White Paper

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Decision-making aids for selection of (modern, multitouch-capable) monitor solutions with touchscreen

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Introduction

Progress in the area of contact-sensitive technology is rapid and the technology is establishing itself in more and more areas of daily life. And not just in the private sphere. With regard to the human-machine interface (HMI) and Industry 4.0, in a broad sense, today industry and medicine would be inconceivable without touchscreen technology (in short: touch technology).

Due to the steady progress of development in the area of touch technology, the number of providers and the options offered by technologies that are already available and by new and coming technologies are proliferating. Today the market offers a diversification, which naturally is advantageous for the market and for customers in terms of competition, price, and solution offerings. However, at the same time this diversification can no longer be surveyed or even compared by "laypersons". Thus, for many customers it is virtually impossible to make an informed decision with respect to the right technology and a safe investment. Without the experience and advice of a specialist the search for the right touch technology can become a risky undertaking.

Objective of this white paper

As a specialist for monitors and touch solutions, with this white paper we would like to cite the available technologies, as well as compare the suitability of these technologies based on specific criteria. The subsequent course of this white paper will be restricted exclusively to the modern multitouch-capable (operable with more than one finger) touchscreens [Projected Capacitive (PCap) [3], Infrared (IR) [4] , ShadowSense™ - page 7 et seq.], as these touchscreens are gaining increasing significance. Solutions with the other touch technologies (e.g. resistive touch) are still being implemented by Canvys, but only for a few customers and the significance of these solutions is increasingly diminishing.

It is not our intent to provide a technical-scientific treatment of the subject. Rather this technical paper should serve as a consulting instrument and provide decision-making aids for selecting the right touch technology. It serves as an overview of the touch technologies that are used today, discusses the benefits of these technologies for customers, and recommends solutions for the application issues that

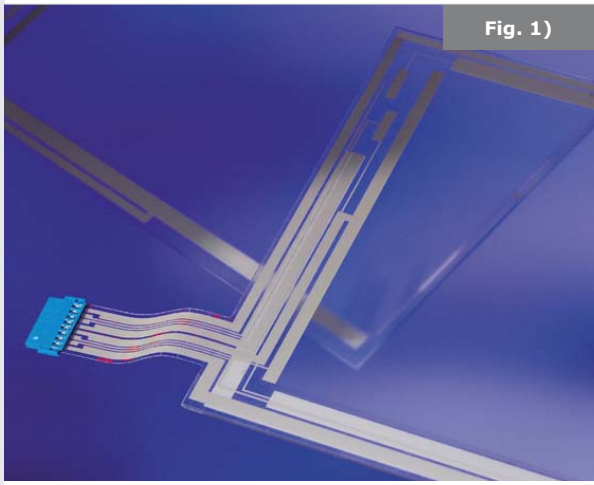
Info 1)

HMI - Human Machine Interface / Interaction

The user interface, in the industrial design field of human-machine interaction, is the space where interaction between humans and machines occurs. The goal of this interaction is effective operation and control of the machine on the user's end, and feedback from the machine, which aids the operator in making operational decisions. Examples of this broad concept of user interfaces include the interactive aspects of computer operating systems, hand tools, heavy machinery operator controls, and process controls... A user interface is the system by which people (users) interact with a machine... Generally, the goal of human-machine interaction engineering is to produce a user interface which makes it easy (self exploratory), efficient, and enjoyable (user friendly) to operate a machine in the way which produces the desired result...

Source: Wikipedia - http://en.wikipedia.org/wiki/User_interface

Fig. 1)



8-Wire Glass, resitive Touch
© 3M

Info 2)

Industry 4.0

The first three industrial revolutions came about as a result of mechanisation, electricity and IT. Now, the introduction of the Internet of Things and Services into the manufacturing environment is ushering in a fourth industrial revolution. In the future, businesses will establish global networks that incorporate their machinery, warehousing systems and production facilities in the shape of Cyber-Physical Systems (CPS). In the manufacturing environment, these Cyber-Physical Systems comprise smart machines, storage systems and production facilities capable of autonomously exchanging information, triggering actions and controlling each other independently.

