INDUSTRY TRENDS: MEMS

The future of MEMS[1] and Sensors: beyond the human senses!

2017 has been quite good year for the MEMS markets and although the MEMS industry reached maturity, it is still expected to grow at a significant rate: 18% in value and 27% in units, over 2018-23. In 2023, the MEMS market should be a US$31 billion market with 88 billion units. Moreover, with new mega trends such as robotic cars, autonomous vehicles, AI[2], AR/VR[3], 5G, and Industry 4.0 ... the demand for sensors will grow as for MEMS.

It is still a domain with a lot of innovation as new devices are in R&D (speakers, gas sensors, hyperspectral imagers ...). This wave of innovation is also confirmed by the good 2017 business year realised by most of the MEMS foundries. This business is highly dynamic, as shown by the shuffle of the MEMS players ranking in 2017/2016 where RF[4] MEMS players are moving to higher ranks.

Over the years, sensors have shifted from detectors to awareness sensors. In the 1970s, sensors were first developed and used for physical sensing: shock, pressure, and then acceleration and rotation. As more effort was been put into R&D, the use of MEMS shifted from physical sensors to light management (e.g. micro mirrors), and then to uncooled infra-red sensing (e.g. microbolometers). It opened the way to the first sensor that can sense beyond human senses. After physical/light sensing, MEMS development has been driven by sound, with microphones. Nowadays, MEMS and sensor developments are aiming to go far beyond human capability with sensing in ultra-sonic, hyperspectral and radio-frequency. We can imagine a next generation of sensors that can be used for emotion/empathy sensing in the long term.

Over the years, my MEMS industry experience made me realised that the MEMS business has moved through three different eras:

1. The "detection era" in the very first years (simple sensors to detect a shock, a level)
2. The "measuring era" when sensors could not only sense and detect but also measure (e.g. a rotation)
3. The "global perception awareness era" when sensors are increasingly used for a mapping of the environment (e.g. 3D with LiDAR, air quality with environmental sensors, gesture recognition and biometry). This is possible thanks to sensor fusion of multiple parameters together with artificial intelligence.

This trend has been possible thanks to the implementation of numerous technological breakthroughs over the years: new sensor designs, new processes and materials, new integration approaches, new packaging, sensor fusion and new detection principles.

1. *MEMS: Micro Electro Mechanical Systems*
2. *AI: Artificial Intelligence*
3. *AR/VR: Augmented Reality/Virtual Reality*
4. *RF: Radio Frequency*

With almost 20 years of experience in MEMS, Sensors and Photonics applications, markets, and technology analyses, **Dr. Eric Mounier** provides deep industry insight into current and future trends. As a Fellow Analyst, Technology & Market, MEMS & Photonics, in the Photonics, Sensing & Display division, he is a daily contributor to the development of MEMS and Photonics activities at Yole Développement, with a large collection of market and technology reports as well as multiple custom consulting projects: business strategy, identification of investments or acquisition targets, due diligences (buy/sell side), market and technology analysis, cost modelling, technology scouting, etc.

