

# Bezel-Less Smartphones and Under-Screen Cameras

Metacog Patent Research

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## 1. At a Glance

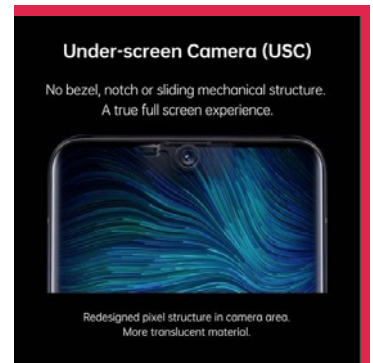
Almost every smartphone company - whether it is a tech behemoth of the likes of Apple and Samsung, or other equally competitive market player like Huawei and OnePlus - is striving towards taking its smartphone game to the next level. One of the key technological battles being fought today focuses on offering a device that is as much aesthetically engaging as possible - and to provide an all-screen, bezel-less phone is one of the aspects that aligns with this ambitious objective.

The existing technologies don't allow a manufacturer to achieve this feat without doing away with the cut-out (notch) on the phone's display to give way for the front camera. The device that doesn't sport a cut-out (notch) on the display comes with a separate motorized front-camera arrangement. For example, the latest flagships from Samsung (S10e, S10, S10 Plus) have a punch hole design to accommodate the camera. Apple still retains the infamous notch on its phones to make space for camera and face-ID components, while the other latest flagship offerings, such as Huawei P30 Pro, OnePlus 7 Pro, and Asus Zenfone 6, either include a motorized component or a cut-out to enable the front camera functionality.

So, in a nutshell, no company currently provides an offering that delivers a true all screen, bezel-less user experience. Now the question arises how can one possibly achieve this seemingly challenging objective? The following companies have devised noteworthy advancements in this domain without using notches or a motorized front-camera arrangement.

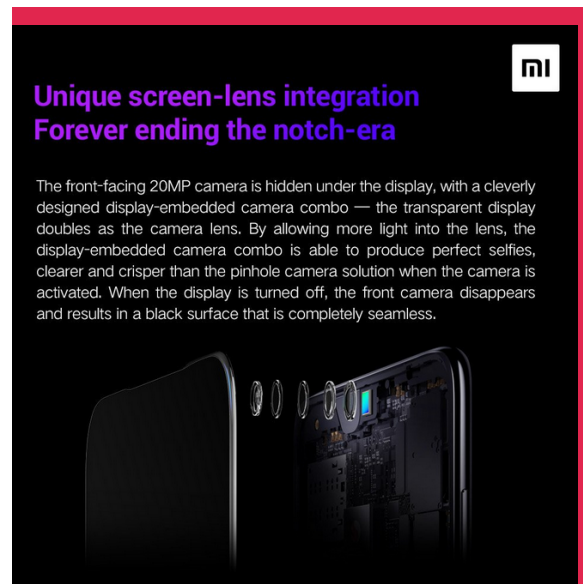
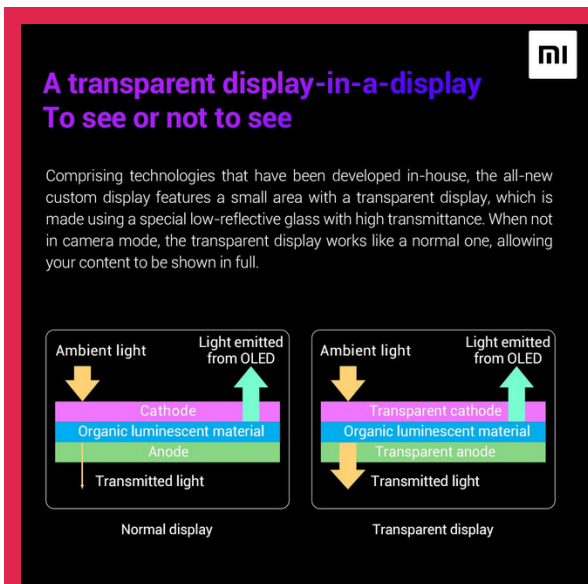
## 2. Oppo

In June 2019, Chinese smartphone manufacturer Oppo demonstrated its under-screen camera technology at the Mobile World Congress Shanghai. According to the technology, a customized camera module is fitted under a screen made of highly transparent material that enhances transmittance of light through the screen. In addition, the camera technology capitalizes on Oppo’s algorithm for haze removal, HDR, and white balance. Using white balance, the colors are calibrated against any light sources that might obstruct the image. Using HDR, the overexposed highlights are reduced, and the sharpness is increased using haze removal.

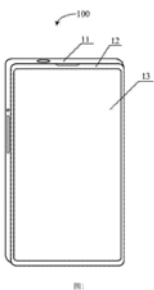


## 3. Xiaomi

Xiaomi is also actively developing the under-screen camera technology, wherein the camera is placed underneath a small transparent area made of a low-reflective glass with high transmittance and this glass also acts as camera lens. When the camera is activated for taking the pictures, the display area becomes transparent and allows light to enter, and the display doubles as the camera lens. When not in the camera mode, the display works like a normal screen.



### Exemplary patent: CN109143670A



1. A kind of mobile terminal characterized by comprising glass cover-plate, display panel and optical sensor ;

The display panel is between the glass cover-plate and the optical sensor ;  
The display panel includes transparency display Area, the transparency display area are opposite with the optical sensor ; The optical sensor for receive sequentially pass through the glass cover-plate, The light in the transparency display area.

## 4. Samsung

Samsung Galaxy S10 and S10+ have the sensor and camera lens under the display and have a hole punch in the corner to house the front camera. The company is now working on a display system where the camera hole punch is not visible. According to Yang Byung-duk, Vice President of Samsung's Mobile Communication R&D Group Display "Though it wouldn't be possible to make (a full-screen smartphone) in the next 1-2 years, the technology can move forward to the point where the camera hole will be invisible, while not affecting the camera's function in any way."

## References

Oppo unveils under-screen camera, MeshTalk tech at MWC Shanghai 2019. Business Standard. See [https://www.business-standard.com/article/technology/oppo-unveils-under-screen-camera-meshtalk-tech-at-mwc-shanghai-2019-119062600646\\_1.html](https://www.business-standard.com/article/technology/oppo-unveils-under-screen-camera-meshtalk-tech-at-mwc-shanghai-2019-119062600646_1.html)

Oppo showcases under-display camera tech with customized display at MWC Shanghai. Digit. See <https://www.digit.in/news/mobile-phones/mwc-shanghai-oppo-showcases-under-display-camera-tech-with-customised-display-and-camera-48802.html>

Xiaomi explains more about how its under-screen camera actually works. The Verge. See <https://www.theverge.com/circuitbreaker/2019/6/5/18654365/xiaomi-camera-under-screen-no-notch-transparent-display-technology>

Wang Xiang. Senior Vice President at Xiaomi. Twitter. See [https://twitter.com/XiangW\\_/status/1135515148423012353/photo/1](https://twitter.com/XiangW_/status/1135515148423012353/photo/1)

Samsung is working on 'perfect full-screen' devices with selfie cameras under the display. The Verge. See <https://www.theverge.com/2019/3/14/18265265/samsung-all-display-phone-under-screen-selfie-camera-no-cutout>