Virtual Touch Screen Using Microsoft Kinect

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Abstract: **Virtual Touch Screen using Microsoft Kinect is a depth-sensing and projection system that enables interactive touch applications on everyday planar surfaces. It provides capabilities similar to that of a mouse or touchscreen. Touch screen surfaces are becoming prevalent, since they are capable of detecting the user's actual touch points that is the points of contact on the surface. Our project presents a practical solution to achieve touch on any planar surface based on mounting a single commodity depth camera that is a Microsoft Kinect above a horizontal surface and using a projector for projection purpose. This will enable us to detect when the surface is being touched. Using Microsoft Kinect to detect touch has significant advantages: firstly, the interactive surface should not be instrumented. Secondly it is more accurate and cost effective.**

Keywords: Microsoft Kinect, depth cameras, interactive surface.

1. Introduction

In today's modern society it is difficult to imagine a world without the touch screen. It can be found in cell phones, computers, tablets and there is also research in flexible and curved touch screens. At first the input was done with help of a stylus, the screens were black and white, but now we have touch screens that spread over several meters. Touch screen has become popular because it is easy to use, allows the user to understand or know something without any reasoning process. The last decade cell phones had no buttons thus to type a text message a person had to click the same button several times to get the right letter but with the introduction of touchscreens it is possible to get all the alphabets on different buttons by using a qwerty keyboard. Touch screen has helped in reducing the users work thereby creating an innovation for developing applications (apps). Now days, there are apps that open on a single click of a button i.e. mails and news. However touch screens have many limitations. It can break into pieces when dropped to the ground also they cause may scratches on the screen. The main question that arises in our minds is what will the future bring? One of the possibilities are smart surfaces. Smart surfaces are a combination of a screen and a surface. This means that all the surfaces in the environment can behave like touch screens.

With the span of time and technology, their portability, cost, durability and robustness is in question.

2. RELATED WORK AND MOTIVATION

The project is concerned with touch interaction, natural user interfaces. Below we review relevant work in these areas

2.1 Vision Based
Vision Based technique is used to distinguish between the fingers of both the hands which have been touched. This canbe achieved by using two cameras mounted above the surface.The

fingers of each hand are detected by using the constraints on the touch position with finger orientation. The hand image is captured on a surface to distinguish between hand postures. The only input device required is a camera and it provides a better interface for mouse interaction system.This method is robust and efficient.The drawback of this technique is that it requires a black background for recognition and also additional hardware is required.[3],[4],[5].

2.2 Pen and Touch-based Interaction
The combination of pen and surface is used in this method. The pen is used to give input i.e. to make contact with the surface. This inreases the hardware that is required[2].

2.3 Specialized Hardware
Tap sense is an acoustic sensing system that recognizes the type of input such as nail,pad,fingertip. This requires an additional database to store different types of taps. It also requires a lot of time for set up and the background noise can cause problems while detecting the input[1].

3. PROBLEM DEFINITION

Our project is an attempt to create a virtual touch screen using Microsoft Kinect. Usually the hardware required for detecting the touch on any surface is either very costly or requires a lot of space. In our project we use a single hardware device and any planar surface to create a virtual touch screen. A problem commonly observed is the high False detection of touch points i.e. even when the surface is not touched the sensor detects touch points or else the surface is touched and still no touch points are detected.

4. PHYSICAL SETUP

The setup (Figure 1) consists of (1) a horizontal surface, for interactions, (2) a projector, which projects on to the surface (3) a depth sensor (Microsoft Kinect) for capturing input, (4) a

computer to process the input data from the Kinect and projecting visual output using the projector.
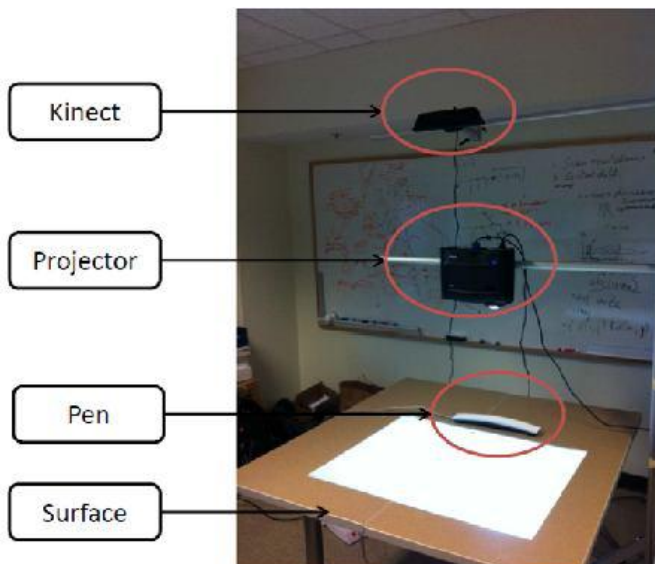