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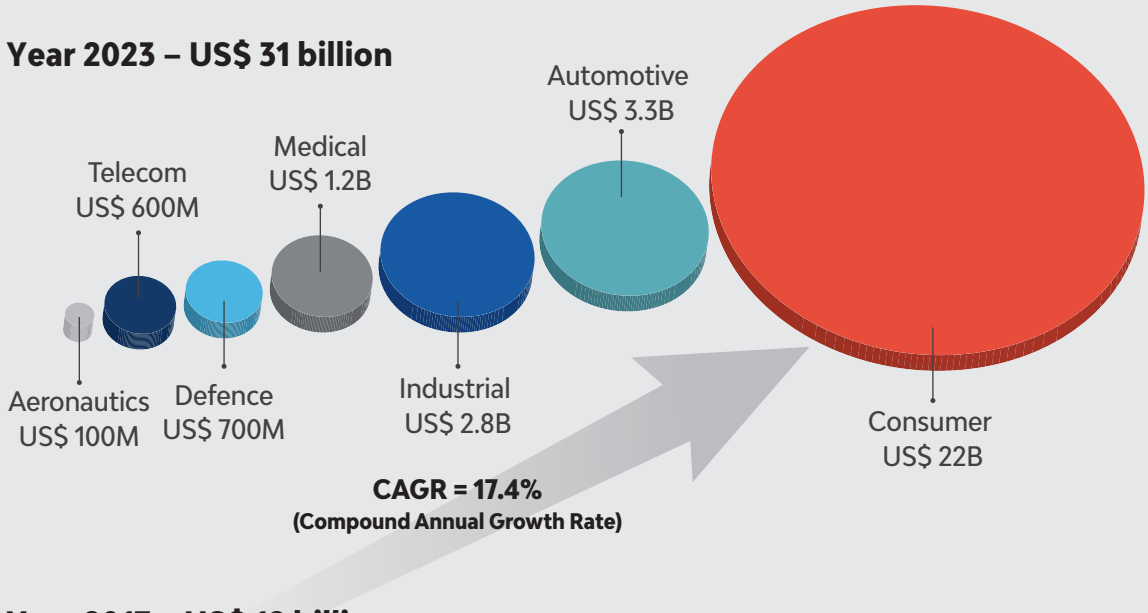
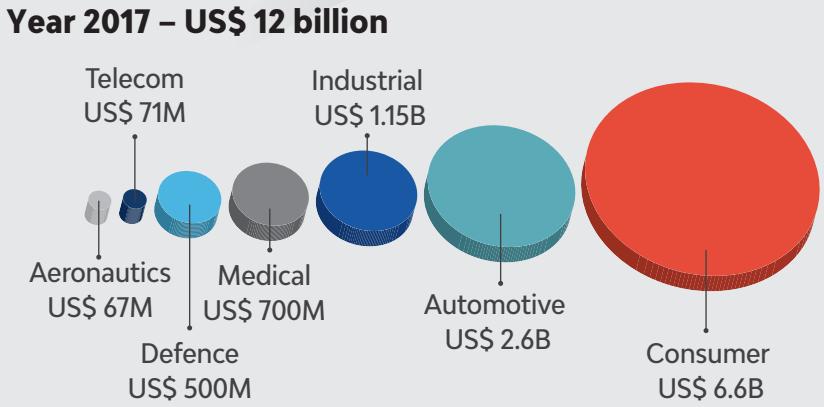
2017 – 2023 MEMS market forecast by segment

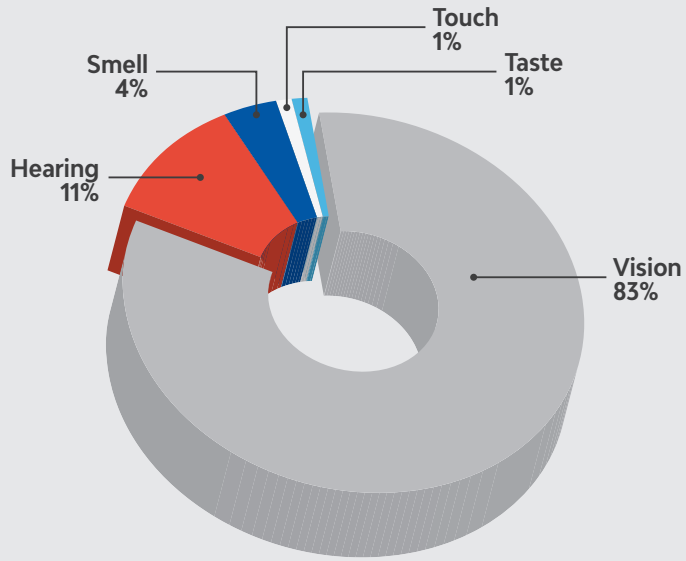
Source: Status of the MEMS Industry report, Yole Développement, 2018





How do we perceive the external world?

Source: Status of the MEMS Industry report, Yole Développement, 2018



Audio is the next innovation!

Psychological study in 1994 by Hatwell (Hatwell, Y., 1994,. Traité de psychologie experimentale. Paris, P.U.F.) showed that 83% of our external world perception is through our vision, followed by hearing which represents 11% of our perception.

- Thus, a high quality image is greatly valued for the user. Today the smartphone bill of materials for camera modules is $10 per unit.
- The next most-used sense is hearing. We believe the next innovation in MEMS and sensors will be audio for sound and voice control.
- Gas sensors could quickly follow microphones as valued functions for consumer applications.