# MR and Sensors Application in the Folding Experience Exhibition of Chinese Traditional Furniture

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## ABSTRACT

The study focuses on the digital and mixed interaction of Chinese traditional furniture in Chinese ancient painting, in which Chinese traditional furniture would be displayed in its ancient real using environment. The virtual character in the painting can interact and communicate with people with the help of MR, sensor and motion capture technology. A game process similar to removing the blind box will be developed to guide people to participate in the fix and unfix process of folding table, fix up for tea tasting, painting, calligraphy and antique appreciation, from which people can know more about the different structure of different tables and even aesthetics, technology, craft and culture at that time. Different people would choose different tables with different shapes, structure, material and craft, which would add interest.

**Keywords**: Mix Reality, Sensor Technology, Chinese Traditional Furniture Systems

# INTRODUCTION

Chinese traditional furniture is the inheritor of Chinese traditional culture, which contains rich cultural genes and cultural connotation, and it illustrates unique shapes, structure, proportions and materials. Especially the strong and ingenious structure, which contains abundant mechanical principles and ingenious thinking. However, most of the structure are hidden in the furniture, which is accessible for most ordinary people.

The study is focus on the display and interaction of Chinese traditional furniture with participants in the exhibition of interaction with the help of Mixed Reality and sensor technology. The high and low dual-purpose tables are typical and unique Chinese traditional furniture, which have a variety of different folding or disassembled structure, showing the infinite possibility of Chinese traditional furniture structure.

# THE SELECTION OF HIGH AND LOW DUAL-PURPOSE TABLES

High and low dual-purpose tables have unique long legs, which can be unfolded or unfixed with unique structure. Therefore, this kind of table can be used not only as high tables but also as low tables. Different high and low dual-purpose tables have different structure, which is invisible from outside except you assemble it yourself. High and low dual-purpose tables are usually used in the suburbs or in the courtyard. Two typical high and long dual-purpose tables are selected in the study, one is made of poplar with brown lacquer (see Figure 1), and the other is made of elm with transparent lacquer (see Figure 2). The two tables have different shapes, different structure, different proportions, and different structure, although they are similar compare with other types of high and low dual-purpose tables (Dehua, 2020).

Figure 1. High and low dual-purpose table with brown lacquer

Figure 2. High and low dual-purpose table with transparent lacquer (Lele,2012)

## THE DIGITAL SCENE CONSTRUCTION FROM CHINESE ANCIENT PAINTING

The painting "Celebrating 60th Birthday in Bamboo Garden" (see Figure 3) from palace painters of Hongzhi, Ming Dynasty have been chosen for the display and interaction. The painting illustrates three officials celebrated their common 60th birthday in official Jing Zhou's bamboo garden, in which the host and guests sometimes watched the crane dancing in the yard, sometimes wrote calligraphy on bamboo in the bamboo grove, sometimes wrote poems and articles on stone tables, surrounding by waiters busy with tea, food and serving. There was also various furniture around them, including tables, stands, folding chairs, stools and so on. In order to increase the realistic experience effect, some real furniture similar to the painting will be placed in the interaction site. In the mixed reality of ancient Chinese scenes, the participants can easily involve in the vivid ancient life where the high and low dual-purpose tables were really used.

Figure 3. The painting "Celebrating 60th Birthday in Bamboo Garden" (Bingwen, 2011)

# FIX AND UNFIX PROCESS WITH MR AND SENSOR TECHNOLOGY

During all the fix and unfix process, the participants should wear Mixed Reality Glasses to feel the virtual environment mixed with real furniture and some other things related to the painting. All the action and position would be captured by the sensor to make corresponding and timely interaction. The high and low dual-purpose tables hidden in the boxes have also the same but real tables placed in the scene to illustrate their using scene.

## Construction of Digital Scene of the Painting

A digital scene of the painting“Celebrating 60th Birthday in Bamboo Garden”would be constructed with real and virtual Chinese ancient furniture and living things with MR technology. When the participants wear MR glasses, they would involve in the virtual painting, where the host, guests and waiters in the painting would interact with them, surrounding by real and virtual furniture. Especially the virtual waiter would interact with them freely by means of motion capture sensor technology (Dehua, 2020), who would direct people to take part in the interaction process of table fix.

## Construction of the Using Scene of High and Low Dual-purpose Tables

After a brief adaptation to the mixed reality scene of the painting, the participants would be guided by the virtual waiter to a place, where a high and low dual-purpose table is used, on which some teapots, tea bowls, or desserts are placed. The virtual would introduce the table simply, that the high and low dual-purpose table would be saved in a special box in the storage room. When the host would have plan to go outside for an outing, play, or writing poems and painted with his friends, the high and low dual-purpose table can be taken outside to support the tea set, dessert, or scholar 's four jewels. There are also other different tables stored in several boxes. The participants would be invited to take part in the fix and unfix process if they would like. During the fix and unfix process, the real tables would also interact with the participants with the help of sensor technology.

## The Fix and Unfix Process

Besides the using scene of high and low dual-purpose tables, there are several similar boxes, in which there are different tables with different shapes, structure, proportions and materials. The virtual waiter can direct people to open the box, put all the parts of the table on the rock, fix its four legs, put the fixed table on proper place, and fix up for tea tasting, painting, calligraphy, antique appreciation, and so on (see Figure 4).

Figure 4. Detail of the fix and unfix process

First, the participants can choose one box randomly to open, then the sensor would capture the choice triggering the box open. They would never know what the table looks before open it, just like open a blind box. There is the low table with foldable or installable long legs in the box.

Secondly, the virtual waiter direct people to carry the low table out of the box and put it on proper position, which would be captured by sensor to project the virtual animation how the long legs are fixed. The participants can follow the animation to put the long legs under the short table and put upside to fix it in the short legs. There are mortise and tenon in the short legs to support the long legs. All the fix process would be directed by the virtual waiter and virtual animation, as simple as building toy blocks.

Finally, the participants can choose some utensils to set up literati exchange scene on the table, for example the tea set, food container, brush pot, or even the seven-stringed plucked instrument. After that, the sensor would capture the action, and the virtual waiter would take some utensils to serve the host and guests, or invite the participants to try the literati activities (see Figure 5).

Figure 5. The fix and unfix process

## CONCLUSIONS

The study chooses an ancient painting to set up a mixed reality digital scene with modern technology. The interaction scene contains both real layout and virtual scene integrated in an ancient painting scene by means of MR glasses and sensor technology. The participants immerse in the mixed reality display environment, interacting with real and virtual furniture directed by virtual waiter, and taking part in the fix and unfix process of high and low dual-purpose tables to support the birthday celebration in bamboo garden. Only in this way, can the participant immerse and enjoy in ancient living scene and experience the using scene of Chinese traditional furniture.

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