Multitouch technology for e-Signage applications

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Abstract

Touchscreens, in particular IR-Touchscreens (infrared) became more and more important for the e-Signage market over the last years. With this technology touch function and interactivity can be easily realized with displays up to 150" size. In parallel, driven by the mobile phone and MP3 player market, the degree of popularity of multitouch devices literally exploded.

In this presentation Andreas Kopietz will talk about the long history of multitouch technology followed by an overview of the related markets. He will work out the benefits of multitouch features for modern e-Signage applications. Furthermore the basic principle of IR-Touchscreens with multitouch features will be explained and ambiguous terms defined. The vast majority of e-Signage applications run under Microsoft Windows based operating systems. Hence the problematic implementation of multitouch devices will be discussed and possible solutions presented. Also Linux based operating systems and interesting open source projects will be covered.
Agenda

- motivation
- history
- application samples
- market
- multi-point vs dual-point
- touch-technology overview

- device driver
- hardware interface
- Windows XP
- CPNMouse open source project
- Linux solutions
Motivation

• revolutionary and evolutionary input method compared to old fashioned mouse

• market driven by the big ones like Apple, Microsoft & Co

• almost everybody talks about it

• people expect multitouch function !!!

• totally new options for user/customer interaction

• it´s pretty cool ...
A brief history of „Multitouch“

• Multitouch has a long history beginning in 1982 (!)

• Bell Labs 1984 (multitouch screens).

• University of Toronto 1985 (multitouch tablets)

• Apple Desktop BUS 1986 (multiple input devices)

• "Simon" in 1992 (!) the world’s first smart phone

• and many, many more ...
Famous application samples

• Jazzmutant - product called Lemur

• Microsoft Surface

• iPod Touch / iPhone

• Apple’s Macbook Air

• very famous: Jeff Han Screens
  http://cs.nyu.edu/~jhan/ftirtouch/
Important markets

- e-Signage (!)
- gaming
- medical
- e-learning
- automotive (maps – navigation)
- collaboration
- entertainment
- retail
- financial
Multi-point vs. Dual-point

• Wikipedia: „Multitouch is a human-computer interaction technique and the hardware devices that implement it.“

• most of the time people say „multi-point“ but mean „dual-point“ while talking about „multitouch“

• big difference concerning hard- and software

• specific touch-points vs. gestures

• dual-point much easier -> gesture detection

• “mouse gesture” is a (old ) way of combining computer mouse movements and clicks which the software recognizes as a specific command

• work GUI with different devices like touchscreen, mouse, joystick etc. simultaneously and using techniques like double-click, dragging, scrolling
Single-user vs. Multi-user mode

<table>
<thead>
<tr>
<th>Single-user</th>
<th>multi-user</th>
</tr>
</thead>
<tbody>
<tr>
<td>• one person</td>
<td>• more persons</td>
</tr>
<tr>
<td>• one application software</td>
<td>• maybe different application software simultaneously</td>
</tr>
<tr>
<td>• special functions</td>
<td>• each person own gestures-functions</td>
</tr>
<tr>
<td>• gestures</td>
<td>• multipoint</td>
</tr>
<tr>
<td>• dual-point</td>
<td></td>
</tr>
</tbody>
</table>
e-signage market - multitouch

- support of large display sizes
- zooming – rotating – moving
- multi-user mode
- more and more people expect a multitouch function
General system structure

Multipoint Touchscreen

Grid of Infrared Light
Edge of Active Display Area
Touch Activation

host system

Application Software
Driver
OS

Interface with protocol
Touch technologies

- Resistive
- Surface Acoustic Wave (SAW)
- Strain Gauge
- Optical Imaging
- ...
IR Touch technology

- principle of light barrier
- touch frame
- IR-LEDs and photo transistors
- sequentially pulsed LEDs
- interrupted IR light beams

- large sizes up to 150" possible
Hardware interface

• possible interfaces to X86 based systems:

• serial port, USB

• midi port – game port – joystick port (!)

• touchscreen just another mouse ?

• ... just install a driver and that´s it ?

• ... plug-and-play ? ... e-Signage application up and running ???
  -> no, not at all !!!
Device driver

- Wikipedia: „A device driver, or software driver is a computer program allowing higher-level computer programs to interact with a computer hardware device.“

- drivers are hardware-dependent and operating-system-specific

- API for specific interface / protocol

- important question concerning multitouch: „does the OS support multiple pointing devices?“

- e.g. zooming pictures needs a „ZUI“ – „zooming user interface“

- does your application-software „know“ what multitouch is?
Windows XP / IR-Touch

- DOS, Win3.x and Win9x supported two mice natively
- Windows 2000/XP/XPe does not differentiate between different mice
- Windows 2000/XP/XPe works with DirectX-9 - X Input
- only single-point structure - Windows mouse subsystem
- no common "driver" possible
- application specific solution
- install filter between hardware dependent driver and the Windows Mouse subsystem ( -> CPNMouse project )
- example: using a IR-Touch - serial port RS232
Simple protocol and problem

