Research on User Operation of High-density Entity Interactive Target Quantitative Simulation Interface

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Abstract. The paper determines the general cognitive model of people in visual information search, and summarizes the basic design criteria that conform to the user's cognitive model. Under the premise of the consistency of user needs, we disassemble and analyse each step of the user interaction process through the tool visualization simulation model, find out the user's inner cognitive law under the guidance of different interfaces, and discuss the interface layout the impact of the difference on the user’s search time. The study found that through the numerical comparison of the experiment combined with the simulation analysis of Cog Tool and the target interaction experiment, the intrinsic cognitive law of the user in the interaction process was extracted. Therefore, we can conclude that the design guidelines for interface layout proposed in the paper can help art designers improve the efficiency of information cognition.

Keywords: High-density entity interaction, target quantification, interactive simulation, user operation.

1. Introduction
The digital information environment has exerted a continuous influence on the contemporary art style from two aspects: technology and culture. In this cultural context, digital technology means are paid attention to by artists, and a new form of artistic expression is formed. In the artistic practice of exploring "virtual interaction", the interpenetration and sequence relationship of visual information search always play a dominant role [1]. Therefore, investigating the way in which art works deal with the logic of interaction and the artistic experience constituted by it is one of the appropriate entry points to interpret the connotation and value of interactivity.

2. Analysis of interactive features of visual information art
The emergence of interactivity in art has given new connotations and important characteristics to art. The artist has made a variety of intricate attempts to express this art by arranging events that interact with the audience in a three-dimensional space. On the other hand, before the new media artist recognizes and devotes himself to the meaning of the audience in the work, and thinks about how to break the habitual thinking of the audience in the interaction and strengthen the concept of the work, in the practical field of installation and sculpture, the audience and the work the exploration of
relationships has begun [2]. The generation of interactivity in art is based on the ability of a system composed of computers and sensors to sense and transmit information to sense changes in real time to make feedback and responses, and this interaction is continuously extending to more forms and deeper levels, such as touch and gaze. Interactive activation methods such as, action, posture, etc. continue to increase and improve, and are no longer limited to the presentation of a single video medium. However, what the author is concerned about is not the changes of these technical means themselves, but the state of the relationship between the audience and the work due to the interactivity constructed by them.

Interface interactive works are currently the most common art form in exhibitions at home and abroad. Its human-computer interaction mode is: the audience can interact with the work through language, touch, gestures, or manipulation of the joystick, remote control and other physical actions, and feedback results can be generated through the screen or "interaction wall" in front of the audience (Figure 1).

![Figure 1](image_url)

**Figure 1.** Illustration of the human-computer interaction mode of the interface-based interactive installation works.

This kind of interactive works are usually placed in a relatively open space. These interactive works generally have a clear human-machine "interface", emphasizing the result of interaction generated by the audience through direct "contact". The mode is mainly visual, direct or instant experience. For example, at "Encoding and Decoding: International Digital Art Exhibition", British artist Mehmet Akten's interactive installation "Human Body Painting" (picture 2 upper left) can transform your dancing posture into the abstract colours of the big screen by activating sensors and related software painting.
3. Immerse yourself in interactive installation art

Different from the above-mentioned interface-based human-computer interaction works, immersive interactive works are mainly displayed in art venues, museums, and public spaces and appear in the form of "environmental experience" or "multi-channel interaction" human-computer interaction mode. This kind of artwork captures a variety of human senses (such as speech, eye contact, facial expression, lip movement, touch, smell or taste, etc.) and actions (such as voice, handwriting, posture, sight, expression, etc.) through the computer, and feedback on the work Time often has the characteristics of indirectness, surround, lag, and delay, and the audience is usually "immersed" in the virtual computer interaction environment and interacts with the work through the interactive detection devices of the work (such as optical fibre, touch and projection sensors, etc.). The works respond to the audience by means of lighting, sound, vibration, or animation [3]. The mode of action of this multi-channel, multimedia, and environment-sensing human-computer interaction is shown in (Figure 3).

4. High-density entity art interactive operation establishment and simulation

4.1. Model establishment

This paper uses the visual model of Cog Tool to disassemble, analyse and research each step in the user interaction process. Use visual cache, visual module, manual module, and hand movement module to explore and study human interaction behaviours and operations. Cog Tool can directly judge whether the interface is good or bad, especially the interface layout [4]. It is not only convenient
and fast, but also after mastering the specific interactive operations, good interface design guidelines will follow, and it can be in accordance with human perception at the beginning of the design. Get used to interface design.

