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M TOUCH - AN ABYSS EXPERIENCE

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Abstract- While touch sensing is a commonplace for single points of contact, multi-point touch sensing technology enables a user to interact with a system with more than one fingers or hands simultaneously. As a result multiple users can interact with the system at the same time and multiple operations can be performed. Our multipoint touch screen comes with some striking features like scalability, economical with good graphical user interface .The smooth interface will replace the necessity of input devices like keyboards and mouse in future. The technique relies on one of the latest and most reliable technologies used for manufacturing touch screens-the infra red light waves. Several basic modifications in the standard IR Touch Screen and some advanced programming architecture can enable us to device such low cost multipoint touch screens. The basic motive behind using this technology is that the screen can be an add on to any other screen and is feasible and more transparent as compared to resistive touch screens. The hardware system is based on ARM (Advanced RISC Machine) technology and the software will be implemented using java as a platform. Multi-touch technology has many potential applications including a whole new way of interfacing with computers using images, videos, animations, maps and multiplayer gaming. Thus we look forward to develop a system that will be economical yet feasible and scalable implementation of multipoint touch screen. This will in turn accommodate multiple users to work, play and interact with the system in parallel.

Index Terms- *Multi touch, Infrared technology, Human Computer Interaction (HCI) and Multimedia.*

I. INTRODUCTION

A multipoint touch screen is the electronic screen that recognizes the presence and location of multiple touch points within the display area. It has two basic features that enables it, one to interact directly with what is displayed on the screen and eliminating the use of the traditional input devices. Secondly, these systems are inherently also able to cater services to multiple users at the same time. Touch screen interfaces are gaining popularity in Industrial market though there are many reasons for this, chief among them is the fact that this technology is portable and offering a simple, direct interaction with graphical icons specific to a task. This helps keep plant-floor operators focused on their application, and can be used by most operators regardless of their computer skills.

It has many potential applications including a whole new way of interfacing with computers in general with images, videos, animation, maps, and games. The regular touch screens available in the market today allow only a single user to access and perform operations while interacting with the device. On the other hand we propose a system which will incorporate some striking features such as (1) It will allow multiple users performing multiple operations at the same time. (2) Cost effective solution (3) System that will be easy to maintain and recover from failure (4) Reducing the overhead of using input devices. (5) It can act as an easy add on to any computer. Majorly, our proposed idea revolves around Infrared technology which a rich area for research and has enormous potential for advances in efficiency, usability, and intuitiveness. Our technique is force sensitive, providing unprecedented resolution and scalability. This helps us to create sophisticated multi-point applications.

II. TYPES OF TOUCH SCREENS

When it comes to touch screen technology, the five most prevalent types are Capacitive, Infrared, Resistive, SAW (surface acoustic wave) and Guided Wave with Resistive and Capacitive being the most widely used types for Industrial Applications. All of these technologies have their own distinct characteristics, both advantageous and with limitations. Our industrial CRT monitors and LCD flat panel displays offer the following optional touch screens to suit your specific application.

A. Capacitive Touch Screens

Capacitive touch screens operate using oscillator circuits that are located in each corner of the glass overlay and measure the capacitance of the area be "touched". Depending on where the person touches the overlay, the oscillators will vary in frequency. Then a touch screen controller measures the frequency variations to ascertain the coordinates of the person's touch. When used with flat panel displays, capacitive offers drift-free stable performance that is not susceptible to deterioration over time. A capacitive touch screen is impervious to grease, dirt and water, which makes it ideal for frequent use.

B. Resistive Touch Screens

Resistive touch screens are anti-glare to reduce reflective shine intensity, which will slightly diffuse the light output throughout the screen. Resistive technology offers tremendous versatility in that activation can be initiated by; a gloved hand, fingernail, mechanical stylus or an ungloved finger. Resistive touch screens can be gasket sealed for NEMA 4 and NEMA 4X environments. Limitations include: Low light output, diffused resolution images and a plastic surface which can be scratched if improperly touched.

