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Implementation of new gestures on the Multi-touch table

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Abstract

This paper describes new gestures on the Multi-touch table. The 2 new gestures with 3 fingers are used for minimizing of all windows that is already open and converting Aero mode. We also implement a FTIR (Frustrated Total Internal Reflection) Multi-touch table that consists of sheet of acrylic, infrared LEDs, camera and rear projector. The operation of proposed gestures is verified on the implemented Multi-touch table.

Keywords: *Gesture, Multi-touch table, FTIR*

1. Introduction

Touch screen technology is widely popularized by Apple iPhone that use Multi-touch technology from 2007. Multi-touch sensing enables a user to interact with a system with more than one finger at a time. Touches are keeping track of how many fingers are on the screen, where they are, and what they're doing. Gestures are important for determining what the user is actually doing when they are interacting with the device at a higher level such as pinching, rotating, swiping and double tapping.[1] FTIR(Frustrated Total Internal Reflection) is to describe the multi-touch methodology developed by Jeff Han.[2] Total Internal Reflection describes a condition present in certain materials when light enters one material from another material with a higher refractive index, at an angle of incidence greater than a specific angle. The specific angle at which this occurs depends on the refractive indexed of both materials, and is known as the critical angle, which can be calculated mathematically using Snell' Law. When this happens, no reflection occurs in the material, and the light beam is totally reflected. [3] In this paper, we describe the principle of operation and construction of Multi-touch table, which is based on FTIR technology. It also includes the proposed gestures and implementation of it. The results of real gestures on the implemented Multi-touch table are shown.

2. System of multi-touch table

2.1 A. Operation of multi-touch tables

Figure 1 shows the implemented Multi-touch table. It consists of screen, LED array, infrared camera, CPU, and beam projector. The screen is 900mm X 600mm sheet of acrylic and edges of sheet have polished clear to work optical waveguide.

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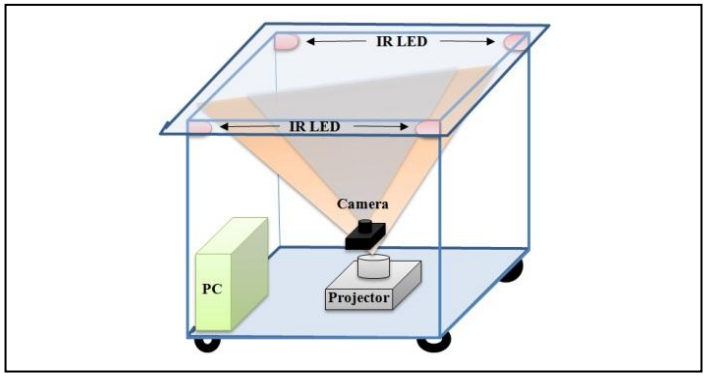

Figure 1. The implemented Multi-touch table

The sheet is edge-lit by 192 array of infrared LEDs array. The high-power infrared LEDs are placed directly against the edges in order to maximize coupling into total internal refraction.

2.1 B. Principle of FTIR operation

The principle of FTIR Multi-touch table operation is shown in Figure 2. The surface of the Multi-touch table is acrylic that is a thin diffuser. It has infrared LED lights and a projector reflected on its underside. LED light encounters an interface with lower index of refraction, light becomes refracted. Refraction depends on the angle of incidence. After a certain angle it undergoes Total Internal Reflection. A finger or the other objects, with a lower index of refraction, comes in contact with that surface can cause the light to escape.

The infrared camera shown in Figure 1 picks up this light and captures image on the screen. The CPU subtracts background image to reduce noise and finds the center and relative size of the pixel groups to drive the gesture.

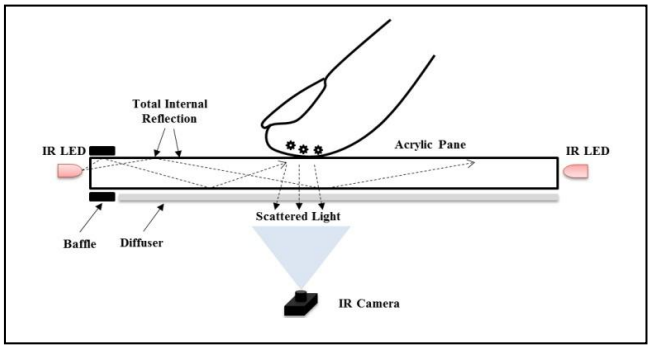

Figure 2. The Principle operation of FTIR Multi-touch table

3. Proposed gestures

In this paper, we propose 2 new gestures. The first gesture is to show desktop. There are inconveniences on the existing Multi-touch table to show desktop in the case of multi windows. The user press one at a time the minimization icons of windows that already open. It is possible to show desktop simply with this gesture. The proposed second gesture is to convert Aero mode. It is difficult to see other running programs when one of the running programs open on the existing Multi-touch table. The proposed second gesture is easy to

