Uncooled Infrared Imaging Technology & Market Trends 2015

Commercial & Military Applications
An infrared thermal camera is a thermal system which converts infrared (IR) radiation into a visible image.

An IR camera’s main parts are:

- Cores are modules that include imagers + electronics, and sometimes lenses. Without lenses, it’s also called a “video engine”.
- Imagers are also called UFPA (Uncooled Focal Plane Arrays) or IR sensors. Detectors provide only a detection signal (no image) and are covered in Yole’s 2013 report on the IR detector market and technology trends.
- An imager can have various formats (1024 x 768 to 16 x 16) and pixel pitch (usually from 12µ - 40µ in 2014).
MARKET RESEARCH SCOPE AND METHODOLOGY (1/2)

• Market research scope:
  • This report surveys the Long Wave Infrared (called LWIR or FIR) uncooled imaging camera and imager markets for both commercial and military businesses.
  • An overview of Near Infrared (NIR), Short Wave Infrared (SWIR) and Medium Wave Infrared (MWIR) technologies is also presented here.
  • Market forecasts are furnished for the 2015 – 2020 period in shipments (units) and in revenue ($M).
  • For an in-depth analysis of IR detector applications & technologies (from 1 – 100 x 100 pixels), see Yole’s “Infrared Detector Market 2013 Report”.

• Methodology:
  • Our research is based on:
    • Primary information sources: direct interviews with companies across the value chain (imager manufacturers, camera manufacturers, camera distributors and end-users).
    • Secondary information sources: conferences, web sites, newsletters, etc.
  • All data, graphs, tables and calculations in this report are based on Yole Développement’s investigation.
  • All market forecast are based on exchange rate $ 1.3 = € 1
New content compared to the 2013 version

• Latest industry news and analysis of new market entrants and exits.
• Summary of mergers & acquisitions over the last 5 years.
• Up-to-date analysis of 20 market segments
• Addition of new ultra low end surveillance segment
• Addition of a new other commercial application that includes commercial UAV and EVS
• 2014 estimates of sensor manufacturers’ market share
• Updated market forecasts (in $ and units) for the 2014-2020 period
• Identification of latest technological trends and ongoing developments
UNCOOLED THERMAL IMAGING

Market forecasts at camera level

UNCOOLED THERMAL CAMERAS
Market forecast in revenue ($M) - Nominal scenario

UNCOOLED THERMAL CAMERAS
Market forecast in shipments (units): Optimistic smartphone scenario

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MICROBOLOMETER MANUFACTURERS & PRODUCTS

Market shares evolution of manufacturers and sensor size
THERMOGRAPHY MARKET

Strong battle on ultra low end cameras

THERMOGRAPHY CAMERA CATEGORIES

<table>
<thead>
<tr>
<th>Category</th>
<th>2014 Price</th>
<th>Imager Size</th>
<th>NETD°C or K</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultra</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low-end and visual thermometer</td>
<td></td>
<td>25 x 22</td>
<td>0.1 to 2</td>
<td>FLIR T100</td>
</tr>
<tr>
<td>Low-end</td>
<td></td>
<td>80 x 60</td>
<td>0.1 - 0.04</td>
<td>FLIR E5</td>
</tr>
<tr>
<td>Mid-range</td>
<td></td>
<td>100 x 100</td>
<td>0.08 - 0.05</td>
<td>FLIR T100</td>
</tr>
<tr>
<td>High-end</td>
<td></td>
<td>640 x 480</td>
<td></td>
<td>Tisa 600</td>
</tr>
</tbody>
</table>

LOW END AND ULTRA LOW END CAMERAS PRICE EVOLUTION

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SURVEILLANCE MARKET

Price erosion open new commercial applications
AUTOMOTIVE MARKET

A concentrated market
Missile seekers is confirmed as a high growth rate application.
CONSUMER APPLICATIONS

Smartphones & personal vision systems

SMARTPHONE MARKET SEGMENT

<table>
<thead>
<tr>
<th>Date</th>
<th>Supplier</th>
<th>Model</th>
<th>Retail Price</th>
<th>Imager technology &amp; resolution</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>March 2014</td>
<td>Oggal</td>
<td>Therm App</td>
<td>$1,600 $939 in 2015</td>
<td>Microbolometer - Ult</td>
<td>QVGA</td>
</tr>
<tr>
<td>June 2014</td>
<td>FLIR</td>
<td>FLIR One Gen 1</td>
<td>$349 $249 in 2015</td>
<td>Microbolometer - FLIR</td>
<td>80 x 60</td>
</tr>
<tr>
<td>Sept 2014</td>
<td>Seek Thermal</td>
<td>Seek Thermal</td>
<td>$249 to 299</td>
<td>Microbolometer - Raytheon</td>
<td>206 x 154</td>
</tr>
<tr>
<td>Q3 2015</td>
<td>FLIR</td>
<td>FLIR One Gen 2</td>
<td>?</td>
<td>Microbolometer - FLIR</td>
<td>160 x 120</td>
</tr>
<tr>
<td>2016</td>
<td>3i systems</td>
<td>Thermal expert</td>
<td>&lt; $300</td>
<td>Microbolometer - i3</td>
<td>QVGA</td>
</tr>
</tbody>
</table>

PERSONAL VISION SYSTEMS (PVS) SEGMENT

Overview

- **Segment description:**
  - Personal vision systems include both portable binocular or monocular and sight for rifles. Those units are used for border patrol, law enforcement and consumer outdoor use, i.e., hunting. LBA is the largest hunting market worldwide. With price erosion, this market becomes more and more oriented towards consumers.
  - There is strong synergy between PVS and military market: soldier vision goggles are very similar to consumer

Market insights:

- **2014:** 50 units
- **2015-2020:** CAGR: 5-10 units
- **Pricing:**
  - ASP 2014: $500
  - Price ranges from $2k - $12K.
- **Main trends and drivers:**
Main technological trends & players

**NEW IR TECHNOLOGIES IMPACT ON CORE: SOME ORDERS OF MAGNITUDE**

- Pixel pitch reduction
- ASIC
- 3D TSV
- WLO

**WLP ROADMAP**

- The majority of players will finish WLP process development by 2015. WLP is interesting for commercial applications where volumes are high and imager size small (QVGA and below). WLP is less attractive for military applications where volumes are low and imager size high (VGA and higher).

WLP is becoming common.
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Expiration date:

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