Sensitive Touch Screen

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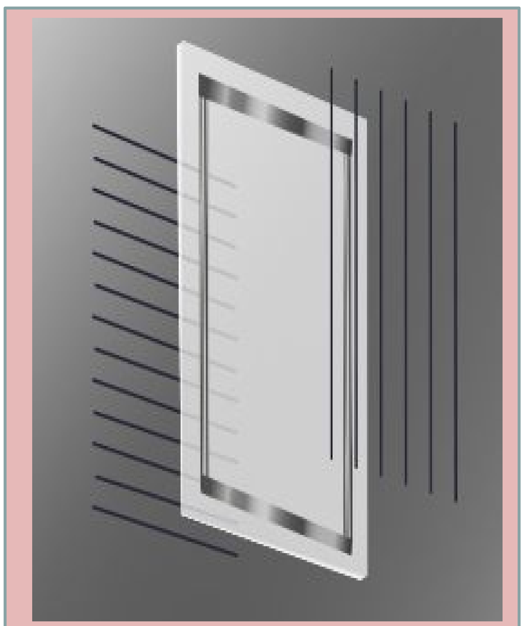
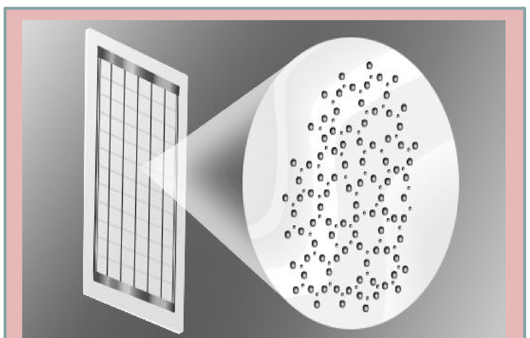
Introduction



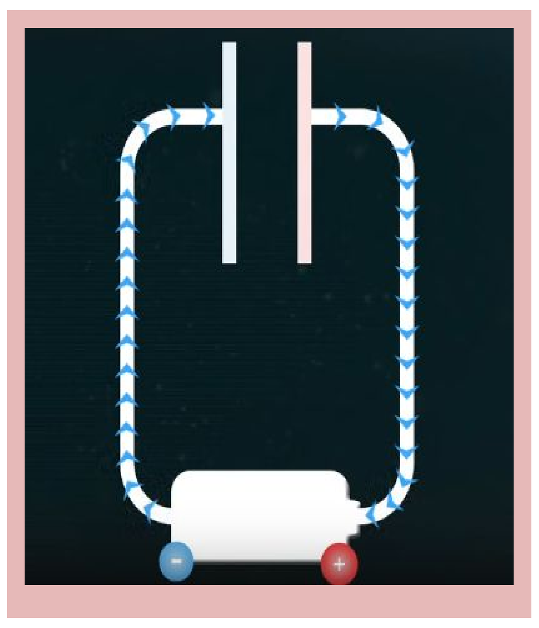
A grid pattern of an electrostatic wires on the second layer.



Glass is an insulator, and its electrons are held tightly by its atoms. So, they are not free to flow as an electric current

The touch sensitive screen is made up of two plates of glass and a numerous electrostatic grid of tiny wires. Top layer is basically built for protection, and the second layer has got the electrostatic wires one hooked up horizontally to the battery's positive terminal on the back, and one hooked up to the negative terminal vertically on the front making a grid. The separated positive and negative charges create an electric field. Electric fields push and pull anything with an electric charge. The sensors at the side measure how many electrons flow through the wire. Once the screen is touched, there is capacitance generated between the finger, touch panel surface, and ITO coating. The sensors will sense more than normal amount of electrons are flowing through the wires[1]. Then, the processor uses the grid to spot exactly which spot was touched.

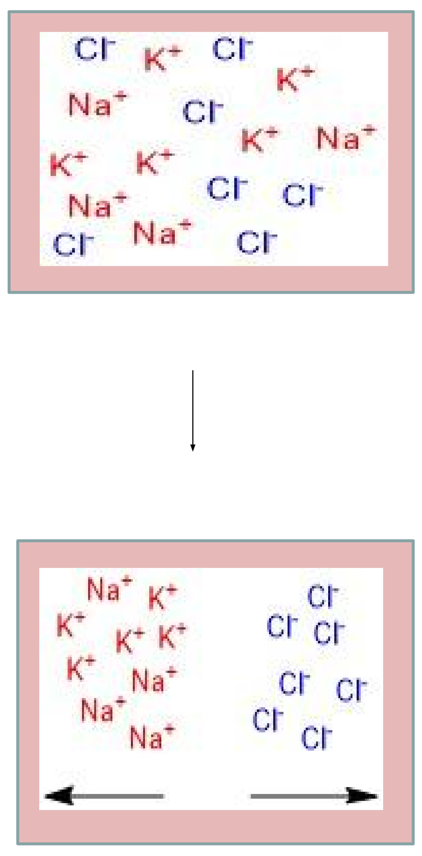
Electric Circuit (Capacitor)



