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Surface Computer

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Abstract*—Multi-touch surface computing is the term for the use of specialized computer in which, instead of keyboard & mouse, the user interacts directly with a touch sensitive screen. Multi-touch system is based on touch technology that utilizes touch sensing as an input. It exists in our daily life such as on smart phones or different types of portable devices. However, current touch systems suffer from many limitations. Natural User Interface community has proposed numerous methodologies to implement surface computers based on imaging touch-screens. In this paper we elucidate a blob detection algorithm for touch sensing. The algorithm has been implemented using Community Core Vision[2].*

Keywords-*Fingertip Blob detection; Multi-touch surface;FTIR;TUIO protocol; Object recognition; Computer Vision.*

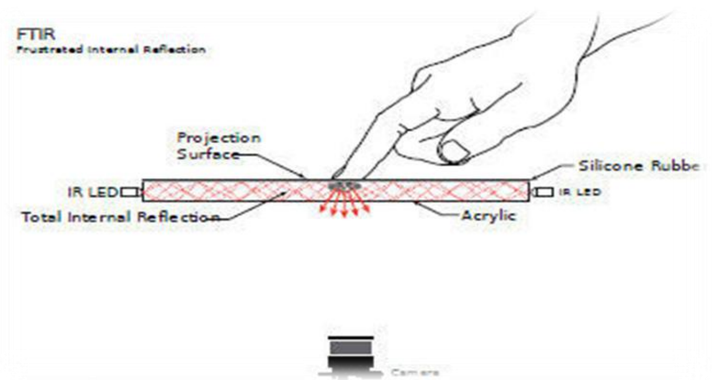
I. INTRODUCTION

A multi touch surface computer is a computer that interacts with the user through the surface of an ordinary object, rather than through a monitor and keyboard. The goal of surface computing is to recognize touch and objects on the screen's surface and to interact with those objects seamlessly.Multi-touch technology is an advanced human-computer interaction technique that recognizes multiple touch points and also includes the hardware devices that implement it, which allow users to compute without conventional input devices. Multi touch using Frustrated Total Internal Reflection is a simple, inexpensive, and scalable technique for enabling high-resolution multi- touch sensing on rear-projected interactive surfaces [3]. Different applications for multi-touch interfaces both exist and are being proposed. The use of multi-touch technology is expected to rapidly become common place. Technology has evolved to a great extent and it promises to evolve further in the years to come.Some of the existing Method for Multi-touch are given below:

- Frustrated Total Internal Reflection
- Rear Diffused Illumination
- Front Diffused Illumination
- Diffused Surface Illumination
- Laser Light Plane

II. Frustrated Total Internal Reflection

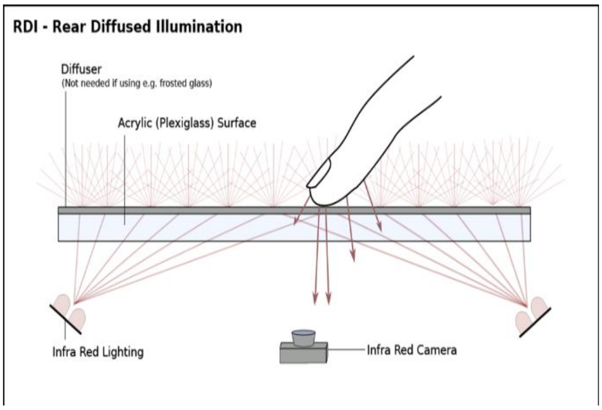
FTIR uses the phenomenon of Total Internal Reflection in which infrared lights are placed at the sides of the acrylic sheet. When the user touches the acrylic surface, the infrared light is “frustrated” which causes the light to escape internal reflection and scatter downwards which is scanned by an infrared camera [1].



