

# Multi-Touch Technology Interface and Computer Interactions

Swastik Chavan, Salonee Ameria, Meher Dodhia, Mahima Jain

**Abstract**— This paper focuses on the future technology which is already here, which allows the human interaction with the computer through recognizing touch. There are many touch technologies, however they cannot be used commercially due to many limitations. Due to the evolution in these recent years, it detects the inputs through tracking algorithm. With the common experiences of touchscreens every day in life, it should focus on the quality for commercial use to access any system. Furthermore, FTIR and DI which are multi-touch technologies used for calibration and interface have been discussed. This challenge and type of interaction has many applications which can be used in shopping malls, restaurants, education and everyday use.

**Index Terms**— multi-touch technology, diffuser, blobs, detection, gestures, IR camera, capacitive, acoustic, optical.

## 1 INTRODUCTION

'Today everything is at the tip of one's fingers'. The invention of touch is evidence of this popular belief. In the recent years of conventional technologies like keyboards and mouse have now been taken over by a touch. The user can access and interact with the computer screens just by using his fingers or for that matter just gestures. The intuitive and elegant nature of this technology makes it user friendly. Infinite applications can be implemented using the technology of multi touch. The popularity and evolution of smart phones with the quality of touch has made the users habitual to adapt the touch technology. The technology has immense potential to be explored in countless ways and is still in an evolving stage. Since 1965 of E.A Johnson's first finger driven touchscreen to 2000's Microsoft touch surface, the technology continues to contribute in the evolution of touchscreen gadgets. Until 2006, when Jeff Hans gave his first public demo using FTIR technology where the software can detect and analyze the co-ordinates through blobs created to perform various tasks.

The aim of this paper is to create the most cost effective and easiest techniques for multi touch technology applications. The applications using gesture analysis is an intermediate between the hardware usage and touch interactions. Multi touch technology is a human-computer interaction technique and aims at reading several inputs simultaneously thereby syncing computation and communication. It is a user-centric and user-friendly interface which facilitates smooth performance, outstanding visual clarity, perfect and precise response time and eminent user experience. A multi touch technology consists of a software that reads the simultaneous inputs in contrast to the single touch screens which senses one input at a time. There are two main features of multi touch. Firstly, one can have a direct interaction with the information displayed on the screen, anywhere and anytime. Secondly, need of a hardware device like a mouse or a stylus to point on the screen which can merely be done by gestures is eliminated. Suppose one needs to zoom in or zoom out, it can be done by using

finger movements. Similarly, one can change, rotate, swipe or span across the entire screen without any intermediate device. Multi touch screens used at a supermarket or a hotel or even in industries increases productivity manifold as the number of users it interacts with increases. Thus, this technology is advantageous in a million ways in data recovery, digital storyboard, geographical exploration and medicinal imaging however, yet this is not used commercially.

## 2. MULTI TOUCH TECHNOLOGY

### 2.1 FTIR (Frustrated Total Internal Reflection):

In the phenomenon, an acrylic panel or sheet is used where IR led of the required wavelength are inserted in the edges of all sides of the panel. The IR led light is blocked in the acrylic sheet by internal reflection due to its thickness. As we touch the surface of the panel, the light is frustrated inside the panel which causes the IR led light to scatter where it is captured by the IR camera. When the blob is visible the IR camera senses the IR light which is not seen by naked eye. Generally, a silicon layer is used to increase the sensitivity of the touch surface. While touching the acrylic one must press harder for the FTIR effect but using silicon rubber no force is required and sensitivity is increased.

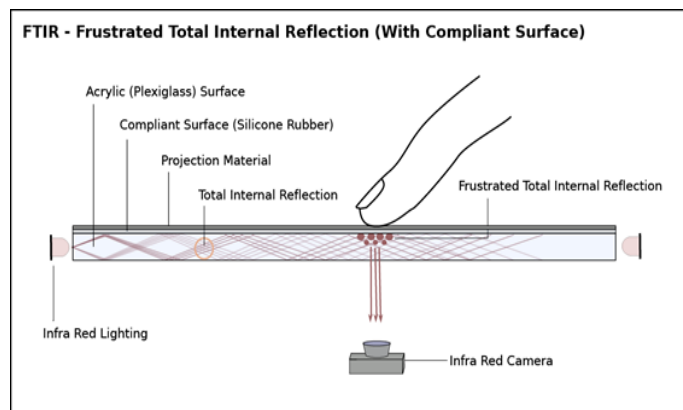


Fig. 1: Frustrated Total Internal Reflection (With Compliant Surface).