C. Surface Acoustic Wave (SAW)

SAW touch screen technology is suggested for use in ATMs, Amusement Parks, Banking and Financial Applications, Gaming Environments, Industrial Control Rooms, and KIOSK. SAW touch cannot be used within NEMA environments, as the technology cannot be gasket sealed. It has excellent durability that allows it to continue working if scratched since the overlay for the touch sensor is a solid glass display. The disadvantage to this glass overlay is that is breakable and won't work in wash down conditions. The waves are spread across the screen by bouncing off reflector arrays along the edges of the overlay. The waves are detected by two "receivers". The acoustic wave weakens when the user touches the glass with their finger, gloved hand or soft stylus. The coordinates are then determined by the controller circuitry that measures the time at which the amplitude declines. It is the only technology that can produce a Z-coordinate axis response. SAW technology offers drift-free stable performance that is always precise. SAW offers superior image clarity, resolution, and high light transmission.

III. UNDERLYING TECHNOLOGY

[2]Infrared light are the electromagnetic radiation that have longer wavelength than visible light ranging from 7nm to 1mm and frequency shorter than light ranging from 405 THz to 300 GHz.

It lies below visible light in Electromagnetic Spectrum. Human eyes can see only very small portion of Electromagnetic spectrum which is called visible light. Infrared rays are not visible to human eyes. Infrared rays have longer wavelength with very low energy and hence, are less harmful. Although humans cannot see Infrared light but they can feel it in the form of heat.

Infrared imaging is largely used in military and civilian purpose. It is widely used to determine thermal efficiency and analysis and short range wireless communication. Infrared astronomy make use of sensor equipped telescope to penetrate dusty region of space such as molecular cloud.

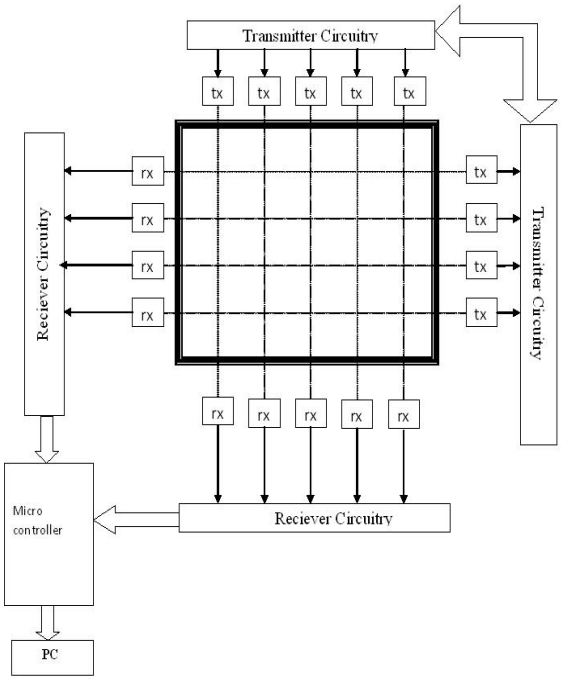
Infrared ray induces vibration mode in molecules by changing dipole moment. This property helps in studying energy states. Infrared spectroscopy evaluates transmission and absorption of Infrared energy on the basis of frequency and intensity.

Why Infrared touch Screen?

We are using Infrared touch screen because

1. Such touch screens can be an add on to any old computer screen making them touch sensitive and thus, eliminating the use of conventional input devices such as keyboard, touchpad.
2. It is quite economical. It uses cheap LED's and phototransistor detectors which surround the Photo transistor.
3. Such screens are more transparent than resistive.
4. Safe to use. It does not harm finger tips while using.
5. Can be used by any screen and any operating system.
6. Excellent cursor stability.
7. No extra layers are involved.
8. Accessibility is excellent.