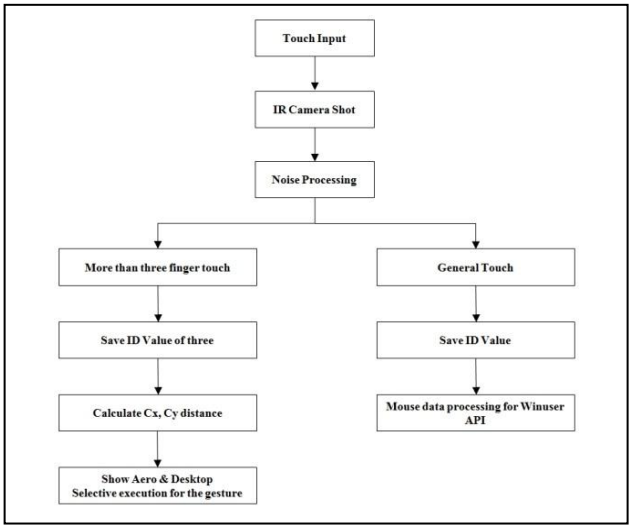

Figure 3. The flowchart of the proposed gesture

identify all of the running programs. Figure 3 shows the flow chart of the proposed gestures. The infrared camera captures image at 2fps at a resolution of 1280x768. The embedded CPU processes this image to remove noise with rectification, background subtraction, corrosion. It also extracts touch data of how many fingers are on the screen, where they are, and what they're doing based on the processed image. The function of trackingPoint is to extract the touch coordinates. It also counts the number of touch points and calculates touch area and center points of touch area. The information of structure that contains touch ID, coordinate, area send to mouse control part that is supported by WinUser API. In the case of simple touch, the mouse coordinates is extracted by comparing touch coordinate and real screen resolution. When there are 3 touch points, each touch identifiers dwID and distance of touch points from final coordinate to start coordinate is extracted from the program. The first gesture of minimization of all running windows is executed when the distance of y-coordinate is over the threshold value. The second gesture of converting to Aero mode is executed when the distance of x-coordinate is over the threshold value.

4. Experiment and results

Figure 4 is the action of 3 fingers that executes the proposed gestures and the partial source code shows on the Figure 5. The Aero mode is executed when the 3 finger slide from left to right as like Figure 4 (a).

The minimization of all running windows is executed when the 3 fingers slide from top to bottom as shown in Fig 4(b). Figure 6(a) is the display of all running windows. Figure 6(b) is the result of executing gesture that minimizes windows.

Figure 4. (a) The action of the first gesture (b) second gesture

```
if(touchToggle ==0)
{
    touchToggle = 1;
    for(int i=0; i<4; i++)
    {
        stpo[i] = po[i];
    }
}
    if(checkmax)
    {
        SetCursorPos(1279-(po[0].x*x),767-(po[0].y*y));
        for(int i=0; i<4; i++) {
            itpo[i] = po[i];
        }
        for(int i=0; i<4; i++) {

            if (stpo[i].y-itpo[i].y >= 30) {

                WinExec("C:₩₩Users₩Default₩AppData₩Roaming₩Microsoft₩Internet Explorer₩Quick Launch₩Shows Desktop", SW_SHOWNORMAL);
            }
            if (stpo[i].x-itpo[i].x >= 30) {

                WinExec("C:₩₩Users₩Defaultr₩AppData₩Roaming₩Microsoft₩Internet Explorer₩Quick Launch₩Windows Switcher", SW_SHOWNORMAL);
            }

        }
    }
    else
    {
        SetCursorPos(1279-(po[maxvalue].x*x),767-(po[maxvalue].y*y));
        tepo = po[maxvalue];
    }
```

Figure5. The partial source code

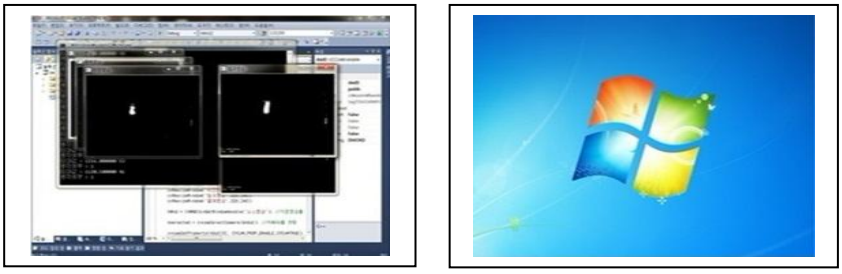

Figure6. (a) The display of all running programs (b) The result of gesture

4. Experiment and results

We have implemented the Multi-touch table using FTIR method. It consists of sheet of acrylic, infrared LEDs, CPU, camera, and rear projector. It detects touch and gestures in order to input commands. The new 2 gestures on this table are also implemented using C++, OpenCV library. The operation of these new gestures is verified on the Multi-touch table. The first gesture is to show desktop. The proposed second gesture is to convert Aero mode. The proposed second gesture is easy to identify all of the running programs. We will develop more gestures to use with ease on the Multi- touch table.

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