Fig. 2: Blobs created using FTIR.

**2.2 DI (DIFFUSED ILLUMINATION):**

In this phenomenon, the IR led are used above or below the projection surface with is called front and rear diffused illumination respectively. The surface is an acrylic panel with a diffuser on the projected surface. When we touch the screen, the blob created reflects extra light than diffuser and this light is recognized by the infrared camera. Thus, as the user touches the light, it can't pass through the finger and IR light hits the surface with extra light which is captured by the IR camera. However, both these techniques have some pros and cons. While DI can recognize objects, the blobs and hovering can be calibrated easily. As FTIR is robust, it does not allow object recognitions easily. In FTIR, the calibration and blobs detection won't have to be adjusted every time using the touch interface as the light is always shining through the acrylic panel in the

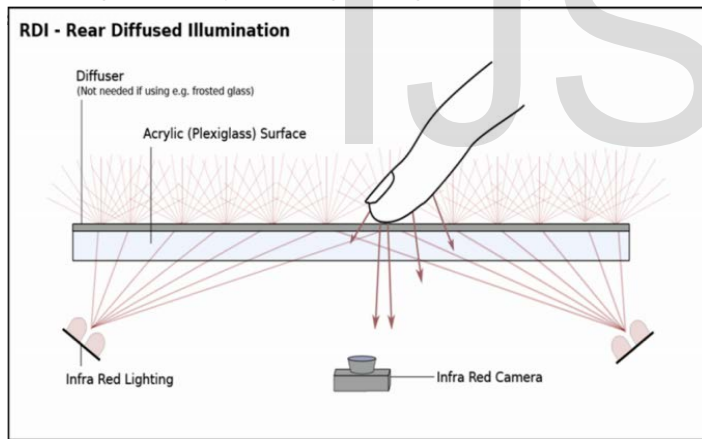


Fig. 3: Rear Diffused Illumination.

However, while implementing there are noises created by surrounding environment, quality of the hardware setup, etc. The calibration allows all the co-ordinate points to line up with the screen between the camera and projection.

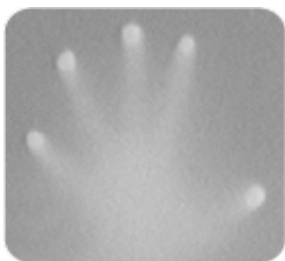


Fig. 4: Blobs created using DI.

**3 WORKING**

There are few ways to construct multi touch surfaces. A projector for vision is connected to the computer for multitouch application which has tracking application software. It is used for visual feedback system where a mirror helps the inverted image for the projection surface on the acrylic. The tracking application /computer is connected to the infrared camera. The IR camera is placed such that the surface is captured to detect the touch surface.

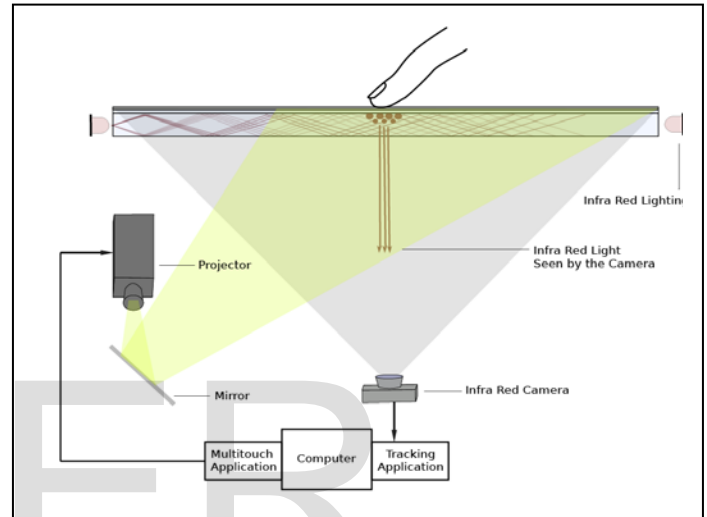


Fig. 5: Multi-touch screen working

**4 TOUCH TECHNOLOGIES**

The main types of multi touch screen technologies:

- 1) Overlay based-In this, the sensors are fixed in the screen which enable the touch features.
- 2) Perimeter based-In this, the sensors are found on sides of the screen.