Source: Final report of the Industrie 4.0 Working Group - http://www.plattform-i40.de/finalreport2013

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must be resolved. Typical requirements and appropriate application examples are cited to enable a better understanding, and an evaluation of which touchscreen is best suited in this regard, is provided. In addition to a rough price indication, we also list the specific causal cost factors, with the goal of making a sensitive topic transparent, i.e. understandable, for you and for your customers.

There are many derivatives; however the following are the main touch technologies:

- Resistive (4-wire/5-wire/8-wire)
- Surface Capacitive
- Projected Capacitive (PCap) - *(siehe Info 3 on page 3 and 3a on page 5)*
- Infrared (IR) - *(see Info 4 on page 6)*
- ShadowSense™
- Surface Acoustic Wave (SAW)
- Dispersive Signal Technology (DST)
- Optical Touchscreen

Additional information or more detailed information concerning the specific technologies and their mode of operation is provided on our website at:

http://www.canvys.de/en/products/touch-technologies/

Info 3)

Projected Capacitive Touch - PCap

Projected Capacitive Technology (PCap) is fast becoming one of the most prevalent touch technologies for an expanding variety of applications ranging from consumer devices to commercial applications in retail and gaming signage. Driven by the increasing number of users of touch-enabled mobile devices, consumer and professional expectations for touch applications have moved far beyond single touch requirements into the realm of multi-touch and multi-user capabilities.
Since "projected capacitive technology" is a relatively broad term this document explores two of the most prominent sensing methods, "self capacitance" and "mutual capacitance", and the different options within these sensing methods. Each of these sensing methods ad-dress different needs and understanding their strengths and capabili-ties can help hardware and software developers choose the appropriate touch technology for their application.

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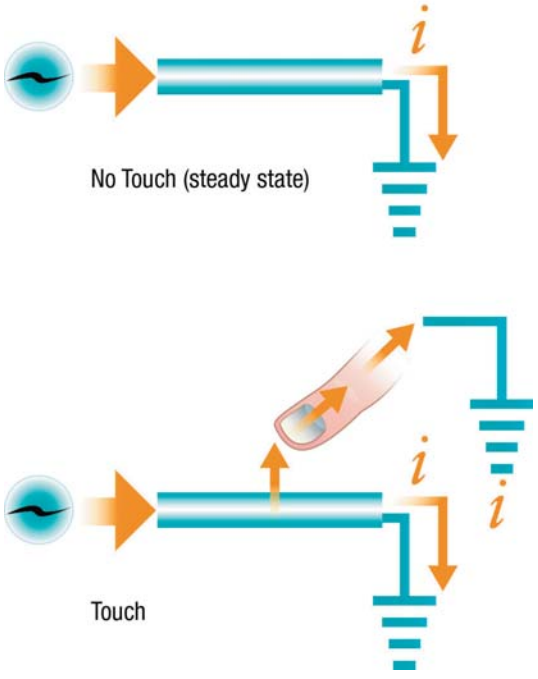
Fig. 2)



How Self Capacitance works
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Comparison of touch technologies

Main feature	Sub feature	Resistive (4-/5-/8-Wire)	Surface Capacitive	Projected Capacitive PCap	Infrared IR	Shadow-Sense™	Surface Acoustic Wave (SAW)	Dispersive Signal Technology (DST)	Optical Touch
Operation / Input	2 Point (Dual touch)	◆	✗	▲	▲	▲	✗	✗	✗
	2+ Point (Multi touch)	◆	✗	▲	▲	▲	✗	✗	✗
	Gestures	◆	◆	▲	◆	▲	◆	◆	◆
	Gloves	▲	◆	◆	▲	▲	◆	✗	✗
	Stylus / Pointer	▲	◆	◆	▲	▲	◆	✗	✗
	Touch sensivity	▼	▼	●	●	●	●	●	●
	Handling of unwanted touches	▼	▼	▼	▼	●	▼	▼	▼
Environ-mental conditions	Surface robustness / vandal-safe	▼	▼	◆	◆	◆	◆	▼	◆
	Water	●	▼	●	●	●	▼	▼	▼
	Moisture	●	▼	●	●	●	▼	▼	▼
	Chemical cleaner	●	●	▲	▲	▲	▼	●	▲
	Other contamination	●	▼	●	▼	●	▼	▼	▼
	Electro-magnetic interferences	◆	▼	▼	◆	◆	◆	◆	◆
Integration / Engineering	Complexity overall	▲	●	▼	▲	▲	▼	●	▼
	True Flat Design	●	▼	▲	▼	▼	▼	▼	▼
	Bonding	●	●	◆	●	▼	●	●	●
Maintenance	Calibration	●	●	◆	▲	▲	◆	●	●
Misc.	Light transmission	●	▲	▲	▲	▲	▲	●	▲
	Durability	▼	◆	▲	▲	▲	▲	▼	◆
	Response time	▲	▲	◆	◆	◆	▲	▲	◆
Pricing		▲	▼	▼	●	▼	●	●	●