“Fig 1. Frustrated Total Internal Reflection”

III. Rear Diffused Illumination

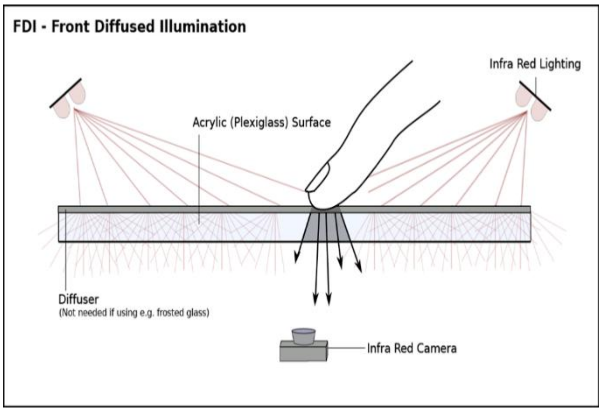
In Rear DI, infrared light illuminates the screen from below the touch surface. A diffuser needs to be placed on top/bottom of the touch surface. When the user touches the surface, the infrared light hits his finger and is reflected downward and sensed by an infrared camera below the surface.



"Fig 2. Rear Diffused Illumination"

IV. Front Diffused Illumination

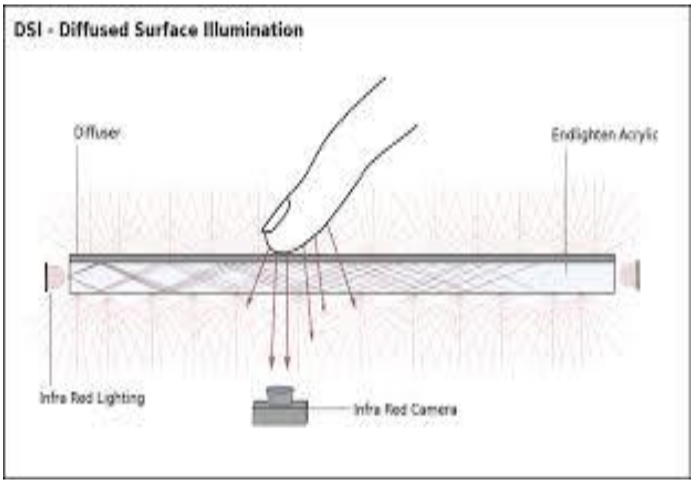
In Front DI, infrared light is shown from above the acrylic plane. A diffuser is placed on top/ bottom of the touch surface. When the user touches the surface, a shadow is formed and it is captured by an infrared camera placed below the surface.



"Fig 3. Front Diffused Illumination"

V. Diffused Surface Illumination

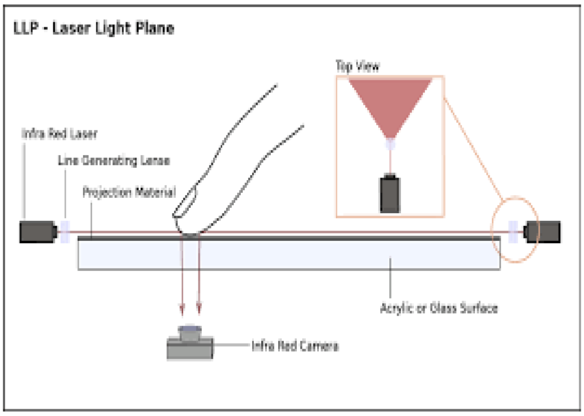
Like FTIR, in DSI infrared light is placed at the sides of the acrylic plane, directed towards the inside. It uses a special acrylic with small particles inside it, which act like reflection of light take place inside the plane. On touching the diffuser, the light escapes out of the surface and thus the touch can be seen by the camera.



"Fig 4. Diffused Surface Illumination"

VI. Laser Light Plane

In LLP, the surface is illuminated by the single or multiple lasers. The laser plane of light is about 1mm thick and positioned to the touch surface. When a finger touches the light plane, the object lights up and viewed by an infrared camera below the surface.