**4.1 Overlay based touchscreen types.**

**4.1.2 Capacitive touch technology**

An oxide is used for coating the panel for allowing the electric current to pass through. The sensor then becomes capacitive and a censored field of electrons is formed along both the axes. Capacitance is also exhibited by humans as it has stored electrons. When the finger touches the screen, the capacitive field of screen transmits a signal for mathematical processing.

**4.1.3 Resistive touch technology**

There is a transparent material between two layers where an air gap exists. On applying pressure to the outer layer, specific

locations on the inner layer are touched. Due to this the electrical current changes and is recognized as a touch event. The controller then processes it. They are less sensitive. Contaminants may affect the touch.

## 4.2 Perimeter based technology types.

### 4.2.1 Infrared touch technology

Infrared lights are used for detecting touch. There are various methods which are employed for the touchscreen panel. In the first method changes in the surface resistance is observed when there are thermal changes. However, the disadvantages of this method are 1) it is comparatively slower 2) it does not sense cold hands. The second method uses interrupted light beam detected by horizontal and vertical sensors on the screen surface.

### 4.2.2 Surface acoustic

Event is detected by ultrasonic waves. The panel absorbs the ultrasonic waves when it passes over it.

### 4.2.3 Optical touch technology

It uses optical sensors, mainly CMOS sensors. This is a relatively versatile and scalable modern touchscreen technology. There are sensors on the edges. The touch is located by a pair of cameras.

## 5 GESTURES

Gesture recognition falls under the domain of human machine interaction which enables users to directly and naturally interact with computer screens without any devices. Mathematical algorithms are used to interpret gestures. Gestures involve movement of the hand or face. The most basic gestures that are defined are select, change, zoom and rotate. There are various techniques which have been used to interpret gestures.

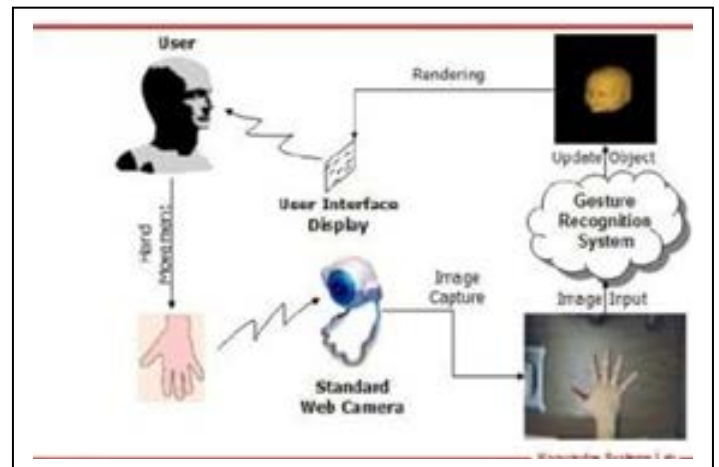
However, the major issue is that no two users can have identical hand movements. Thus, the screen should be efficient so as to understand the general meaning behind the gesture, provided it is near to the one that the screen actually recognizes. Only then will we obtain the desired outputs.

We can categorize gestures in two types, Direct Manipulation Gesture and symbolic gestures pattern. In direct manipulation gesture our fingers can be used for basic operations like translation, rotation and scaling whereas in symbolic gesture we can make pattern like circle, triangle or some text.

Steps in converting input to multi touch gesture

- 1) Input layer-input is collected as video and electric signals.
- 2) Hardware abstraction layer -processing of data is performed for the generation of image co-ordinates.
- 3) Transformation layer-calibration of the screen so converting of data to screen co-ordinates takes place.
- 4) Interpretation layer- gesture recognition system as input.
- 5) Widget layer-this layer gives the output. Zoom and pinch takes place here.

Fig. 6: Gesture Recognition.



## 6 APPLICATIONS:

The collaborative approach to these technologies gives rise to various applications which makes it more interesting and gives a unique touch to the technology. The main usage of these applications can be in museums, libraries, art galleries, schools, colleges and many other places. It can make a feature more interactive and collaborative. Day by day new ideas are improving the technology of multi touch screen techniques.

