# Study of Tile Menu Selection Technique Using the Relative Position of Joints for Gesture Operation

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**Abstract.** In this paper, we describe about our selected method by using the 3D tile menu by hand gesture motion. In the discussion of our approach,it is a mainly subject to realize the efficient selection gesture by user's arm for any position on the screen. Therefore, we designed the selection method by using relative position of the user's arm joints. The method uses user's hands, elbows and shoulder position at each arm. It recognized user's selected points by the relative position of these joints. We make the prototype system which has been implemented our method. And we examined the basic evaluation of our selection method by comparing with the conventional method. As a result of this evaluation, it is confirmed that our method allows users to perform smooth selecting operation regardless of the position.

**Keywords:** 3D pointing · Selection method · Gesture · Two-hand manipulation

## 1 Introduction

It is increasing to use natural user interface, like gesture recognition, gesture pointing operation, and so on. Especially pointing operation is much popular operation, because mobile PC, like smartphone or tablet PC, has become much popular in recent years. it has touch panel display and enable to realizing direct operation. The user can select any objects by touching on a screen and do anything what they would like to. This natural direct operation is used in some situation like on a large display environment such as projection screen or digital signage screen. There are many kinds of selection method using 3D gesture input [1–3]. But in some case, it is difficult to select object depending on the object position on a screen.

Therefore, we developed a selection method on the 3D tile menu by using hand gesture motion. The 3D tile menu is 3D GUI widget which consists of planes and selective objects. To be able to select any objects on the screen, we focus on the joint position of the user's arm. We implement our method on the 3D tile menu system. And we introduce a result of our preliminary evaluation. Figure 1 shows our prototype system.


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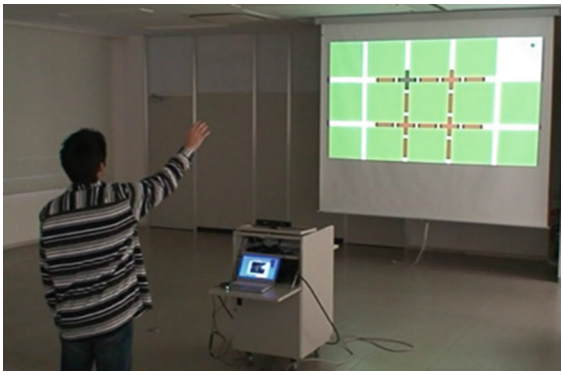

**Fig. 1.** Our prototype system

## 2 3D Tile Menu

We designed a tile menu platform which is called 3D tile menu. It is consist of planes which include selective objects, such as icon. And these planes are set on depth axis in 3D environment. The user can select these objects by using 3D hand motion. Figure 2 shows manipulation methods of the 3D tile menu. Figure 2(a) shows the selecting object phase. The user can manipulate a pointer on the plane and select an object. Figure 2(b) shows the moving user's view area phase. The user can manipulate the view region by user's hand motion. The user can switch these phase by using non-dominant hand movement.