The name of this touchscreen is derived from the "capacitor", which is an electrical circuit comprised of two electrodes that are separated by a gap. Capacitive touchscreens contain a grid of electrodes across the screen that utilize the natural AC current of the human body to bridge the gap and complete the circuit[1].

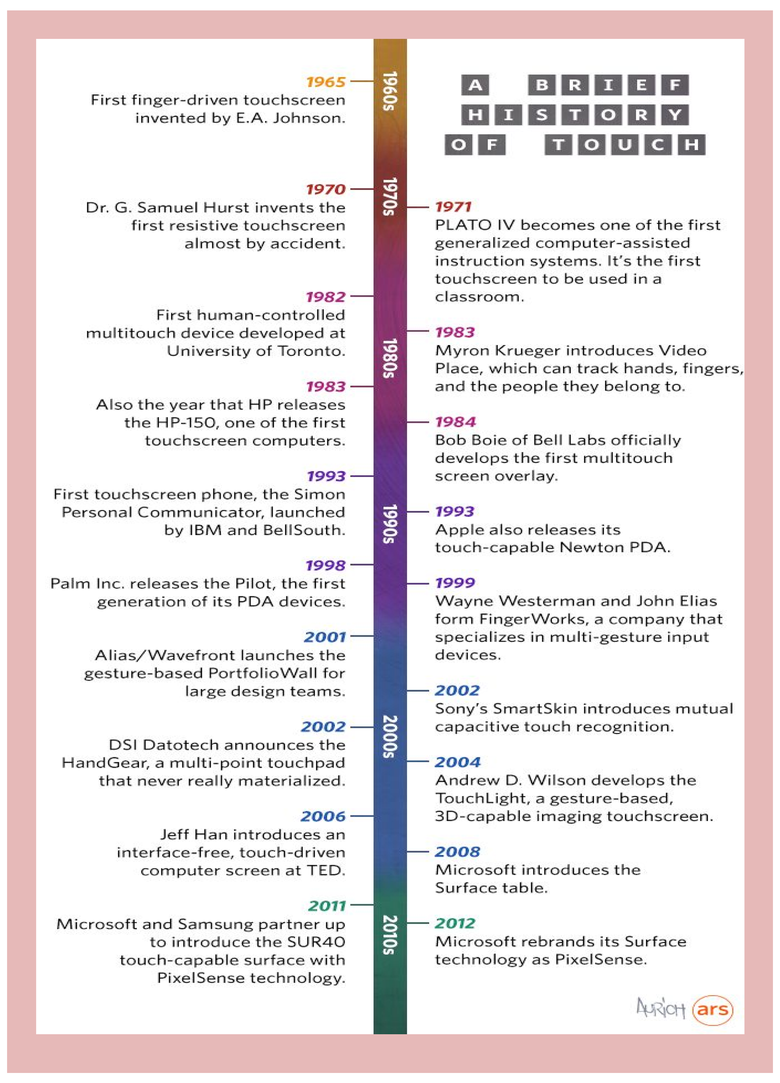
The Blood and Cells

The blood and cells in the fingers are full of water with a lot of charged atoms dissolved in it. Positive ions such as sodium(Na+), potassium(K+), and negative ions such as chloride (Cl-). This, when a finger contacts the screen, causes the electrical field to pull the negative ions towards the positive wires and pushes the positive ions away. The negative ions from the surface of the finger balance some of the positive charge in the wire. This causes the battery to retain more electrons, and the wire gets more positive. As the wire gets more positive, the battery pumps more electrons into the negative wire to balance the charge[4].



History of the Touchscreen

The first capacitive touchscreen was invented by E.A. Johnson in 1965 for use in air traffic control. Johnson's touchscreen could only detect one touch at a time and did not include pressure sensitivity, unlike the more advanced screens that we use today. This achievement was soon followed up by the invention of the world's first resistive touchscreen by Dr. G. Samuel Hurst in 1970. One of the first commercially available touchscreens was the PLATO IV terminal, an assisted-instruction system used in classrooms. In 1982, the first multi-touch touchscreen was invented Nimish Mehta at the University of Toronto.