Legend:

▲ good ◆ limited ● neutral ▼ bad ✗ not possible

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Costs / Pricing

The costs cited in the table above are merely guide values and they only make sense if applications are considered that allow the implementation of diverse touch technologies in the first place. However, there are applications that do not permit a choice: In these cases only one touchscreen variant is possible.

In order to select the most cost-effective solution and a functioning solution, the customer must know his application precisely or must become precisely acquainted with his application. Canvys supports you in this early phase. We help with the evaluation of the planned application, identify points in this respect that the customer perhaps may not be aware of, and then provide a recommendation concerning the technology to be implemented and the associated monitor solution or touch solution.

Price and quality of the touch solution

There are various factors that are critical for the price of a touch solution. These factors are primarily substantiated technologically and from a production perspective. There are numerous comparisons of touchscreens on the Internet. However, quite frequently in these comparisons, the quality of the end product is not considered. Experience with our clientele shows us clearly that an ever increasing number of customers are relying on a higher quality product solution. Why this is so, is demonstrated by the current developments in the private sphere. The vast majority of end users use smart phones and touchpads that can be operated with several fingers. A return to old operating methods is unthinkable. This trend is now spilling over like a wave into industrial and medical applications. In this area as well, the manufacturers want to offer this new, intuitive, and better user experience to their target group. They use the modern touch technologies primarily to differentiate themselves from their competitors.

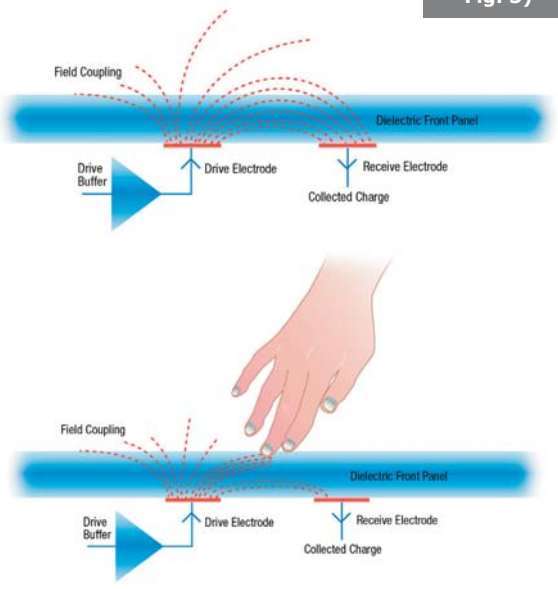
Info 3a)

How Projected Capacitive Technology Works

Projected capacitive technologies detect touch by measuring the capacitance at each addressable electrode. When a finger or a conductive stylus approaches an electrode, it disturbs the electromagnetic field and alters the capacitance. This change in capacitance can be measured by the electronics and then converted into X,Y locations that the system can use to detect touch. There are two main types of sensing methods, self-capacitance and mutual capacitance [see figures 2 and 3], where each has its own advantages and disadvantages.