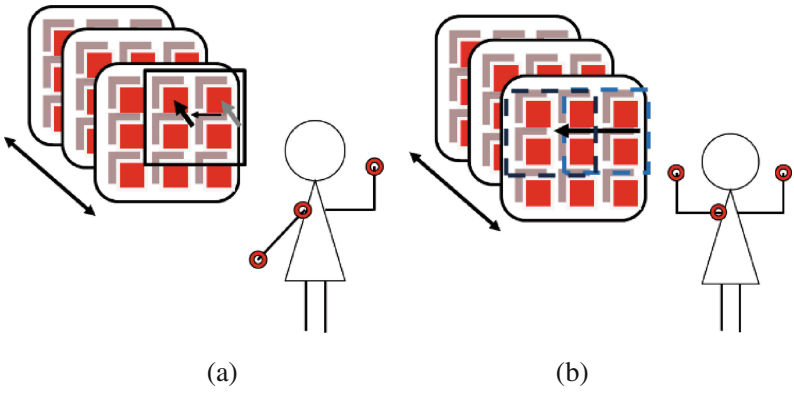


**Fig. 2.** 3D tile menu operation. (a) selecting object phase. (b) moving view area phase

## 3 Selection Method by Using the Relative Position of Joint

The selection method in 3D gesture motion is generally used overlay method. It is selected objects by expanding the user's arm to the object. However, in the large display environment, it is sometimes difficult to select the object according to the position on the screen. Because it becomes out of movable range of the arm. Therefore, we study the method based on the positional relationship between the arm joints to allow a more natural selective operation. Figure 3 shows our method summary. It uses the hand, elbow and shoulder positions. It calculated two vectors, shoulder-elbow and shoulder-hand. And it uses the angle by the two vectors to determine the selection operation. Since the orientation of the two vectors in our extended arms becomes almost same, the angle is close to 0 degree. The results were verified by preliminary experiments, the θ when fully extended arms had a value of less than 25 degree. Therefore our method uses 25 degree as the threshold of selection operation.

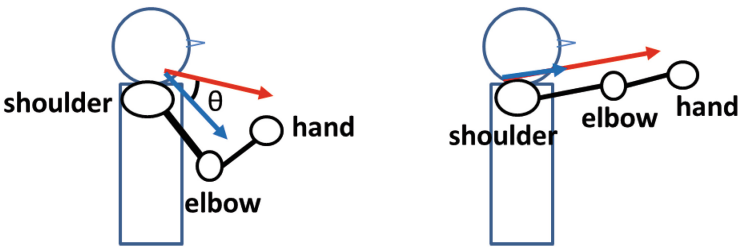


**Fig. 3.** Selection method overview

## 4 Implementation

We developed the prototype system which is implemented our method. Our system is implemented on Windows PC and measure the user's each joint position by using Kinect. Figure 4 shows an image of our system. To confirm the usability of our method, we make a comparative experiment with conventional selection method which use just user's hand position. As an experimental task, it is prepared that participant selects all objects randomly which are set 3 × 3 on the screen. And the task completion time is measured at each method. At first, the participants are introduced each method by performing the operation. And they practice each method in 2 min. Then, they execute each task 3 times by using all methods and the completion time is measured. The participants were intended for 5 students.

Figure 5 shows the result of it. It is confirmed that the time of our proposed method is less than that of the conventional method. And it is confirmed that the participant can select all objects easily. Through this experiment, we have found that the malfunction of the system is going as a problem. When the participant arm is fully extended, the system sometimes makes a selection that is not intended or deviates location to be selected.

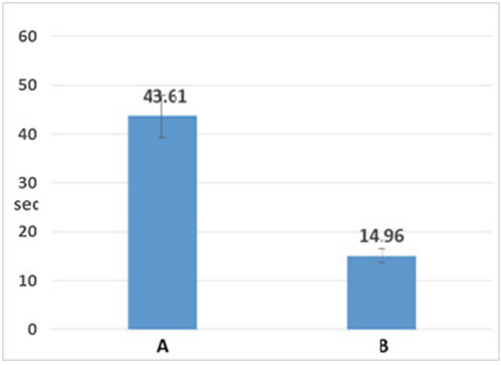


**Fig. 4.** Task completion time. (A) Conventional method. (B) Proposed method.

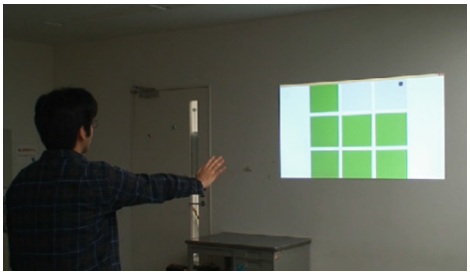

**Fig. 5.** Evaluation system.

## 5 Conclusion

In this study, we studied the tile menu selection method by using the relative position of user's arm joints. Our method uses the user's three joint position to manipulate the pointer. We implemented the method in our prototype system to confirm the usability of this method. As a result of our preliminary evaluation, we confirmed it. In the future work, it is needed to evaluate our method more precisely. And we have to study of the gestures pattern which is adequate to our method.

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