### Shopping Billing System:

In these last months, virtual stores have been a dynamic technology all around the world. QR codes are used for shopping items instead of carts. Here, the items are directly received by the customer at the billing counter. But further this technology can be used for touch interface. While billing, sometimes the monitor hangs, freezes or QR scanner doesn't work which causes chaos. By using multi touch technology with raspberry pi + camera modules, these techniques can be implemented for product tracking and item identification for marketing. Thus, just by keeping the item on the table, the product will be tracked and identified by the camera module and the information of the item will be directly stored into the system. While shopping if the customer wants to the details or health factors of a particular item they can just keep the item on the table. Here the items have different codes and with data insertion into the system. The customer will know about it eventually about the specifications and if they would like to purchase the product. These approaches in the automated industries will have fast readability and customer satisfaction.

### Collaborative Gaming:

Many players can come together and have an experience of touch in the field of gaming. It provides an ambiance for gaming which comprises of music that goes with the game aesthetics, the virtual effects and animation.

### Face Creator:

For this application, one can create an art work in which the user can create a face and add on many features. Features such as nose, eyes, hair color, sunglasses and many more. The image can then be saved and uploaded on any website. This is a unique way for the user to express their uniqueness in an art form. Many advancements can be made to this application so as to improve its functioning. The users can get as creative as they wish to be. Social media accounts of the user can be linked to this application so that it makes it easier for the user to share their creation.

#### *Musical instruments:*

Users can play the piano with ease and advanced technologies and techniques. The variations that can be brought in the sound field by this technology is immense. The improvements in the sound quality and the ease with which a musician can play the piano is commendable.

#### *Food chains and restaurants:*

The customers at the restaurants are able to order their food from their table itself. They can easily place, cancel, and update the order as per their wish. The Multi Touch Table will also detect the object that gets placed on the table. Details of the placed item can also be retrieved by this application. The bill information can also be fetched by this application.

## 7 CONCLUSION

Touchscreens are 21st century interfaces. Sooner they may replace the existing technology with greater experience and providing many applications for commercial use. The technology using FTIR is robust and very easy to implement, however noises may create defects in quality of calibration. Millions of dollars are invested for the development in various applications all around the globe using this technology. This technology will be the future generation of data analysis which will blend your digital life into the integration of the experience to reality in the years ahead.

## 8 REFERENCES

- [1]International Journal of Scientific and Research Publications, Volume 3, Issue 4, April 20
- [2]International Journal of Scientific and Research Publications, Volume 3, Issue 4, April 2013 1 ISSN 22503153Multi Touch: An Optical Approach (Comparison of Various techniques)
- [3]<http://pokristensson.com/pubs/KristenssonEtAlNordCHI2008.pdf>
- [4]<http://sethsandler.com/blog/>
- [5] <https://arstechnica.com/gadgets/2013/04/from-touch-displays-to-the-surface-a-brief-history-of-touchscreen-technology/3/>
- [6][http://wiki.nuigroup.com/Compliant\\_surface](http://wiki.nuigroup.com/Compliant_surface)

- [7]<http://www.multigesture.net/projects/multi-touch-media-application-pro/>
- [8] <http://johnsear.com/multi-touch-table-applications/>
- [9]<http://www.military-technologies.net/2018/01/27/multi-touch-screen-market-global-industry-analysis-and-opportunity-assessment-2017-2022/>
- [10] <https://arstechnica.com/gadgets/2017/10/sonys-projector-that-turns-your-wall-into-a-touchscreen-is-now-available/>
- [11] <https://mobilemarketingwatch.com/exclusive-mmw-touches-future-touch-technology-zytronic-73933/>

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- Swastik Chavan is currently pursuing undergraduate degree program in Computer Engineering, Thakur College of Engineering and Technology, Kandivali East, Mumbai 400101.  
Email id: swastikchavan1234@gmail.com
  - Salonee Ameria is currently pursuing undergraduate degree program in Computer Engineering, Thakur College of Engineering and Technology, Kandivali East, Mumbai 400101.  
Email id: salonee.ameria@gmail.com
  - Meher Dodhia is currently pursuing undergraduate degree program in Computer Engineering, Thakur College of Engineering and Technology, Kandivali East, Mumbai 400101.  
Email id: mehermdodhia@gmail.com
  - Mahima Jain is currently pursuing undergraduate degree program in Computer Engineering, Thakur College of Engineering and Technology, Kandivali East, Mumbai 400101.  
Email id: jain.mahi107@gmail.com