© 3M

Fig. 3)



How Mutual Capacitance works
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Price-determining factors of a touch solution

- Manufacturing complexity
- Raw materials used
- Characteristics of the technology:
  - Surface hardness / scratch resistance:
    For example, does the application have to be vandal-proof, or not?
  - Resistance to environmental influences:
    For example: Dust, water, chemicals, etc,…
  - Life time of the components used
  - Translucence: Image quality, operability in sunlight
  - Required calibration frequency
    (is initial calibration necessary or must calibration be executed at regular intervals? ➡ Down time)
- Characteristics relative to operation:
  - Which input methods are demanded?
    Does one finger suffice, or are several fingers necessary? Stylus, gloves, touch, gestures?
  - Touch sensitivity: Cannot be changed, can be changed through programmability
- What level of quality does the customer want for his product?
  There are applications that allow a resistive touch or a PCap touch; however PCap offers a better user experience, and thus also offers a product that is much higher in quality.
- Other characteristics or requirements:
  - Size of the display or touchscreen
  - Completely new development of the total solution, or can it be implemented through available platform products?
    (In this regard, see section: "Lower costs through Canvys Platform Products" on page 8)
  - Effort required for mechanical or electronic integration
  - Necessary certifications:
    For example, medical approval or not

Info 4)

Infrared (Grid) (IR)

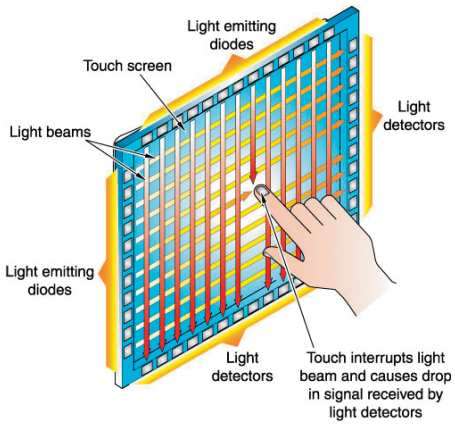
Sensor Materials

Glass or acrylic substrate, wrap-around-bezel frame, LED matrix

Principle of Operation

- LEDs create a grid of X and Y infrared light beams projected above the display and are detected by photoreceptors on the opposite edge.
- Touch occurs when a finger or stylus blocks the beam from reaching light detectors.
- Controller's constant X and Y axis scanning detects blocked light detectors and triangulates touch location.

Fig. 4)



How Infrarot Touch works

Pros

- Functions with scratches and surface wear
- Touch activated by bare finger, gloved hand, or a wide stylust
- Transmission typically 90 % to 92 %

Cons

- Solid contaminants, moving liquids or obstructions may cause a false touch and may create dead zones until completely removed
- Does not scale easily (new layout required)
- Beam spacing limits accuracy and stylus width
- Touch occurs slightly above the actual surface resulting in possible touch parallax or an unintended touch response
- Requires a bezel design to house the LEDs and detectors
- Limited to 2 or 3 resolvable touches

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Touch technologies considered in the subsequent course of this white paper

As explained above, in the subsequent course of this white paper we will restrict ourselves to the three following multitouch-capable touch technologies:

- Projected Capacitive (PCap)
- Infrared Touch (IR)
- ShadowSense™

Application and suitability evaluation, examples provided for the purpose of better understanding

To provide a better understanding, in the table below we have listed possible requirements on the application side, as examples – the list is by no means complete. These requirements are evaluated according to the touch technology used, in the form of report card grades (A = very good / F = failure). Finally, an application example is provided for additional clarity.

