September 2022

A SOLUTION TO ENHANCE OFFICE CONFERENCE EXPERIENCE BY NON-CONTACT FLOATING-IN-AIR USER INTERFACE

HP INC

A solution to enhance office conference experience by non-contact floating-in-air user interface

Abstract

In the post covid-19 pandemic era, more and more persons come back to office. Comparing with the ear before covid-19 pandemic, one important thing changed eco system is user pay more care about to keep themselves away from the virus. Since this design mainly tends to set the product in a public place, considering that if the user directly touches it, it will greatly increase the possibility of pathogenic disease, so the input is selected in a non-touch manner. User do care the interface they touched in public area and want to make sure if the device can provide a safe and clean way to manipulate with user? For this we provide a solution to let user communicate its office conference device safely.

Method

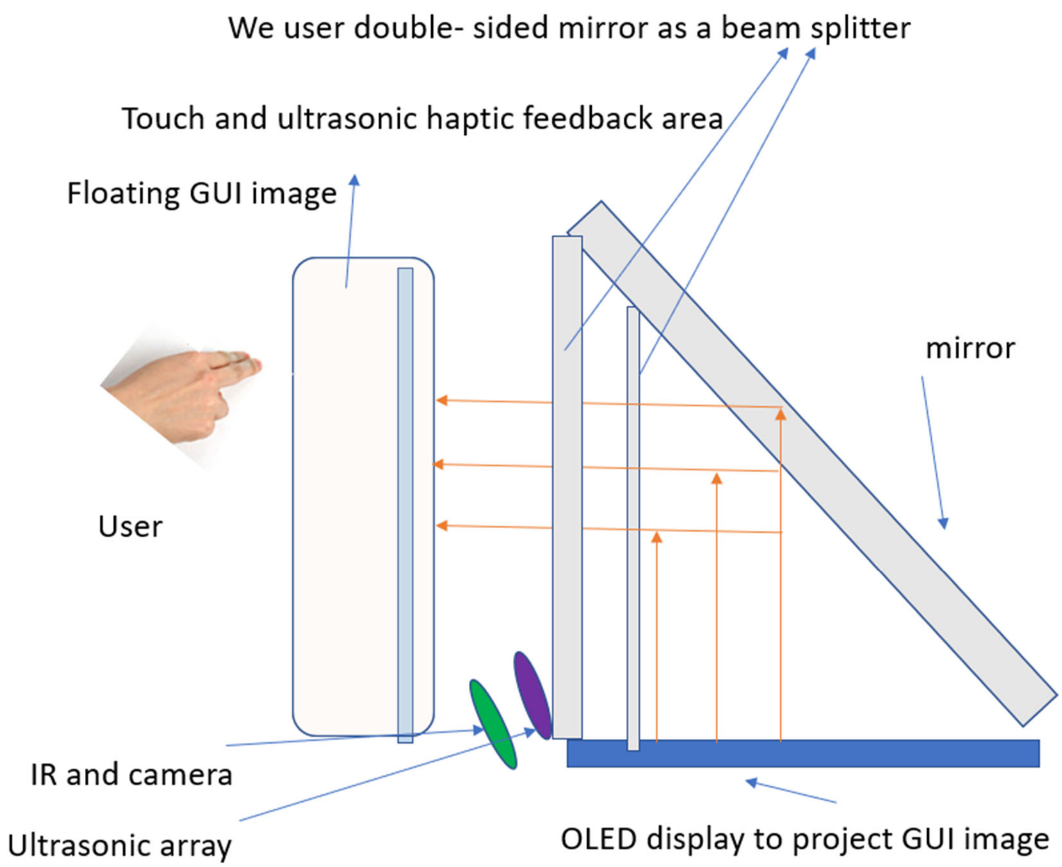
For the pain point, we provide:

- 2 double side mirrors to reflect the image
- 1 LED display to display the image
- 1 camera to detect the click point of the finger
- 2 ultrasonic array to feedback the touch feeling.
- Algorithms for virtual haptic touch

Double-sided mirror and ordinary mirror in fact the structure is the same, are a transparent glass plus a layer of metal plating, the difference between the two lies in this coating, ordinary mirror plating is basically opaque, light through the glass will be reflected back by the coating, these reflected light to the human eye We see the mirror image. And the double-sided mirror coating is thinner, is translucent, although this coating can also reflect light, but there will be 1/3 of the light will penetrate the coating, leaking to the other side, when the double-sided mirror side of the dark side of the light when this translucent coating is very magical.