IV. HARDWARE INTERFACING



Block Diagram

The main components in the hardware circuitary are :

1 .Frame

IR Frame consists of IR transmitter (LED's) and IR Receiver (Phototransistor). They are evenly placed on border. Each transmitter and receiver is arranged in a manner that single transmitter faces single receiver giving one to one mapping. Thus, making an invisible IR matrix across the glass sheet.

2. Transmitter circuitry
It consists of transmitters that generate supply voltage that is provided to IR LEDs which in turn emit light. The intensity of light depends upon frequency and current flowing in IR LED. If the current intensity is increased electron eject at a much faster rate thus improving the performance of IR. Range and frequency are directly related i.e. if frequency is increased than there will be rapid alteration and hence range also need to increase. IR LEDs are the source of Infrared Light.

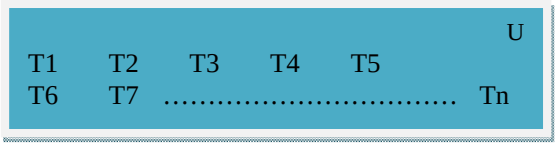
3. Receiver Circuitry
Phototransistor acts as IR detector. It receives IR light emitted by transistor and converts it to corresponding electrical signal (0's and 1's). Receiver circuitry also amplifies the signal and gives to micro-controller.

4. Microcontroller and Serial Circuitry
Microcontroller scans the touch points and converts it into standard 7- bit code. It then transmits to computer serially with the help of serial communication circuitry.

V. MATHEMATICAL MODELING

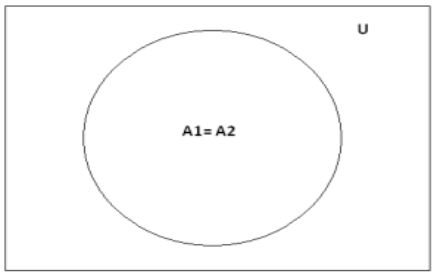
A. Set Theory

The set theory of our proposed system is demonstrated as follows :
Let U be a universal set consisting of Valid (active) and Invalid (inactive) touch points.
i.e U = {T1, T2,…Tn}

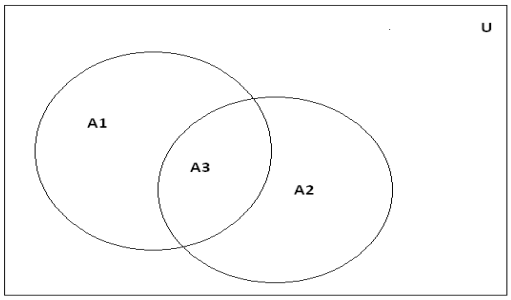


To activate a touch point it must be processed (touched) and that particular sensed point should be recognized by the system.
Case 1: When user touches two different area's of the screen at a time.
Let us say area A1 and area A2.
The points that are touched are said to be active touch points. Hence A1 ∪ A2 = A1 + A2
i.e Set of active touch points.
And A1 (intersection) A2 = {0}
i.e. no common touch points.

Case 2: When the user touches the same area more than once at the same time.
Thus, here A1 ∪ A2 = A
Where A1=A2=A
And A1 ∩A2 = A
Where A1=A2=A
Thus, for such a case the system must response just once.



Case 3: When there is some portion common between the sensed touch points.
Then A1 ∩A2 = A3
Where A3 is the set of common touch points between A1 and A2.
A1 ∪ A2 = A1 + A2 – A1 ∪ A2



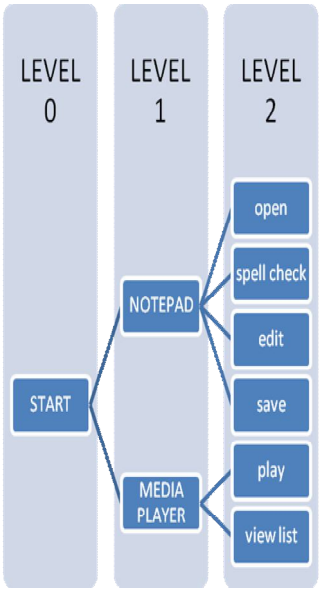
B. Complexities Involved:

