Disruptive InGlass™ Touchscreen Technology for Interactive Digital Signage

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Introduction to Touchscreen Technologies in Digital Displays

There are two popular incumbent touchscreen technologies today. These are Projected Capacitive based (p-cap) and IR-based. Both are suitable for yesterday’s devices, but may not be the best choice in interactive Digital Signage going forward.

P-Cap: The P-cap technology was introduced into mainstream consumer market with the iPhone (Walker, Geoff/Intel 2014). Conductive sensors are placed inside the touchscreen glass or underneath the cover glass. An electric circuit is required to detect a touch and the location, by
sensing the electrical properties of the sensors. This technology is suitable for mobile phones and tablets, but does not adequately scale to large size displays. Additionally, the inherent touch sensors embedded in the glass reduce the optical clarity of the display.

**IR-Touch:** This technology works by injecting infrared (IR) light on top of the glass and detecting whether it reaches the detector on the opposite side of the glass. Though suitable for large sizes, it requires that a frame (bezel) be placed on top of the LCD, resulting in an unattractive display. The frame hosts the IR sensors and ensures that the detection signal is sent on top of the glass. The technology struggles to detect many touch events at the same time (multi-touch). This is problematic when placing a palm on the screen, multi-finger gestures, and multi-users. Since the detection occurs on the surface, IR-touch is susceptible to dust and surface contamination. These can appear as incorrect touch events.

**FlatFrog InGlass™:** An emerging technology that is suitable for Digital Displays is Frustrated Total Internal Reflection (FTIR) by FlatFrog (InGlass™). Specific light wavelengths are injected into the core glass and touch disturbances are detected via novel algorithms that have been patented by FlatFrog. Unlike p-cap, FlatFrog InGlass™ does not utilize any sensors in the glass. By removing the need for light obstructing sensors, the light from the underlying display passes perfectly through the glass without degradation. Unlike IR, no frame (bezel) is required because the sensing is taking place in the body of the glass and not on top of the glass. This results in a tablet-like, bezel-free device that is also multi-touch capable. These key features of this technology are well aligned with the market trends that are transforming Digital Signage. By understanding these capabilities, developers are now enabled to leverage the interactive touch technology in a new way.
Key Market Trends #1: HD & UHD Displays

HD/UHD displays are altering the LCD (Ultra High Definition (UHD) Panel (4K) Market Expected to Reach USD 30,404.6 Million by 2020 2014) and the Digital Signage market (LeBlanc 2014). Put two identical displays next to each other with identical content, and you will be attracted to the clearer more vibrant picture. However, what is the use if we are to add a touch interface that reduces the quality of the picture? This is precisely why p-cap based solutions are not suitable for HD/UHD displays. The embedded sensors in or under the glass obstruct the display light, resulting in a distorted image.

FlatFrog InGlass™ is ideal for UD/UHD because it does not obstruct the LCD picture with image altering sensors. The use of a sensor-free cover glass allows the audience to enjoy the high-resolution display generated picture to its fullest.

What does this mean to Interactive Digital Signage: Using InGlass™ allows developers to leverage the incredibly attractive HD/UHD with touchscreen experience that is not degraded by the touch interface. The superior clariy allows users to use their fingers to zoom in on a picture without loss of content. This applies when zooming into a Google Map, personal picture, or on a purchasing object such as a shoe that we want to buy. Uncompromised HD/UHD with interactive touch opens new options that invite users to move in and out of a specific content. The vivid colors invite the users to explore the image without the frustration of a blurred image.
Figure 6: HD/UHD touch enabled zoom without clarity degradation.

Figure 7: Low-resolution display zoom with degradation.

**Key Market Trends #2: Display Sizes are Increasing**

As the price of LCDs lowers, the availability of more displays and bigger displays is on the rise. Put two identical displays next to each other, the bigger size will grab your attention.

Figure 8: Size matters.

Beyond the obvious visual advantage of a larger display, the larger displays also enable developers to add more content into a single display. In many instances, the designer can petition the visual content into zones. This allows for a richer content showing animation, product information, and a
logo all on the same display (Cisco 2007). So, how has the touchscreen industry adapted to these new options?

Figure 9: Display petitioning leveraging company logo, video content, interactive buttons, and picture selection.

P-cap based touchscreens are the most common touch interface in smart phones and tablets. As the incumbent technology, touchscreen vendors simply attempted to scale up in size. However, the standard conductive sensors that are used for 4-10” displays fail once you extent much beyond the tablet space. To adapt, new types of sensors structures were designed (Walker, Geoff/Intel 2014) However, when the new structures were not enough, new exotic sensor material replacements were developed by printing thin metal lines (metal mesh) that are more conductive to support larger sizes. To adequately drive larger panels, the sensor matrix is further sub-divided into segments or quadrants.

Figure 10: Four separate metal mesh grids utilized to cover a full screen.

This results in a non-scalable p-cap technology architecture that has to be significantly modified to support various sizes. Therefore, while displays kept on growing in size, the touch interface has not kept up.