In the WMIP interface, GTN can be constructed for the interactive process to assist users in operating in the correct sequence of actions. The following takes the construction of a mathematical programming model as an example to introduce the realization of its learning and forecasting functions. Suppose a system allows users to construct linear programming models (including integer programming) according to similar natural writing habits. For example, a linear programming model is written as

$$\max z = 3x_1 - x_2 - x_3$$

$$s.t. \begin{cases}
x_1 - 2x_2 + x_3 \leq 11 \\
-4x_1 + x_2 + 2x_3 \geq 3 \\
-2x_1 + x_2 + x_3 = 1 \\
x_1, x_2, x_3 \geq 0
\end{cases}$$

(1)

The GTN diagram of the linear programming model can be constructed. Templates represent embedded subgraphs, which can be expanded by levels. The direction of the arc without arrows is from top to bottom. The process of user modelling corresponds to a path from the state start to the terminal. The following explains from the aspect of learning and prediction. At the beginning, the initial GTN can be established by teaching. In modelling practice, new processes may appear, which requires dynamic modification of GTN. It can also be extended to support 0-1 planning, that is, in state 7, 0-1 constraints may be entered. At this time, you only need to add an arc between state 7 and terminal, which represents a 0-1 constraint template, and the same is true. Support non-linear programming. When predicting user behaviour, the main basis is the transition between states. According to GTN, the user's next possible operation can be determined. For example, in state 2, the user's next input may be max or min, while in state 4, only subject may be input. Furthermore, when there are multiple possibilities for the next operation, it can be sorted according to a certain rule. At this time, it can be performed separately for different users to adapt to different habits of users. The simplest sorting method is the state transition probability. According to the user's practice, the frequency of state transition is recorded as the sorting basis [5]. When forecasting, the various possibilities are displayed to the user in order, and the most frequent transfer is taken as the default. Of course, more complicated sorting methods need to be introduced in practical applications and embedded in each state of GTN.

4.2. Analysis of simulation results

4.2.1. Different interactive methods complete the results. The experiment was carried out in three times, and the proportion of the number of people who successfully completed the zoom-in, zoom-out, and panning operations to the total number of participants was statistically measured. In the experiment, the first test was conducted without training; the second test was conducted after the first test was completed and after 5 minutes of training in use; the third test was conducted at 6 minutes after the second test was completed. The experimental results are shown in Table 1.

|          | Enlarge | Zoom out | Pan | Enlarge | Zoom out | Pan |
|----------|---------|----------|-----|---------|----------|-----|
| First time | 0.7     | 0.8      | 0.9 | 0.3     | 0.2      | 0.9 |
| Second time | 0.8     | 0.8      | 0.9 | 0.8     | 0.7      | 1   |
| Third time  | 0.7     | 0.7      | 0.8 | 0.3     | 0.3      | 0.7 |
4.2.2. Analysis of the difference between experimental data and model data. In order to verify whether the Cog Tool model data meets the cognitive habits of actual users, this study used the TobiiTX300 combined eye tracker to collect the actual eye movement data of 20 subjects in the process of completing 12 sets of interface tasks [6]. In order to ensure the comparability of the two data, in the eye movement experiment, the sum of the user's first gaze time and the gaze process time at each task point is analysed corresponding to the sum of the two eye movement processes in the interactive operation. The test showed that the two have a weak correlation (P<0.05). The correlation between the interactive operation data and the actual eye movement data of the subjects believes that the starting point for setting the eye movement in the Cog Tool interactive operation is the upper left corner of the interface. In the actual eye movement experiment record, due to the screen and the relationship between the position of the eyes of the subject, the normal point of sight is not in the upper left corner of the interface, but close to the middle area of the interface, as shown in Figure 4.

![First sight path diagram](image)

**Figure 4.** First sight path diagram.

Therefore, there is a distance between the interactive operation of Cog Tool and the actual eye movement behaviour. It is expected that the equivalent point of the eye movement experiment will replace the origin of the current interactive operation in the later research. In addition, in each group of interfaces, in addition to the search for the first target (first-level menu item), the sight start point of the other search processes (secondary menu item and target item) is the end point of the last search target. The starting point of each task is consistent with the setting of the target point of the previous task (Figure 5).
Figure 5. Confirm the starting point of the "target item" line of sight.

Based on the disassembly of the Cog Tool model, and without considering the impact of implicit thinking, the hand-eye-related behaviour patterns are analysed, and the interactive behaviour can be decomposed into the query target’s eye movement preparation and eye movement (first eye movement), coordinated with the eye movement preparation and eye movement the (second eye movement) of the mouse cursor, and mouse movement (mouse moves to the target point) these three execution actions related to the spatial position.

5. Conclusion
Time and space are the most basic elements for people to grasp the world. As an experience of time and space, people perceive their own existence in it. However, under the influence of digital media, we have shown contradictions and conflicts when facing the existing linear and closed concept of time and space. Therefore, the new time and space experience constitutes the essential source of art. At the same time, the emergence of interactivity allows viewers to obtain an interface connecting virtual space-time and real space-time, so time and space themes are increasingly difficult to distinguish from each other. The artist obviously hopes to find a way to interpret between the virtual space-time and the real space-time, between the inherent space-time concept and the nonlinear space-time consciousness, in order to practice the artistic exploration of how to present contemporary space-time experience on a variety of hybrid technology creation platforms. This kind of exploration is gaining more freedom and more vitality from the two aspects of technology and art.

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