that unreasonable designresults from machine-centered logic design. Then, with user-centered design principles, a new user-centered intelligent interaction model of vending machines is developed.The result of the test shows that the user-centered interface system can effectively reduce the operational time and decrease the mistake type and mistake rate. The process followed in the present study can also serve as a general framework for the analysis and development of UCD interfaces for other self-service systems.

Keywords: User-Centered Design (UCD); Novice Users; Vending Machines; User-Machine Interaction Model

Introduction

A vending machine is a self-service machine which sells items such as snacks, beverages, cigarettes, and a multitude of other commodities to customers. Advances in technology, reduced hardware costs and increased cost of manual labor [1] have driven the rapid increase in deployment of vending machines in public spaces.

However, the development of vending machines in China's market is very slow in past few decades. Meanwhile, there is low utilization rate of vending machines in some public areas. According to the Internet Survey, "Being worried about making mistakes (31.30%)" and "the operational process need to be learn and it's a little bit troublesome (18.70%)" accounts for approximately half the responses as a reason for low utilization rates for vending machines. Irrationally-designed human-machine interface may result to users' operational mistakes and aggravate users' mental load of learning. It is reasonable to assume that irrationally-designed human-machine interface may be a primary reason that hinders the promotion of vending machines' coverage.

Chinese vending machine users are mostly novice users who need comprehensive, intuitive prompt via audio-visual information channels , which requires a rational interface and clear instructions. However, most current vending machine interfaces mainly displays machine-centered logic to the customer [2], disregarding the individual user's physical and cognitive abilities, and failing to focus on user friendliness and the User experience (UX) . The shortcomings mentioned above reduce the users' trust in vending machines and cause the user to lose confidence in operation. Basing on their negative experiences, they often develop a tendency to avoid using vending machines to make purchases.

Since the 1980s, "user-centered design (UCD)" has been proposed and generally accepted as an alternative to machine-centered logic for vending machine interfaces. User-centered design adapts to the user's cognitive psychology and behavior custom [3]. Over the last two decades, UCDs have been used in computers, website design, and vehicle operation. However, very few studies have focused on the use of UCDs for self-service machines for mostly novice users. Nowadays, computer system and touch screen technology have developed by leaps and bounds. Intelligent computer system could be transplanted into vending machines and combined with touch screen; therefore operation mode would be more flexible. It could be possible to develop a user-centered intelligent interaction model without mechanical or electrical constrains.

1. Analysis of user-machine interaction model of current vending machines

User-machine interaction model of current vending machines can be summarized in Figure.1, where, because of the machine-centered logic design of the mechanical and electrical parts, novice users are bound to follow the operation sequence. At each operation stage, users interacted with different vending machine interface elements and received different

machine responses. Figure.1 shows that the design of interface was just actualizing the basic function of vending goods without concerning the operation problems that users may encounter. Therefore, the current user interface was a totally "machine-centered" design.
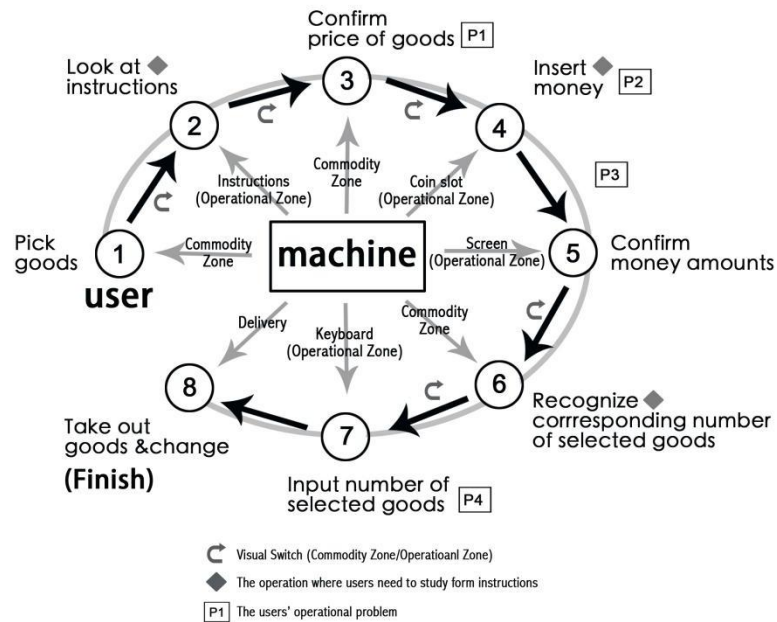

Figure.1. User-machine interaction model of current vending machines

Then, an experiment is designed to determine the types of novice users' mistakes. Nine volunteers who have never used vending machines before were invited to use a typical vending machine to finish a given task (to buy a bottle of orange juice from a vending machine).