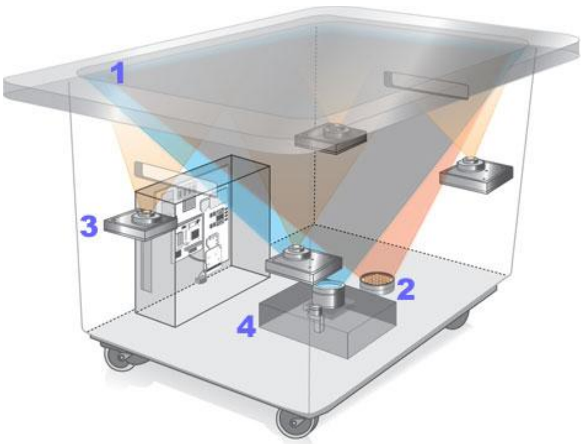
"Fig 5. Laser Light Plane"

VII. Hardware Setup

Fig 6 shows the hardware setup and hardware setup we have used to implement this project is given below:

- IR Camera
  - Frame rate- 120fps
  - Type- stationary web cam
  - Resolution- 640x480
  - Focus type- fixed
  - Connection USB

The camera we have used is ps3 eye camera we have modified the camera by removing IR filter to detect infrared. Camera is placed under the touch surface it is used to capture blob which are created by user when he touches the screen.



"Fig 6. Hardware Setup"

- Projector
  - White light output- 3000lumens
  - Resolution – SVGA
  - Native aspect ratio- 4:3
  - Contrast ratio-10,000:1

The projector we have used is Epson EB-S18, it is placed at the bottom of the setup under the touch screen for projection of visuals on the screen.

- IR LED
  - Wavelength-1000nm
  - Bandwidth-50nm
  - Size-5mm

- Colour-Purple Casing
- Illuminance-20mW(Maximum),1mW(Minimum)

IR LED's is bounded around the Acrylic Sheet which will emits the IR light and cause total internal reflection inside the acrylic sheet. In this experiment we used 112 IR LED's. The specification acrylic sheet and power supply required require for this project is given below:

- Acrylic sheet
  - Size-36x24 (inch)
  - Width-8mm

- Power Supply
  - Voltage-12v
  - Current-1.8 Amp

VIII. Working

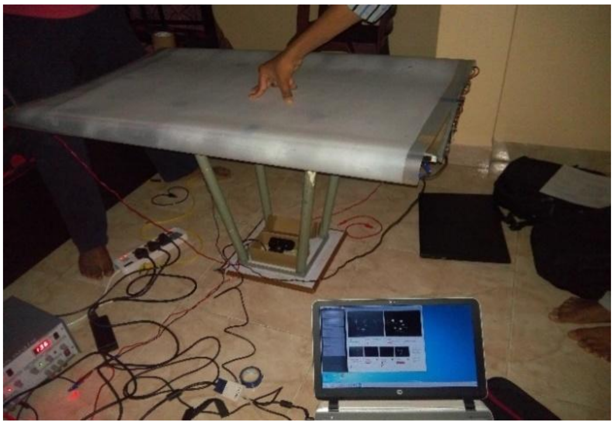
FTIR method stands for frustrated total internal reflection. In this method internal reflection of light is present this light is infrared light which is emitted from the infrared led that are placed at the sides of acrylic sheet which causes the internal reflection of infrared light. As the finger touches the screen (acrylic) infrared reflection gets frustrated. This infrared light gets scattered and the finger tips are captured by the infrared camera place behind the acrylic sheet. The grey scale images captured by camera are then processed with the help of processing tool which results in white blob. These blobs are analysed by software. Every blob corresponds to certain coordinates. Software analyses these co-ordinates to perform certain task such as: touch, drag, move, resize, rotate objects, zoom-in and zoom-out [4].

IX. Test result

Frames: The acrylic sheet is surrounded by the four frames which contain 116 IR LED's. Two shorter Frames having a dimension of 24 inch and Two Longer frame having size of 36 inch. Each frame contains LED's which connected in series in group of six LED's and each group further connected in parallel with each other. Fig.10 shows the aluminium frame which we used in this project.

