From Physics to Daily Life

The ‘Touch Screen’ Revolution

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CERN Geneva 26/09/2014
A Touch Screen is, an interface and a device

where it is possible to provoke an action due to the presence of a finger or an object directly in front of the screen.
A view of part of the PS control room in 1974, showing rows of individual units with many knobs, switches and oscilloscopes.
With 3 new components

Touch Screen + Trackball + Smart Knob
= Infinite possibilities

<table>
<thead>
<tr>
<th>Choice level</th>
<th>16 Buttons</th>
<th>4 Buttons</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>16,00</td>
<td>4,00</td>
</tr>
<tr>
<td>2</td>
<td>256,00</td>
<td>16,00</td>
</tr>
<tr>
<td>3</td>
<td>4,096,00</td>
<td>64,00</td>
</tr>
<tr>
<td>4</td>
<td>65,536,00</td>
<td>256,00</td>
</tr>
<tr>
<td>5</td>
<td>1,048,576,00</td>
<td>1,024,00</td>
</tr>
<tr>
<td>6</td>
<td>16,777,216,00</td>
<td>4,096,00</td>
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<tr>
<td>7</td>
<td>268,435,456,00</td>
<td>16,384,00</td>
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<tr>
<td>8</td>
<td>4,294,967,296,00</td>
<td>65,536,00</td>
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<tr>
<td>9</td>
<td>68,719,476,736,00</td>
<td>262,144,00</td>
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<td>1,099,511,627,776,00</td>
<td>1,048,576,00</td>
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<tr>
<td>11</td>
<td>17,592,186,044,416,00</td>
<td>4,194,304,00</td>
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<tr>
<td>12</td>
<td>281,474,976,710,656,00</td>
<td>16,777,216,00</td>
</tr>
<tr>
<td>13</td>
<td>4,503,599,627,370,500,00</td>
<td>67,108,864,00</td>
</tr>
</tbody>
</table>

Etc..., Infinite
The SPS control room in 1977. Ted Wilson and Rae Stiening are at the desk, with its touch screens; George Shering with me standing behind.
Prototype console

The SPS prototype console in 1973 showing the Touch Screen, the Tracker Ball the Computer Controlled Knob.
The console

The Touch-Button Control System used for central control of the SPS-accelerator at CERN (The European Organization for Nuclear Research).

Every CERN needed operations from one “Small” console
Prototype Circuit board in 1960

The thought behind this experiment was to see whether it would be possible to replace real coils with coils directly printed on the board and thus allow to produce a cheaper circuit board equipped with all components including coils.

A photo of the experimental printed circuit board having 35 tiny spirals printed on the board is shown here. Line thickness and distance between lines are about 80 micron.
The capacitor

The prototype of a semi transparent capacitor of a one single “touch button” developed at CERN in 1972.

This prototype was a proof of concept for the coming 16 touch buttons screen to be produced…
16 self capacitance touch capacitors on a glass plate
16 Mutual capacitance touch principle
In 1977 CERN starts the developments of the x-y Multi capacitance and Multi Touch screen which principle is now used in many iPhones and Smart phones or other devices.

To now a days commercial use.
The “Multi-touch” Control Board

A photo of the CERN 16 channel “Touch Detector Board” allowing the detection of 16 simultaneous touches at the same time. The CERN development can therefore be called a “Multi-Touch” system.
One of the first prototype produce by the Danish firm FERROPERM and commercialized in 1973.
Commercial use at the time

FERROPERM Touch Screens are transparent push-button panels developed with CERN, Geneva (European Organization for Nuclear Research), partly in co-operation with our company.

The Touch Screen was developed for use in the control centre for the CERN Super Proton Synchrotron (SPS) accelerator. This new 1½ tonne linear accelerator now in operation is a very complicated machine and as a consequence of what has been experienced with CERN's other accelerators, they have chosen to design a quite new type of control centre for the SPS.

A computer control system using a control language and a keyboard has been tried before at the National Accelerator Laboratory, Batavia, Ill., but the lack of conventional control facilities becomes evident. It is easier to push a button than to type in a request. One of the results of this work is the Touch Screen.

A system of conventional buttons with one button per function to be controlled would be too complicated to operate as the number of buttons can be more than thousand. A possible solution is a light pen, but it is easier to use a finger. The Touch Screen is a set of buttons with programmable legends. The buttons disappear when not in use.

The buttons on the Touch Screen are capacitor area mode as a thin film pattern like this:

![Image of Touch Screen pattern](image)

Because of the thin lines, the structure is barely visible (see front page). The capacitors are protected from contact with the finger by a thin coating. The proximity of a finger increases the capacity sufficiently for detection. As the button area has much more capacity than the lead to the detector circuit, a touch on the lead will give no false detection.

The use of the FERROPERM Touch Screen is not restricted to control center accelerators. It can be used in any control system in the communication between an intelligent terminal and the operator.

Ref.

   This report also describes the electronic system used.

As an example we give dimensions and specifications for Touch Screen TF 310:

<table>
<thead>
<tr>
<th>Glass Substrate Dimensions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>length</td>
</tr>
<tr>
<td>width</td>
</tr>
<tr>
<td>Thickness</td>
</tr>
</tbody>
</table>

| Transparent pattern area | 140 mm x 197 mm |
| Pattern line width       | 70 µm |
| Pattern line spacing     | 30 µm |
| Button dimensions        | 15 mm x 20 mm |
| Number of buttons        | 100 |
| Button capacitance without touch | 80 pF ± 30 pF |
| Change in capacitance by finger pressure | ± 30% to ± 100% |
| Resistance of a button including leads | max. 1000 Ω |
| Coating with lacquer, thickness approx. | 10 µm |

Belting is possible, but as the metal layer is very thin, we recommend conductive spray.