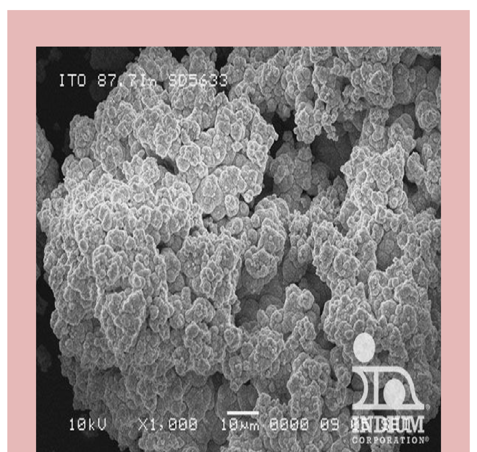


Future Technologies

Current touch screen technologies are always being analyzed in order to improve upon their designs. For example, the industry standard touch screen for smart phones uses indium tin oxide (ITO) and is characterized by rigidity which leads to the screen cracking when dropped. A new material based on silver nanowires (AgNW) is looking to replace the outdated ITO and improve touch screens by making them more flexible and durable. AgNW will also reduce the costs of manufacturing touch screens. New ideas are also the key to advancing this technology. Future predictions of what touch screens could evolve into include screens with transparent displays, screens that can be accessed without having to even touch it, and screens that can be molded by the user.

Indium Tin Oxide

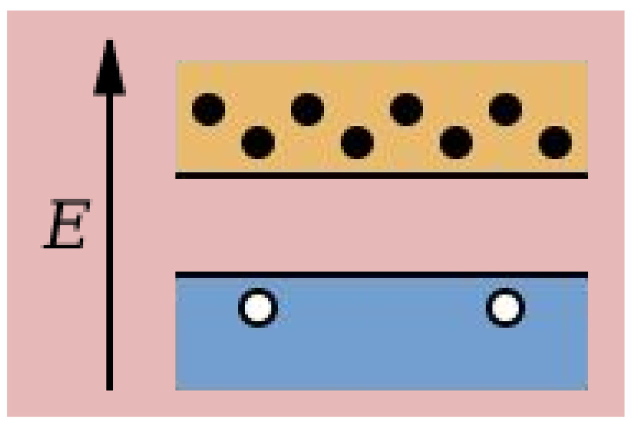
In powder form, indium tin oxide (ITO) is yellow-green color.



Indium tin oxide(ITO) is a mixture of indium(III) oxide(In_2O_3) and tin(IV) oxide(SnO_2). Usually, 74% In, 18% O_2, and 8% Sn by weight.

Indium tin oxide (ITO) is widely used for its electrical conductivity and optical transparency in its thinnest form. This ITO film is often used to make transparent conductive coating for displays, including touch screens.

ITO Applications
Liquid crystal displays (LCDs)
Plasma Screens
LEDs
Touch Screen
Sensor coating
Heated windscreens
Electronic ink applications



ITO is a heavily doped n-type semiconductor with a large bandgap of around 4 eV. This material has high level of transmittance and a unique electrical conductivity due to its highly degenerate behavior as an n-type semiconductor with a large band gap.

Conclusion

The capacitive touch screen is a widely used technology in everyday life, from phone screens and car navigation systems to restaurants and homes. The technology uses indium tin oxide as the primary material in the screens, along with capacitor circuits and the human body in order to detect touches. Although the touch screen is more than five decades old, the technology is still making large strides in terms of advancement and will continue to do so in the foreseeable future.

Acknowledgements

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References

1. http://engineering.mit.edu/ask/how-do-touch-sensitive-screens-work (accessed Apr 5, 2017).
2. https://en.wikipedia.org/wiki/Indium_tin_oxide (accessed Apr 5, 2017).
3. http://scienceline.org/2012/01/okay-but-how-do-touch-screens-actually-work (accessed Apr 3, 2017).
4. http://www.abc.net.au/science/articles/2013/08/21/3830267.htm (accessed Apr 5, 2017).
5. https://en.wikipedia.org/wiki/Extrinsic_semiconductor#N-type_semiconductors (accessed Apr 5, 2017).
6. http://www.indium.com/inorganic-compounds/indium-compounds/indium-tin-oxide/ (accessed Apr 5, 2017