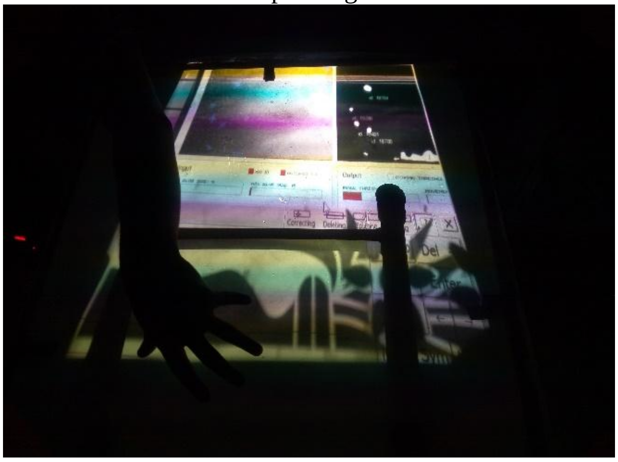
"Fig 7. Aluminium Frame"

Fig.11 shows the actual setup of our project, the glass is placed on the table, projector is used for projection of screen and camera used to capture the touch of the fingertip and gestures are placed under the glass.



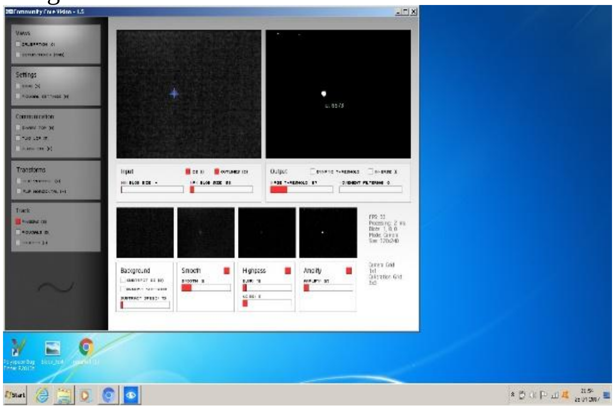
"Fig 8. Actual Project Setup"

Fig.12 shows the surface which will we observed while operating the screen.

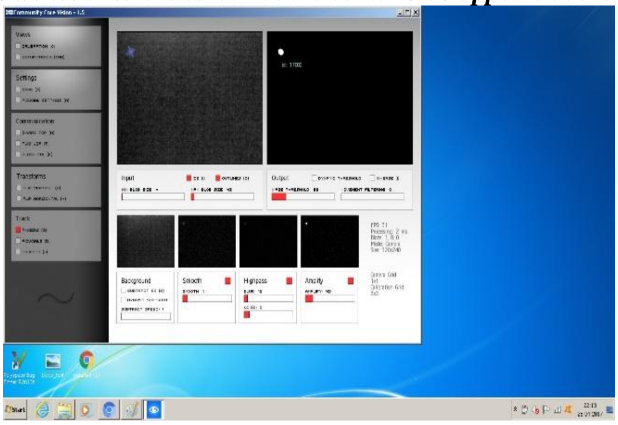


"Fig 9.Actual view while operating the screen"

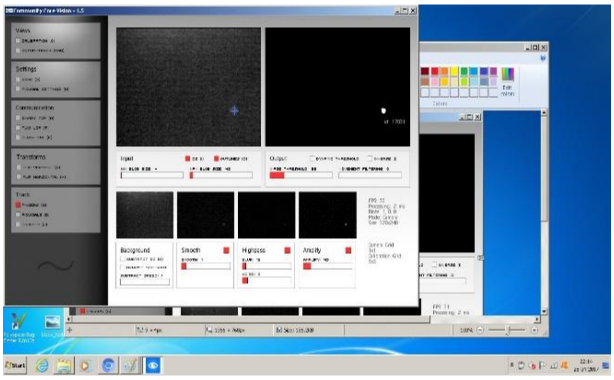
Fig.10 to 12 shows the results of Finger touch on the different corners of screen.



"Fig 10. we touched the screen at the center blob appears at the center"



"Fig 11. we touched the screen at the left side blob appears at the left side"



"Fig 12. we touched the screen at the right side blob appears at the right side"

X. Conclusion

Touch screen are the interface for the 21^{st} century. Touch screen address the conflicting demands for the smaller portable electronics with larger display, eliminating traditional buttons without sacrificing screen size. The future of multi-touch screen in which it will change the interaction with the computers where mouse and keyboard will be replaced by it. The application of this multi-touch surface is digital gaming simulations, entertainment, drawing etc. This proposed prois completed by using Community Core Vision.

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