From the experiment, four types of problems are found. Problem 1 is "sequence error"：Users should firstly insert money and then input the number of selected goods to make purchase on vending machines. However, some users pick goods before inserting coin. The reason is that users operate as their habitual consumption order; Problem 2 is "wrong payment"：Inserted money cannot be recognized. The reason is that the instructions of payment on vending machines is not clear; Problem 3 is "operational time is too long (more than 2min)", the reason is that novice users have to read instructions to learn how to operate every step, which lengthens operational time; Problem 4 is "input wrong number of selected goods". When users make this mistake, wrong goods will be delivered. It may lead to users' economic loss.

In sum, the defects of User-machine interaction model of current vending machines can be summarized as: simplex operating procedure, violation of consumption behavior, lack of clear instructions of operation order, lack of feedback, no chance to cancel or correct user's behavior.

2. A user-centered intelligent interaction model of vending machines

According to the methods and key principles of user-centered design and the ISO 13407 standard on human-centered design, a new user-centered intelligent interaction model of vending machines can be established in Figure.2: Users' behavior and intention in vending machines' operation were induced, and the machine was designed to follow users. Vending machine shows all the goods on touchscreen, users pick goods and click on the item, then, the information of selected goods will appear on the screen. After confirming to buy, users can insert money according to the price and direction of payment. The amounts of inserted money will be shown on the screen. Users can get back in all the steps above. After users' confirming to deliver goods, machine will deliver and users can take out goods and changes.
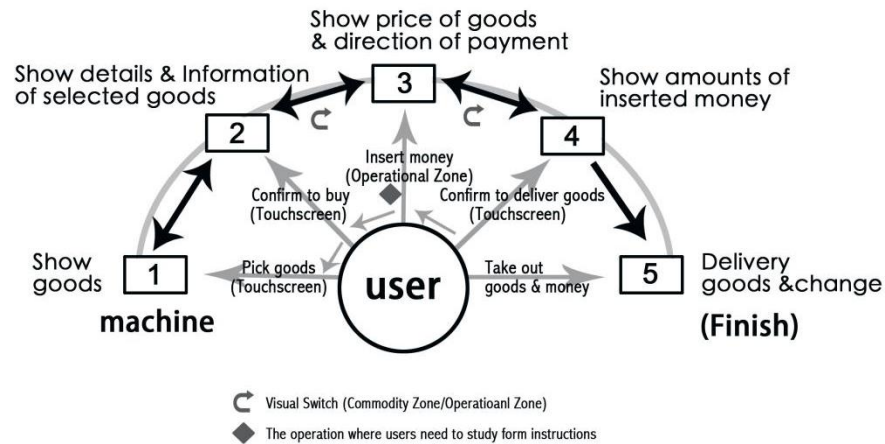
Figure.2. A new user-centered intelligent interaction model of vending machines

In the user-centered intelligent interaction system, there are many advantages:

① User-centered process: In each step, the machine reflects according to the users' operation.

② Easy to learn.

③ Conform to consumption behavior in daily life: This model is similar to the shopping process in a supermarket. Without violation of consumption behavior, user's operation would be more fluently than before.

④ Necessary and effective feedback: Any operation on the touch screen will get a feedback in time.

⑤ Low mental load: The whole process has simple and clear instructions and natural feedback. Even the users who have low affinity with technology can use the vending machines easily.

⑥ Fault - tolerance: If users choose wrong item, they can cancel and correct it easily.   It will promote the affinity between users and vending machines.

3. Test of current and new interface system of vending machines

In order to verify the efficiency of the new user-centered intelligent interaction model of vending machines, a test was carried out, it can be found that there are two remarkable improvements of the new vending machines interface system compared with the current one:

3.1 Decrease of operational time

From the comparison of average operational time, the operational time of user-centered interface system(66.8s) is much shorter than machine-centered interface system(146.22s). User's study time will decrease from 3 times to once.

3.2 Decrease of mistake rate

The average amount of mistakes using the machine-centered interface system is 1.4 while the user-centered interface system one is 0. The type of mistake of machine-centered interface system is 4 while the user-centered interface system one is only 1. So the mistake type and mistake rate both decrease significantly.

Conclusion

In this paper, compared with current vending machines' user interaction model of machine-centered logic, according to consumption behavior in daily life and the principles of user-centered design, a new user-centered intelligent interaction model of vending machines was developed.

After designing and testing, the user-centered intelligent interaction model would be an example of user-centered design (UCD) process for other self-service systems with transplanting of computer system and using touch screen. It can serve as an effective solution to solve the interface problems in current machines, which were also designed in machine-centered logic.

References

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