Smart Sense Multi-Touch Screen Technology

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ABSTRACT
In this paper, the design and fabrication of the smart sense technology is presented. The tracking software (ccv), communication protocol and multitouch tool kit is used for tracking the gestures. Later a touch screen is designed using acrylic glass with polycarbonate sheet surrounding IR-LED's for effective sensing. Frustrated total internal reflection (FTIR) is the multitouch sensing technique used for this touch screen. Hitachi ED-220nm ultra short throw projector is used as a source. Play station 3 camera is used for high frame rate and it will let in only 880nm range of light.

Keywords
FTIR (frustrated total internal reflection), CCV (community core vision).

1. INTRODUCTION
Touch screen technology is an exciting area of technology which has grown over the past few years. Although this area of technology is seems to be a new concept there has been research in multitouch technologies since the early 1980's.In this technology the device does not require the use of a traditional pc mouse, and keyboard. It does not require any training or foreknowledge to operate this technology. This smart sense technology brings people together to connect, learn and decide with 360degree interface. This technology is the next generation vision based computer a uniquely designed for people to quickly and easily share the content using touch and objects.

2. DESIGN AND ANALYSIS
Frustrated Total Internal Reflection (FTIR): Is the multitouch sensing technique used for this touch screen. The technique relies on the principles of total internal reflection. Every material has a refractive index, whether it is air, water, metal, plastic etc. When light passes from one material to another, it either gets reflected or refracted. Whether the light gets reflected or refracted depends on the refractive index of the two materials and the angle at which the light is coming from is shown below

Figure 1: Scattering of light

When the light gets reflected, it is known to be "reflected internally". In an FTIR screen, infrared light is injected into a plastic screen and is constantly being reflected internally throughout the screen, it is essentially bouncing around inside the plastic. However, if a finger touches the plastic screen, the refractive index of the finger disrupts the reflected path of the infrared light. The light escapes the plastic screen and reflects or scatters across the fingertip, resulting in the fingertip being illuminated in infrared light. There is "blob" of infrared light where the finger has pressed the screen.

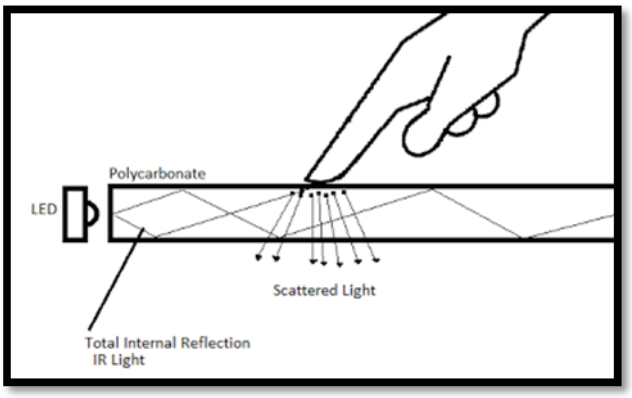

Figure 2: Total internal reflection of light

3. IR-CAMERA
The Play station 3 Eye Camera is chosen as a suitable camera because it runs at a high frame-rate and it is inexpensive. The camera was designed for the Sony Play station 3 gaming system. It connects to the system via USB 2.0. USB is a common interface of modern computers so this camera can connect to them. Since the camera was not designed to be run on computers running Windows or any other operating system, drivers needed to be created to interface to that operating system.

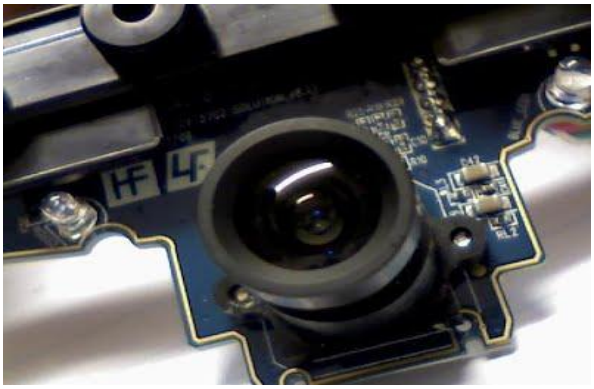

Fig 3: IR-Camera

The camera can be tested by viewing an infrared LED. The image will be a grayscale image because the camera will only let in the 880nm range of light. Visible colours fall in the range of 380nm to 780nm; the band pass filter will simply block these colours from the image. The image seen be the camera will be a grayscale image.

4. PROJECTOR
A projector can be used in a custom-made multitouch screen to display visual feedback. There are for a smart sense screen.

Rear projection requires a special type of projection material which captures the light from the rear and can be seen clearly from the front. The advantage of this method is that there is no shadows from the user touch the screen.