For people standing on the light leaked from the dark place is too weak, will be ignored by the eyes and brain, can only see their own side of the reflected back of the light, that is, their own mirror, at this time the double-sided mirror is equivalent to an ordinary mirror. And for people standing in the dark, the light reflected back from their side is too weak, it will be ignored, and all that can be seen is the light that leaks in from the opposite side, that is, the opposite scene, the double-sided mirror at this time is equivalent to a transparent glass, so the conditions for the double-sided mirror to play a role have nothing to do with how the mirror is placed, only related to the chiaroscuro contrast on both sides of the mirror.

The projection module consists of two parts: display and optical mirror system. Taking advantage of the physical characteristics of the double-sided mirror, 2 double-sided mirror with a 45° angle between the two sides is used to form a 1:1 virtual image of the screen in the mirror group.
The hardware part of the gesture detection module we expect to use camera for image capture, after which the optical signal will be directly analyzed to obtain the click address.



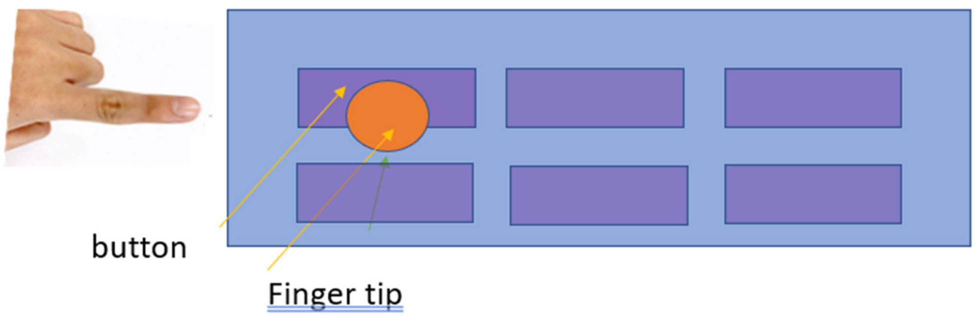
We use Ultrasonic to form the virtual button for computer to replace the physical hotkey. Ultrasonic “force feedback”, also known as ultrasonic haptic feedback, provides different feedbacks through ultrasonic tactile pulses. Research have emerged to produce more precise sense of touch with the radiation force of ultrasonic sound.

The acoustic radiation force triggers a shear wave on the skin, creating a feeling of movement, as well as triggering a mechanical stimulator in the skin to make the sense of touch clearer. We set a virtual finger on the left or right side of the computer.

There is an IR distance module can be used to detect the finger position and distance of the finger then submit ultrasonic to that position to form the tactile of that finger "press button" . Sound emission force that creates a tactile touch in our skin and changing the intensity of the ultrasound allows it to produce more combinations.

Ultrasonic default mode is disable and will be trigger when IR distance detect an obstacle near it. Different frequency of ultrasonic vibrations mapping to different writing feedback. High –before press, low—after press. We define 2 kinds of duration to control the ultrasonic on/off T1,T2, which map to High –before press , low—after press. T1 is set to 100 ms, T2 is 10ms.

Our finger identification is a backend firmware to get contour from web cam, then create a software algorithm to analyze the image from webcam and to judge the finger .After judging whether the finger is in the area which button located then check the position and compare with the coordinate with original GUI button. The captured video is separated into continuous image frames .

