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TOU-AR:Touchable Interface for Interactive Interaction in Augmented Reality Environment

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ABSTRACT

Touchable interface is one of the future interfaces that can be implemented at any medium such as water, table or even sand. The word multi touch refers to the ability to distinguish between two or more fingers touching a touch-sensing surface, such as a touch screen or a touch pad. This interface is provided tracking the area by using depth camera and projected the interface into the medium. This interface is widely used in augmented reality environment. User will project the particular interface into real world medium and user hand will be tracked simultaneously when touching the area. User can interact in more freely ways and as natural as human did in their daily life.

Keywords: Touchable interface, projector, Finger tracking.

1. INTRODUCTION

Each part of human daily life currently control and exposed through computer system. People used it at school or university, office, or even at home. Most of people known computer interaction with only mouse and keyboard which is invented in early 1960. Recently, the technology has evolved very fast and changed the human computer interaction with natural user interface (NUI). Most of the smartphone have implemented multi touch interaction that has closed to natural interaction since it controlled by human finger directly rather than keypad or stylus. Furthermore, since Microsoft launch Kinect camera, it open wide possibility for research that involving the human body tracking.

2. RELATED WORKS

Augmented reality is become popular application because its capability to enhance the user interactivity that can involve direct physical input to the virtual environment for e.g. Kinect camera able to track human joint or skeleton then mapped onto computer as regular input. The initial research of natural interface has started quite long time ago, researcher want to provide great combination between real/physical world with AR(Augmented Reality) and Tangible interface. The Tangible interface can have various types such as: paddle, glove or even human hand[1-3]. The other researcher focus on inventing the interaction that can use hand directly towards projected interface. The multi touch and tactile feedback also invented and discussed for the future interface of application [4-7]. Izadi et.al and Newcombe et.al have proposed Kinect fusion for 3D reconstruction as a new step towards AR technology in reconstructing the object in the real world [8-9]. Instead

of providing interface, the other researcher has produced realistic facial expression of virtual human to augment the interactivity of user in virtual environment. They used various technique such as: fluid simulation for sweating and tears effect or even the oxygenation level adjustment which is incorporated with facial skin colour of virtual human [10-14]. The interactivity of user also being attained by reading and analyzing the brain signal in accordance to the emotional condition of human. Afterward, the emotion will be synchronized with physical action of the virtual human such as walking, collision avoidance or facial expression [15-18]. As discussed before, the invention of Kinect has drawn attention in some research topic, some of researcher produce an innovative ways of interaction for medical purpose such as controlling the application for assisted surgery and even create the touch interface for projected display. The Kinect and regular camera is widely used to produce variety of AR application by tracking its specific features[19-22].

3. RESEARCH METHOD

The first stage is detecting the optimum object then it continues with depth image data stream processing. The next step is doing pattern classification with random decision forest. Afterward, the both hand will be tracked and synchronized simultaneously. The position of hand will be synchronized with the projector display to measure and detect the location of finger on canvas which is projected onto wall, refer to Figure 1.

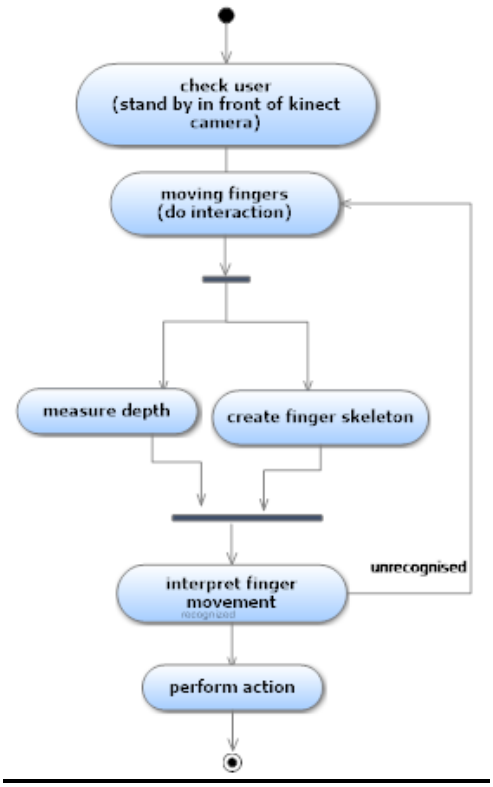

FIGURE 1. Methodology

The concept of building the TOU-AR system is consist of depth image tracking, motion tracking and gesture interpretation. The proposed research is projected a particular interface to wall any physical medium and track the human hand that associated with the medium to determine what kind of action that occurred.

3.1 Functional Requirement

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There are some core function touchable interfaces:

- Area for touching (Medium interaction: wall, desk , etc)
- Tracking the position of hand and the pad area
- Touching tracking

Besides the functional requirement that provided in the application, the non-functional is act as additional support to the proposed system. Non Functional Requirement relate to other information needed to produce the correct system and are detailed separately such as: Rough surface touching, dark environment and multiple user touching

3.2 Material

This research carried out by three core devices: Kinect Camera, Projector(portable is preferred) and Laptop/PC.