FERROPERM commercial documentation.

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Commercial use at the time

The TOUCH-BUTTON SYSTEM is developed at CERN (The European Organisation for Nuclear Research).

NESELCO manufactures and supplies:

- 601 F 1000 DISPLAY-CONTROLLER: Single-width CAMAC module based on a 16 bit microprocessor, containing 4k x 16 bit EPROM display program storage and 2k x 16 bit RAM working area. The DISPLAY-CONTROLLER is able to generate and transfer display-data to the 601 F 1200 DISPLAY-MEMORY by means of very few instructions from the host computer.

- 601 F 1200 DISPLAY-MEMORY: Double-width CAMAC module for storing and generating full graphics and character TV-monitor display with the high resolution of 512 lines of 768 pixels each. The module is supplied with a TV synchronising generator.

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CERN Application in 1973

The FERROPERM touch screen integrated for SPS Central Control Console
The CERN “Intelligent Touch Terminal”

Miniaturization of the control room becoming the ancestor of the Personal Computer…1979
The CERN “Intelligent Touch Terminal”

Simon van der Meer (1984 Physics Nobel Price) in local AA Control Room with the SPS style touch terminal, Jan 1984
The next commercial “Touch Terminal”

In 1983, four years after us, Hewlett-Packard released what may have been one of the world's first commercial Personal Computer with an integrated touch-screen.
In computing, **multi-touch** refers to the ability of a surface (a trackpad or touchscreen) to recognize the presence of more than one or more than two points of contact with the surface.
WIKIPEDIA definition of “Prior Art”

Prior art (state of the art or background art), in most systems of patent law, constitutes all information that has been made available to the public in any form before a given date that might be relevant to a patent's claims of originality.

If an invention has been described in the prior art, a patent on that invention is not valid.
Prior Art...?

Presentation from the CERN yellow Report
Prior Art...?

CERN note on the Hannover Messe of 1977

Birth of the first touch DRINKOMAT !...
Prior Art...?

Article in "Design News" Distributed in Silicon Valley California.

294 Requests from major Companies (IBM, HP, General Motors, Honeywell...) and Institutions (Stanford University, US Navy,....) only from USA
Asking for more information sent to CERN

26/09/2014
Rolex “The intelligent oyster”

1. Introduction

What is the “intelligent oyster”? The intelligent oyster is one of the many revolutionary new things ever built. It within seconds is possible to complete its function in a programmed way. To give a few examples of how many really new things such as a watch, a computer, for many a dictionary, etc. It can also be your personal “intelligent” from which you can get access to other computer programs.

What does it look like? Like a real oyster or a watch you prefer.

Now how is it operated? Just by the touch of a finger on “oyster” and it becomes what you want it to be and it will do what you want done or to be done between you and a computer.

Is it technologically possible? It is possible by using known and new techniques with some developments or improvements.

2. What does it look like?

Figure 1 shows the face of a normal watch where any transparent touch sensitive area which can be used as the “display” is a fingerprint on a watch. The area is separated by a metal (for the “oyster”). The watch you are wearing is a steel 10 and the special displays 6 are visible under the watch.

Each area of the display contains a text symbol of six places information and the two big cases can contain in places of the watch.

3. What are the inner parts?

a) A touch sensitive transparent surface (e.g., watch)
b) An alphanumeric display under the touch surface
c) A microcomputer
d) A solid state memory
e) A crystal for driving = the clock, the day
f) The clock for the time

4. How is it operated?

The operation of the “oyster” is best described by example. Suppose that we have a version of the “oyster” was programmed for being selected by a few only to say:

a) A watch with seconds and date
b) A calendar for one or more years
c) A desk calculator
d) A dictionary

A watch with seconds and date

Operation sequence: 

1. Open the watch
2. The “oyster” will now show (Fig. 2)

A watch with seconds and date

Note the difference between the display for a given page and those which are around the feel.

NEXT

A watch with seconds and date

Next, just continues from Fig. 2 in the system works,

Note that the watch will next give the next page and go back step by step to previously known pages.

Closing of the shell of the “oyster” will close the watch.

The “oyster” itself will do everything automatically. The mechanical contact of it can be touching or touching as absolutely as it can be in this technologically possible.

The above examples of possible any number of modes which can be real time of the person creating them. It can be programmed, but the touch of the watch may not be so closely associated with the watch, as it will not be the watch itself.

If we go back to chapter 3 and to the fundamentals for making such a watch, consider the following and sufficient to be given in these examples:

We have discussed the history of the pocket watch and the wrist watch and what they look like today. Will this description show how these “oysters” will look like in the coming years?
Rolex “The intelligent oyster”

This private proposal describes clearly the technology to develop the most advanced electronic wrist watch ever made at that time. IN 1977
Dear Sir,

We thank you for your interest in the "Rolex Awards for Enterprise" and for your letter of March 29, 1977 which reached us on March 30, 1977.

We regret very much to inform you that we have to apply strictly the regulations of the "Rolex Awards for Enterprise" which provide that only applications submitted on the official entry form can be taken into consideration by the Selection Committee (please go through the cancelled copy of an application form which we are enclosing for information).

It was unfortunately too late at that time we received your letter to send you the official entry form, which you would have to return to the Secretariat duly completed before the closing date of the Awards i.e. March 31, 1977.

As a consequence we are obliged to return to you, enclosed, your documentation and remain,

The big question which has never been answered, is whether the Rolex Selection Committee ever saw the proposal, or it was refused or returned by the secretary simply due to administrative rules.
Or other brands of touch watches…
1977 Rolex private proposal Vs Apple Watch© 2014

Another Prior Art ?...
Merci

Thank you
QUESTIONS...
And for the future...
The Knob