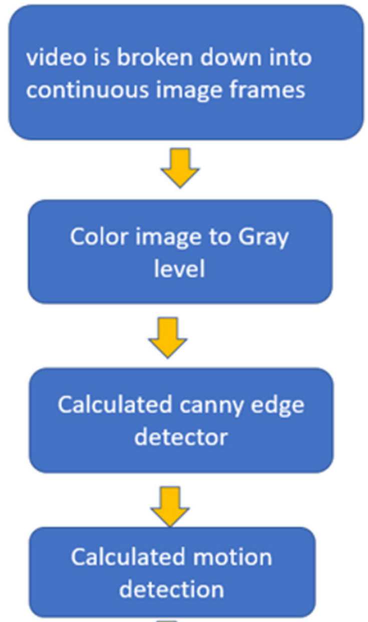


For Color image to Gray level image transfer, we choose the most standard method of converting an RGB image into an equivalent gray scale image is to use RGB to YUV transform and get the luminance Y component which represents the brightness of the RGB image.

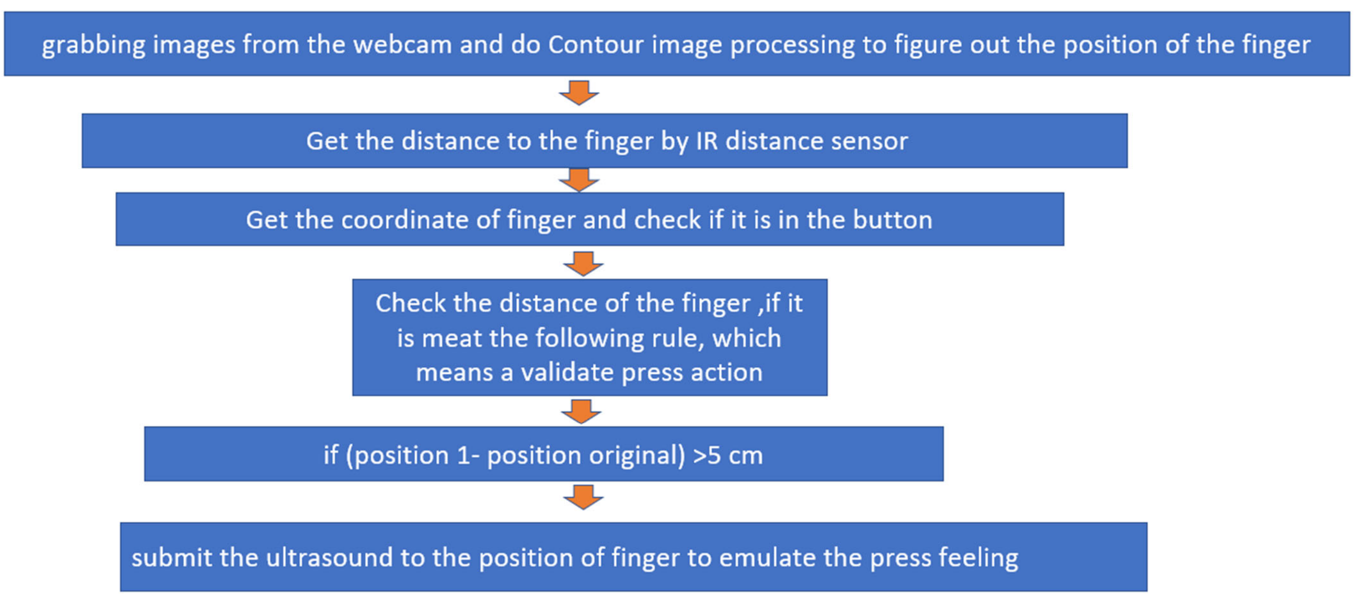
For skull shape, there are many approaches for you to get the segmentation of the skull shape. Even those simple ones, like a simple Sobel mask, will give you good detection on the contour of the skull. To get a better edge map, you may use Canny Edge detector.

For motion detection we use the Block Matching Algorithm, a Block Matching Algorithm is a way of locating matching macroblocks in a sequence of digital video frames for the purposes of motion estimation.

This can be used to discover temporal redundancy in the video sequence, increasing the effectiveness of inter-frame video compression by defining the contents of a macroblock by reference to the contents of a known macroblock which is minimally different.



The following is the algorithm for virtual haptic touch:



Disclosed by David Ke (Hsiang-Ta Ke), HP Inc.