4. RESULT AND DISCUSSION

The touchable interface require two main hardware needed: projector and Kinect. User should do calibration to the system for first time as shown in Figure 3. After user do calibration, user may save the calibration result for future purpose. Afterwards, user can directly create the surface and display the touchable interface after do the calibration. The interface of touchable interface is shown in Figure 4.

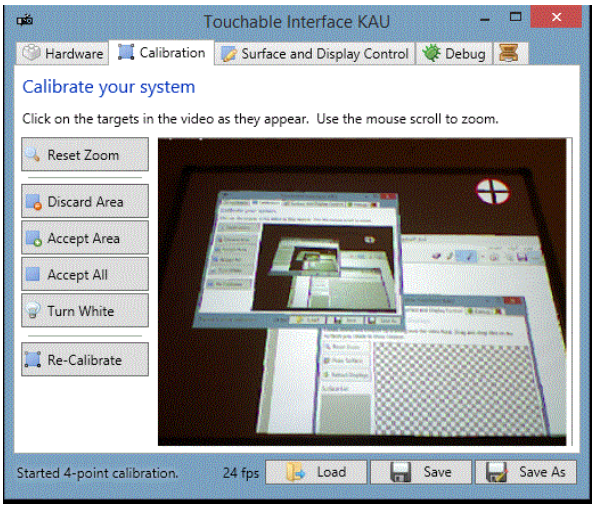


FIGURE 2. Calibration Process

```
#sound
{
top: 95px;
left: 521px;
background-color: #e3c;
background : url(images/A.GIF);
background-size:100% 100%;
background-repeat:no-repeat;
}
```

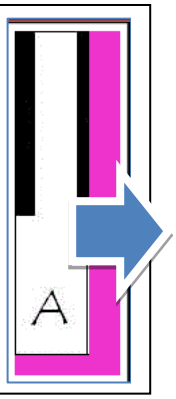


FIGURE 3. Css Code for creating GUI

Figure 5 is part of Css code in html5 GUI that handle the display interface of piano (in this case). Furthermore, Figure 5.6 is part of javascript that recognize the area of surface and turn it into touchable interface.

The testing is divided in three main scenarios: testing for piano interface,fluid dynamics and image scroller. The first testing is the identify the touching area by pressing some piano keys button in the surface, then it continued by following the finger movement in the fluid dynamics, then continued by recognizing dragging effect on the image scrolled.

4.1 Finger Tracking Control for Piano Interface

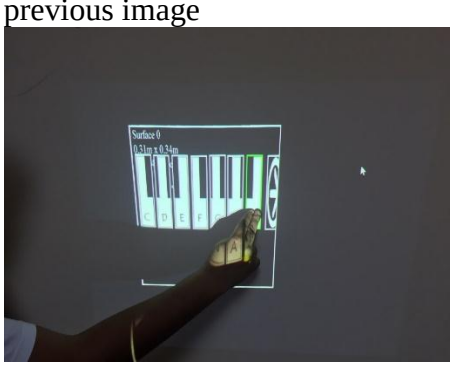
The finger tracking control is used for motion detection, this section show the testing process by creating a piano interface that will certain sound during touching. Figure 6.1 show the model of piano interface that projected to the wall. When you touch the piano surface appears green color palette and then the audio will be played.

4.2 Finger Tracking Control for Ball simulation

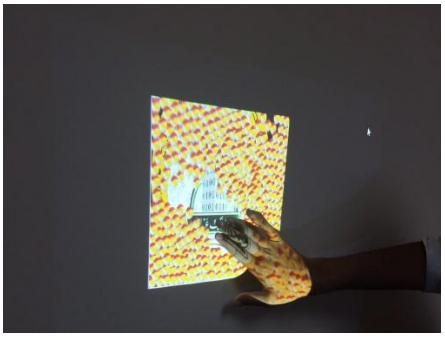
Figure 6.2 is another sample of interface that simulate ball movement according to physics rule. When you move your finger towards the ball, the ball will react according to fluid dynamic rules.

4.3 Finger Tracking Control for Image scroller

The other interface that presented in this project is image scroller, we provide four main different images that can be scrolled to do navigation between images as shown in Figure 6.3. it show when you want to move the image and show the image that then move the image from right to left or vice versa to show the next or previous image



(A) Touchable Piano



(B) Touchable Fluid

(C) Touchable Image

FIGURE 4. Tou-AR

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4. CONCLUSION

The touchable interface is become more popular now, since the tracking device like Kinect become cheaper and easy to buy. User very interested to interact with the system in natural ways just using their hand and wall or any surface. Piano interface give different sensation when it used because user didn't experience the button touch during playing the piano keyboard on top of surface. Furthermore, the ball and image scroller give different experience and sensation to the user. This interface is getting interesting and it is believed can be implemented for various purpose in the future. The result is quite fascinating, synchronization between finger and user interface is occurred in real time. There are plenty of works that need to be improved in future such as: implementation of touchable interface in different medium such as water, glass or sand. Creating different interface such as touchable phone through wall or desk will be interested in the future

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