CAMERA LENSES

Today, brilliant images are possible with the smallest smartphone lenses. Why then is it still necessary to have large lenses in photography?

SIZE COMPARISON

(original sizes)
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**Size Comparison**

Despite their small size, smartphone lenses have sophisticated optics with complex lens arrangements.

**Lens Arrangement**

The most important consequence of the size difference is the different depths of field.

**Depth of Field**

Smartphones display all objects from near to far with the same sharpness. The depth of field can be set selectively with large SLR lenses.
GESTURE CONTROL

Optical systems can capture and interpret hand movements contactlessly – this is ideal in sterile workplaces such as hospital operating rooms.

SURGICAL HAND-TRACKING SYSTEM
detailed view from below

Two infrared (IR) cameras capture the scene like two human eyes from slightly shifted perspectives.

A 3D camera, which is based on the propagation time of light, verifies the distance.
In contrast to early cathode ray tubes, flat screens save a great deal of energy per unit area. Impressive global production capacities meet the high demand for these displays.

**ELECTRICITY CONSUMPTION AT SAME DISPLAY SIZE**

<table>
<thead>
<tr>
<th></th>
<th>cathode ray tube</th>
<th>LCD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption</td>
<td>100%</td>
<td>25%</td>
</tr>
</tbody>
</table>

**PRODUCTION OF FLATSCREENS WITHIN ONE HOUR**

- 200,000 smartphone displays
- Total area of produced flat screens (TVs, tablets, smartphones, and others) = 2 football fields
LCD vs OLED

Today, LCD displays dominate the flatscreen market, but in smartphones, organic LEDs (OLEDs) are conquering an increasingly larger market share. OLED displays are thinner, more energy-efficient, and higher in contrast but more expensive to produce.

LCD DISPLAY STRUCTURE

Today’s most common type of display creates images by blocking off or letting through white light that LEDs create across the back of the display.
LCD vs OLED

Today, LCD displays dominate the flatscreen market, but in smartphones, organic LEDs (OLEDs) are conquering an increasingly larger market share. OLED displays are thinner, more energy-efficient, and higher in contrast but more expensive to produce.

### Display Resolutions

<table>
<thead>
<tr>
<th>Resolution</th>
<th>Pixels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Resolution</td>
<td>720 x 480</td>
</tr>
<tr>
<td>Full HD</td>
<td>1920 x 1080</td>
</tr>
<tr>
<td>Full HD</td>
<td>1920 x 1080</td>
</tr>
<tr>
<td>4K Ultra HD</td>
<td>3840 x 2160</td>
</tr>
<tr>
<td>8K Ultra HD</td>
<td>7680 x 4320</td>
</tr>
</tbody>
</table>

### OLED Display Structure

Organically luminous materials in OLED displays do not require a separate light source, which makes their construction depth much thinner.

- cover glass
- cathode
- anode
- TFT = thin-film transistors
- carrier material (glass or plastic)
- organic layers
  - Molecules are electrically excited to make them glow.

- These layers together are around 200 times thinner than a human hair.