Application Requirements	Qualification of touch technology / Rating (A = very good / F = failure)			Application Example
	PCap	IR	ShadowSense™	
True Flat / Zero-bezel display	**A**	**F**	**F**	Tablets, Medical Engineering (Cleaning, Disinfection)
Reason	Passepartout glass print possible, easy cleaning	Requires front / integration		
High light transmission	**C**	**A**	**A**	Medical Engineering
Reason	Limited by wire grid of touch	No wirde-grid		
Laminating / Bonding to panel	**B**	**B**	**D**	Medical Engineering (requires high light transmission)
Reason	Completely smooth surface		Housing	
Sunlight readability	**A**	**F**	**F**	Museum
Reason	Fully functional	Limited functionality		
Touch activation with finger, gloves (med.), objects	**D**	**A**	**A**	Industrial Process Control
Reason	Not possible with objects	Touch activation possible		
Touch activation through thick work gloves	**F**	**A**	**A**	Industrial Process Control
Reason	Can be handled by only a few PCap manufacturers	Touch activation possible		
Touch sensivity	**A**	**A**	**A**	Medical Engineering
Reason	works without pressure, sensivity depends on used glass (coated or uncoated)			
No faulty touch activation under flowing water	**D**	**C**	**C**	Industrial Cleaning of Monitors
Reason	Limited by touch sensivity settings			
Touch activation with water drops or dirt on glass	**C**	**B**	**A**	Food Industry
Reason	Limited by touch sensivity settings	Touch sensivity settings		
No faulty touch activation with chewing gum on glass	**B**	**F**	**A**	Public Information System
Reason	Touch sensivity settings	Limited by touch sensivity settings	Touch sensivity settings	
Touch activation possible despite scratches on glass	**A**	**A**	**A**	Public Information System
Reason	Touch activation possible			
Vandal-safe	**D**	**B**	**D**	Public Information System
Reason	Depends on thickness of glass, thickness is limited	Depends on thickness of glass	Depends on thickness of glass, thickness is limited	
Impact of electronic interferences	**F**	**A**	**A**	Production of Defibrillators
Reason	Requires high shielding	Requires low or no shielding		
Chemical resistance	**B**	**D**	**D**	Industrial Process Control
Reason	Glass surface	Glass with ABS frame		
Usability in moisture-prone area	**B**	**D**	**D**	Food Industry
Reason	Density	Density and sensor		

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Touch solutions in conjunction with HMI – Industry 4.0

With touch technology we are a major step closer to the ideal of the intelligent human-machine interface (keywords "HMI" / "Industry 4.0"). We can thank touch-sensitive technology for the fact that many applications have become more user-friendly and more intuitive than they were with keyboard and mouse operation. Touchscreens have generated new applications or have even made them possible in the first place: For example, the success of Tablet PCs is also based, among other things, on the touch technology used. Other innovative applications will certainly follow.

Lower costs through Canvys Platform Products

Touch solutions are often very individual product developments, which in the past required the purchase of large quantities. Previously these developments were reserved only for large OEM suppliers. With the development of its "Platform Products", Canvys now enables smaller customers and budgets to also comply with or implement the requirements imposed on corporate design in the product development and integration (either their own requirements or requirements on the customer side).

For customers it is now easier than it has ever been before to equip the interfaces necessary for communication between human and machine (in this case the monitor and the entire operating concept) with a unique identity and unique design. For the customer, expensive in-house developments on the hardware side are dispensed with, thanks to the availability of a base of "finished" products (Canvys Platform Products) that are integrated with the suitable touch technology, and due to the customizing offer. Control, i.e. communication between touchscreen and application, is handled by modern operating systems. Now the customer can concentrate solely on implementation of the actual application software or content.

Summary

Canvys Platform Products allow the customer to cost-effectively increase his competitiveness, and to produce innovative, high quality products with modern applications and an enhanced user experience.

Info 5)

Industry 4.0 - The dual strategy: Becoming a leading market and supplier

Existing basic IT technologies need to be adapted to the specific requirements of manufacturing and continue to be developed with this particular application in mind. In order to achieve economies of scale and ensure widespread effectiveness, it will be necessary to enhance the manufacturing technology and IT systems of existing facilities with CPS capabilities as part of the strategy for migrating to Industry 4.0. At the same time, it will be necessary to develop models and strategies for designing and implementing CPS manufacturing structures at new sites.…

Source: Final report of the Industrie 4.0 Working Group - http://www.plattform-i40.de/finalreport2013

Fig. 5)

Canvys True Flat S Series:
An example for Canvys Platform Products: Modularly designed monitors for flexible OEM solutions in industrial and medical applications integrated with PCap (Projected Capacitive) Touch

Credits: © VILevi, Sergey Nivens, industrieblick - Fotolia.com

Info 6)

Canvys True Flat S Series

21.5" / 54.6 cm Full-HD True Flat Display with a brilliant contrast ratio of 3000:1. A plain glass surface with smooth closed edges avoids the buildup of dust and dirt. It enables easy cleaning and disinfection.

Features of the Basic Monitor

- Aluminium Housing
- IP 54 Protection
- Slim Design
- Leight Weight
- Long-term Availability
- PCap Touch
- and many more options

Learn more: http://www.canvys.de/en/products/trueflat/smart-true-flat-series/