1) Size - Fingers have a certain size. So, screen elements have to have a minimum size, to ensure that a touch screen can be operated with few errors
2) Strain - Keying in many numbers or letters by pointing with the finger is also very straining and tiring
3) Feedback - Touch screen users directly point on a screen element. If they are lucky, they can withdraw their finger if they touched the wrong

C. Why is M-Touch P-Complete?

Our Multipoint touch screen is susceptible of multiple touch at a time. These touches can be represented as nodes. Processor will proceed to respond to touches in a sequence as per given by user (level by level in Breadth First Search tree) until whole of the given inputs as touches have been responded by our screen. Our touch screen percepts and store multiple points given in a single time and respond to input through actions sequentially in a breadth first search manner after certain period of time, but this time is so small(in nanoseconds) that it appears to our user that actions

are performed in parallel. Also, Multipoint touch screen and BFS are inherently sequential which is a major property of p-completeness. Thus, Multipoint touch screen supports BFS and is therefore p-complete.



The above figure shows a tree which visualizes the operations that our proposed system would perform. To prove P-Completeness the following assumptions are made:

1) The system will always give a predefined output for a particular input.
2) The operations will occur level wise that is following a Breadth First Search approach.

Hence, using BFS we can easily prove that the system is P-Complete executing operations in an orderly manner.

VI. SPECIFICATION TABLE

Description	40" 6-Touch display
Available sizes	All Monitor Screen Sizes
Number of Touch Points	56 touch Points
Frame Dimension	For a 17” Flatron (13” X 10”)
Luminous transmission	95-100% typical with clear glass
Touch technology	Infrared
Touch Activation force	No pressure required
Touch resolution	Average Finger Size
Touch durability	Unlimited
Touch Response Time	Typical response time 7 - 13ms
Environment	Operating temperature: 0° C - 60° C; Storage temperature: -40° C - 85° C; Operating Humidity: 10% to 90% RH, non-condensing; Storage humidity: 10% to 90%RH, non-condensing
Power supply	+5V, - 5V 500 mA
Maintenance	Requires simply changing IR Pair
Interface	Parallel
Operating Systems	Windows 7/8, Vista, XP, Mac OS X, Linux² . TUIO supported
Connection options	Custom DB25 Parallel Port
Software	Java Platform

VII. ADVANTAGES

(1)It acts as an add on screen to any old computer system, thereby making it touch sensitive.
(2)It eliminates the use of input devices such as keyboard, mouse.
(3)Many people can play in parallel at the same time as well as many applications can run simultaneously.
(4)It is scalable.
(5)Dragging multiple images simultaneously.
(6)No damage to finger tissues as in case of capacitive touch screen.
(7)It is quite economical.
(8)Maintenance is easy. Requires simply changing IR pair.

VIII. LIMITATIONS

(1) The finger may be too large for accurate pointing of small objects. Thus, it may interrupt two or more coordinates giving an incorrect output,
(2) Keying in many numbers or letters by pointing with the finger is also very straining and tiring.
(3) Dirt sensitive.

IX. ACKNOWLEDGEMENT

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X. CONCLUSION

In this paper, we have explored theoretical issues related to the interface of multi-point touch screen into desktop computing environment. We have acquired the background knowledge about present touch screen system available in the market and generated the new idea of developing a touch screen using IR technology .This screen will act as an add on screen to any computer system eliminating the use of input devices. We explored the design and various user touch input abilities.

Thus, guided by the search result we proposed the idea of developing a screen which have features of present screen and adding extra features like scalability, quick response, and good sensitivity, quite economical and requires low maintenance. The scalability feature of the system is quite noteworthy as the cost of the system varies linearly with increase in size of the screen, which a striking advantage today where the cost Vs size of screen varies exponentially. Our work includes developing a screen with above features and creating applications such as notepad, games, gesture recognition and media player.

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