Figure 1. The physical setup

5. ALGORITHM SELECTION

5.1. Calibration

One-to-one mapping is present in traditional multi touch surfaces between the physical location that is being touched and the digital location on the display. This provides users with the feeling of directly manipulating the digital content underneath their fingers. To facilitate a similar interactive experience in the depth camera-based approach, map the depth camera scene to the projected display area as shown in figure(2).
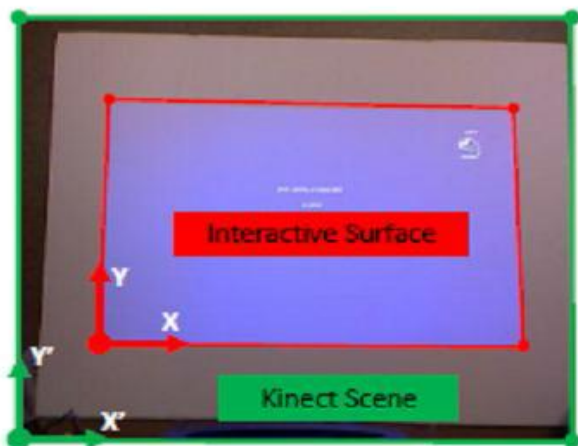

Figure 2. Calibration

Find the nearest neighbor between points in the frames and associate touch points in consecutive depth frames. Since the Kinect can record at a maximum rate of thirty frames per second, not all depth frames are necessarily used in tracking touches. Our system intelligently discards outlier depth frames thereby increasing robustness

5.2. Touch Sensing

The touch is detected by analyzing the image produced by the depth camera. Every pixel's intensity in the depth image corresponds to the distance from the camera. This allows us to define a "touch input region". This touch input region is of a small size in close proximity to the interactive surface. When the finger comes in the proximity of touch input region the touch is detected and the appropriate action is performed. If the input is bigger than the finger for example when you place the entire hand on the surface it gets detected as a blob and is discarded[1].
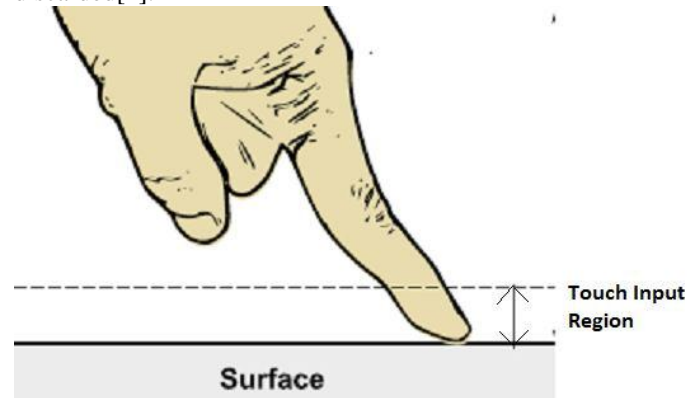

Figure 3. Touch Input Region

6. CONCLUSION

From our research and tests we come up with the following conclusions. Firstly when working with the Microsoft Kinect the operating range of the Kinect needs to be kept in mind. If the Kinect is too far from the surface there is lack of precision. For this reason the Kinect is placed at a distance varying from 0.8m to 4m. Secondly, the Kinect cannot be very close to the surface otherwise the skeleton model received will not be very accurate and precise. The result is that the coordinates of the joints will fluctuate and thus it will be very difficult to place any application on the surface.
Another conclusion that can be drawn is that while calibrating it is possible to get accurate and precise transformations from camera coordinates to projection coordinates.

7. FUTURE WORK

The calibration can be changed to a calibration process which takes in account that hovering might be a possibility. Another change that would be a great improvement would be that the application adapts to the surface. If for example there is a round surface, that the application could appear as if it is glued to said surface. Another area that could improve is the hardware. At the time of writing, the release of the Microsoft Kinect 2 has been announced. If a better camera is used or if the camera were placed at a further distance from the surface, more precise interaction can be done. This would result in a more suitable environment for several users to work on the same virtual touch screen. Another option which promises a bright future is 3D. At the moment there are 3D televisions, 3D computer screens, even 3D movies in the movie theatres. A smart surface with3D would allow more interaction and intuitively. For example an architect is drawing a plan of a house on a virtual touch screen. It would probably greatly help the architect if he/she could see the building in 3D in or on the touch screen.

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