For FlatFrog InGlass™ whether the glass is 20”, 100” or 200”, the basic sensor architecture and the components are identical. This scalable architecture results in a technology that can serve from 15” to 200”. As the displays increase in size, FlatFrog InGlass™ simply scales up without the need for material or architectural changes.
What does this mean to Interactive Digital Signage: Touch interface is no longer limited by p-cap limitations such as the sensor type, sensor design and custom electronics. If you wish to develop a 20”, 45”, 65”, 78”, 90”, 100” or 200” touchscreen enabled display, it is all supported using a single scalable technology.

Key Market Trends #3: Intuitive Multi-Touch Content

Interactive Digital Signage Displays offer an interesting challenge. Unlike most Operating Systems, gaming, or work related software, users expect to look at a new content and intuitively use it. There is little to no learning cycle. If the user cannot understand the content or the interface within a few seconds, they will simply walk away never to try again. Interactive Digital Signage developers get a single shot to embrace the user.

The number of touches that you can detect with IR is limited. This means that if a user rests their palm on the screen, it may be identified incorrectly as a finger touch event. Palm placement could also block other fingers from being detected altogether. Furthermore, if you double click but your finger is not raised above the IR detection, the double click is not identified as an event. These experiences force the user to adapt the touch to the display limitations as opposed to having an intuitive touch experience.

FlatFrog InGlass™ is multi-touch capable. As many as 80 simultaneous touches can be resolved. Therefore, in one usage case multiple users can interact on the display at the same time and enjoy touch experience identical to what they are accustomed to with smart phone and tablet.
Palm can be identified and rejected, while still detecting finger touch events.

![Figure 13: Unintended palm placement on screen can be detected and ignored.](image)

In addition, InGlass™ multi-touch pressure events can also be detected with more than 1000 pressure points. This means that a soft or hard press on the screen can be distinguished. Even passive stylus pens can be detected.

![Figure 14: More than 1000 pressure levels multi-touch.](image)

FlatFrog InGlass™ technology is capable of detecting multi-touch gloves events. This allows for glove usage in hospitals and outdoor environments. This feature is a significant limitation with p-cap technology.

![Figure 15: Multi-touch glove.](image)
What does this mean to Interactive Digital Signage: Users can now exercise multiple fingers to scroll, zoom, flip, or move objects. Resting your palm on the screen will not disable the screen or cause unwanted events. Pressure activation options can also be leveraged to create a pressure based select option. Whether in a cold environment, medical setting, or simply making a fashion statement consumers can interact without removing their gloves. Multi-touch is now available to multi-users on same display therefore shortening the wait in line or enabling multi-users to interact with the display. Remarkably, these detection capabilities can work simultaneously. These touchscreen detection features empower a much more natural and intuitive touch interface experience.

Key Market Trends #4: Attractive No Bezel and Curved Displays

The evolution of displays has resulted in a need for flat edge-to-edge tablet-like high-resolution panels and the introduction of curved displays. Both introduce a new eye catching look, which is attractive to the eye and the touch interface.

![Figure 16: Tablet like display with flat edge-to-edge look & curved displays.](image1)

Edge-to-edge designs were introduced with the smart phones. The sleek flat glass is now the norm, and it has moved to tablets, laptops, and All-In-One PCs. The trend has continued to larger displays. IR has serious multi-touch limitation, but is capable of scaling in size. However, the bezel is a hard requirement, which results in a bulky looking bezel on top of the borders. As the display gets larger, if the glass in non-uniform due to vibration or simply the glass weight, a thicker bulkier frame is required.

![Figure 17: IR required bezel.](image2)
Curve screens embrace the user and provide a new exciting look. In the case of IR touchscreen technology, an optical signal from one side of the panel is transmitted on top of the glass and is detected on the opposite side. With the curved surface, the optical signal cannot be delivered to the detection. It requires a flat surface.

FlatFrog InGlass™ sends the light signals inside the glass. Therefore, no bezel framing is required. Because the light is captured inside the glass using patentable technology, curved screens are well suitable for the technology.

**What does this mean to Interactive Digital Signage:** Whether we wish to build a frameless 15-200” tablet-like panel, or an innovative curved display, Digital Displays are not bounded by the touch technology. FlatFrog InGlass™ technology is not constrained by the size limitation that limits p-cap, or by the bezel and curved LCDs that confine IR-touch.

**Summary**

Older generation touch technology have constrained our ability to capitalize on HD/UHD displays, larger sized displays, tablet-like designs, curved displays, and improved intuitive content. For a few years now, the Digital Signage market has accepted these limitations resulting in an inferior touchscreen experience or no touch interface altogether. Content software has accepted a 1-2 finger touch. HD/UHD displays have not leveraged touch to showcase content. Curved screens and large flat edge-to-edge designs have avoided touch interface. Lastly, super large displays with multi-touch were viewed as impossible to design. InGlass™ technology allows for intuitive user interface features for a wide range of sizes.

![Figure 18: Exemplary screen size vs feature technology options.](image)

You can now have 15-200” HD/UHD interactive multi-touch displays that are either curved, or tablet-like with an intuitive interface and unmatched optical clarity. The combination of these features are unmatched by the existing p-cap or IR technologies. FlatFrog InGlass™ disruptive touch technology is moving the interactive display benchmark and enabling a new class of innovative products.
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