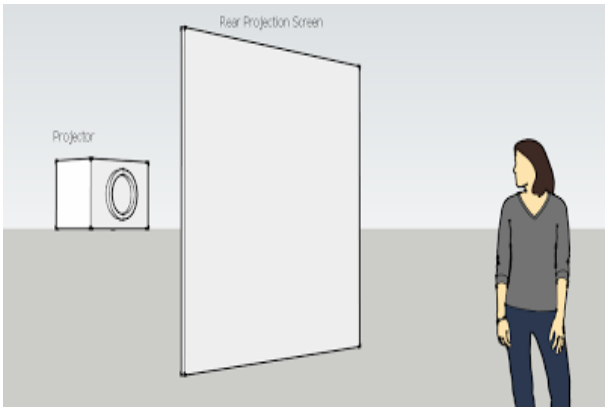

Fig 4: Principle of Projection

Throw distance: The throw distance of a projector is the distance between the lens of a projector and the projection surface. As the distance between the projector and the projection surface increases, the width and height of the projected image increases. Once you know the width of the projection screen and the throw distance, you can calculate the throw ratio.

Throw ratio=throw distance/width of the projection screen. ---------- →(1)

The throw distance for my touch screen is approximately 37", the width of the projection image is 47" so the throw ratio is 37/47=.7872. I needed a projector with a throw ratio of approximately 0.8 or less.

It was decided that the Hitachi ED-A220NM Ultra throw projector would be suitable for this multitouch display.

Fig 5: Hitachi ED-220NM Ultra throw projector

5. SOFTWARE

Smart sense software consist of different layers

1. Tracking Software
2. Communication Protocol
3. Multitouch Framework or Multitouch Toolkit

Tracking software: Community Core Vision (CCV) is open source software for multitouch tracking and sensing. Once your touch screen is giving the desired results, you can use CCV to sense and track the interactions. The CCV interface may be intimidating at first, but it is actually quite simple. The interface is made up of panels and each panel is made up of streams of video, check boxes and sliders. When the check boxes are red, this means they are activated, when they are white, they are deactivated.

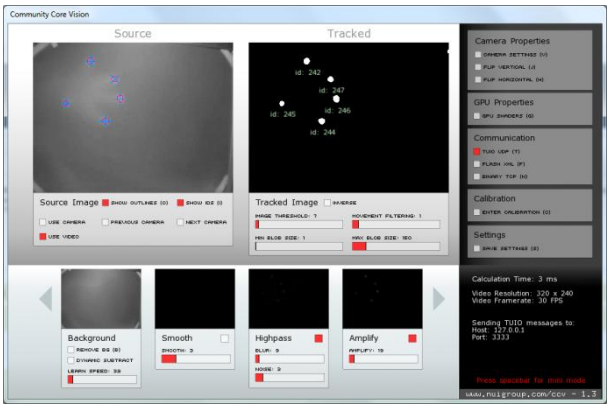

Fig 6: Community core vision software showing the five fingers pressed.

The first thing you should look at is the 'Source' panel. The source panel consists of the stream coming in from the webcam, PS3 Eye camera or a previously recorded video. If you are seeing the video feed from your camera, you can see the image change when you interact with the touch surface. Underneath the source video stream you can see a few check boxes. The 'show outlines' check box, when enabled will display an outline around a tracked finger press. In the image above you can see there are 5 presses getting registered.

6. TESTING AND RESULTS DISCUSSION

The test required an infrared sensitive camera The camera needed to be sensitive to the 880nm spectrum that the IR-LEDs were producing. A PS3 Eye camera was chosen as a suitable camera for this project because it provides a high frame rate and inexpensive. The Only problem with PS3 Eye camera is that there is an IR blocking filter installed in it. This needed to be removed, and an infrared band-pass filter needed to be installed. The smart sense screen was built and tested successfully. But the result was not up to the expectation. The accuracy of the image detected by the IR-Camera was little blurring due to the use of simple glass screen rather than an acrylic glass with polycarbonate sheet. The device is successfully recognizing the objects placed on the screen and shown by fig 6 as five fingers placed on the screen.

7. APPLICATIONS

- Interactive surface computing platform that allows one or more people to use touch and real world objects, and share digital content at the same time
- Medical field: Virtual body dissection and In Healthcare
- Technical field: device recognition
- Student mate: reduces the paper work(for further generation student should carry only storage device like pen-drive)
- Digital Business field: to build an open relationship with employs, customers, suppliers and other external partners though digital networks.

- Media and Entertainment
- Digital money: To clear any means of payments in electronic form and it can be turned into physical money.
- EGovernment: to develop a digital interaction between a citizen and government (C2G).
- It is a 360degree multiuser application.

8. LIMITATIONS

- Difficult to get an illumination throughout the touch surface
- Consumes more power supply
- Touch events can get triggered by objects hovering over the screen.

9. CONCLUSION

- To create a completely digitalized classroom environment.
- To make paperless work for the students and it is eco-friendly.
- It helps for the people suffering from dementia.
- It will be a new technology in Medical field, and business field.
- It replaces desktops, laptops, and tabs, etc in future.

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