- independent X and Y coordinates, no coherent X / Y combination
- the display provides the coordinates X: 1 and 50; Y: 2 and 200
- actual points could be 1 / 2 and 50/200, or 1 / 200 and 2 / 50?
- it could happen that, although only 2 points can be detected, in fact, up to 4 touches on the display exist
- totally 7 pairs of coordinates given by the hardware

<table>
<thead>
<tr>
<th>Byte0</th>
<th>Byte1</th>
<th>Byte2</th>
<th>Byte3</th>
<th>Byte4</th>
<th>Byte5</th>
<th>Byte6</th>
</tr>
</thead>
<tbody>
<tr>
<td>0xaa</td>
<td>Coordinates of shaded LED on X axis</td>
<td>Coordinates of shaded LED on Y axis</td>
<td>Starting coordinates of the first Touch Point on X axis</td>
<td>Touch Width of the first Touch Point on X axis</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Byte7</td>
<td>Byte8</td>
<td>Byte9</td>
<td>Byte10</td>
<td>...</td>
<td>N-9</td>
<td>N-8</td>
</tr>
<tr>
<td></td>
<td>Starting coordinates of the second Touch Point on X</td>
<td>Touch Width of the second Touch Point on X axis</td>
<td>...</td>
<td>Starting coordinates of the second-last Touch Point on Y axis</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>N-7</td>
<td>N-6</td>
<td>N-5</td>
<td>N-4</td>
<td>N-3</td>
<td>N-2</td>
<td>N-1</td>
</tr>
<tr>
<td></td>
<td>Touch Width of the second-last Touch Point on Y axis</td>
<td>Starting coordinates of the last Touch Point on Y axis</td>
<td>Touch Width of the last Touch Point on Y axis</td>
<td>CRC</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>
Application note from Elektrosil

• don´t worry !!! We have something for you …

• application note explains in detail the hardware protocol

• mentions typical problems like:
  – near accuracy limits
  – coherence between interruptions
  – fluctuation
  – shadowing

• explains how to interpret gestures like:
  – two finger zooming
  – two finger rotating
  – two finger zooming and rotating
  – sweeping
  – whole hand moving

• available for customers exclusively from Elektrosil
Reference project

• BrainLAB Digital Lightbox
• Medical Application
• IR-Touch with multi-touch
• serial interface
• Designed for team and group discussions
• Improvement of collaboration and productivity

• Rotation of images
• Zooming
• Panning
Existing solution for dual-point

- since 1992 dual-point multitouch with Citron infrared touch screens
- enhanced Citron protocol overcomes drawbacks of simple protocol as mentioned before

<table>
<thead>
<tr>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>STX (0x14)</td>
<td>Report ID (0x19)</td>
<td>X-coordinate of first touch point</td>
<td>Y-coordinate of first touch point</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Byte 6</td>
<td>Byte 7</td>
<td>Byte 8</td>
<td>Byte 9</td>
<td>Byte 10</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X-coordinate of second touch point</td>
<td>Y-coordinate of second touch point</td>
<td>ETX (0x14)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- dedicated detection of 2 touch points, 1 point can be tracked
Examples for usage

On the fly drawing tool selection

- Simple mouse button emulation:
  Move with one finger, second finger triggers button
  (standard with Citron touch drivers)

- Enhanced mouse button emulation:
  Move with one finger,
  second touch left of movement triggers left mouse button,
  second touch right of movement triggers right mouse button.

True shift-key on virtual touch keyboards
CPNMouse open source project

- CPNMouse allows developers to use more than one pointing device in Windows 2000/XP applications, while maintaining backward compatibility with old applications.

- precompiled binaries or sourcecode in C++ available

- not 100% stable but working

- problem: multiple pointing devices but only on different interfaces (e.g. 4 mice on 4 USB ports)

The Multi-Pointer X Server (MPX)

- modified X Server (GUI) for Linux
- each cursor operates as a true system cursor
- pointers can operate in multiple applications simultaneously
- not only an add-on, but a complete revolutionary new windowing system
- other projects: SDGToolkit, MIDDesktop
- http://www.youtube.com/watch?v=olWjnfBoY8E
Latest research @ Citron Labs

- totally new infrared technology
- up to 20 (!) touch events simultaneously
- 100% coherent x/y-coordinates
- 100% definite allocation and security
- real multitouch and multi-user mode possible
- mechanically easy scalable

how does it work? … no, no, no, … not yet 😞

when ready?

-> samples ready for next year KIOSK EUROPE SHOW in Essen
the end …
the end … ?

no, not at all !!!

a worldwide community works on that interesting stuff

join us !!!

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mobile: +49 172 991 0012

Multitouch shown on *Sharp 65“ display* right here at this forum