

# MEMS Applications and Devices in IoT



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# MEMS Explained

What you need to know



What is MEMS?

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MEMS Designing

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Why MEMS for Sensors

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MEMS Sensors and  
Applications

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Future of MEMS & IoT

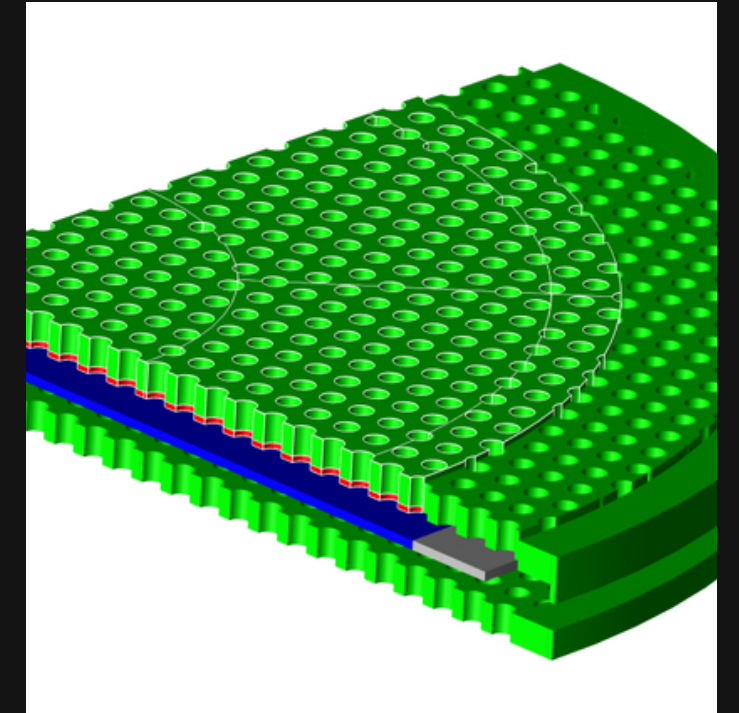
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# What is MEMS



- MEMS or Micro-Electrical Mechanical System is a technique of combining Electrical and Mechanical components on a chip, to produce a system of miniature dimensions.
- MEMs is the integration of a number of micro-components on a single chip which allows the microsystem to both sense and control the environment.
- The components are integrated on a single chip using microfabrication technologies.

# MEMS Design Process



There are three building blocks in MEMS technology:

1. **Deposition Process:** Ability to deposit thin films of materials on base
2. **Lithography:** Apply a patterned mask on top of the films by photolithographic imaging.
3. **Etching:** To etch the films selectively to the mask.

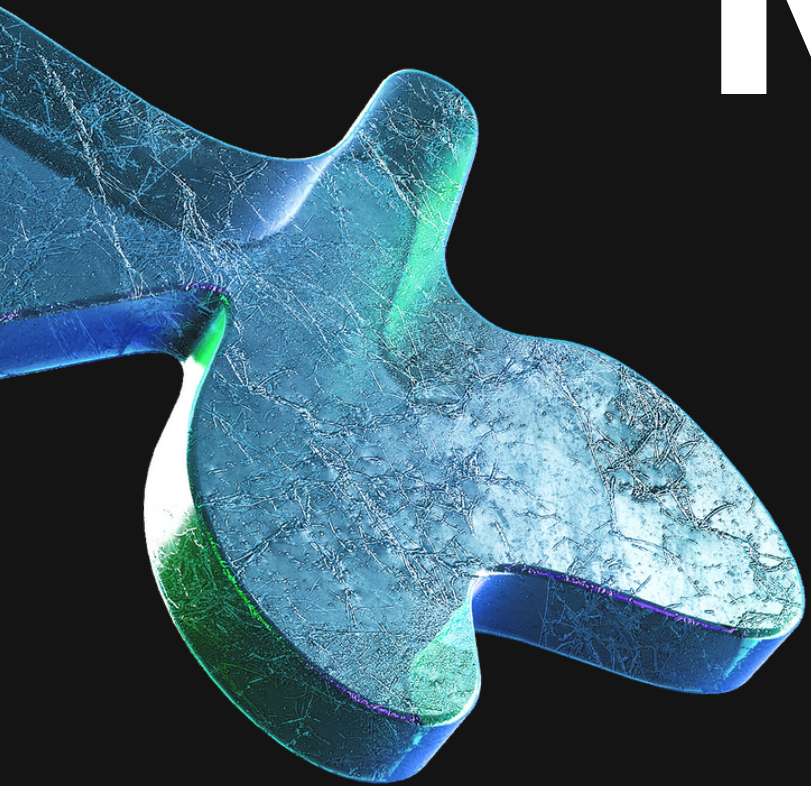


# Why MEMS for Sensors

- Smaller in Size
- Have lower power consumption
- More sensitive to input variations
- Cheaper due to mass production
- Less invasive than larger devices



# MEMS Sensors

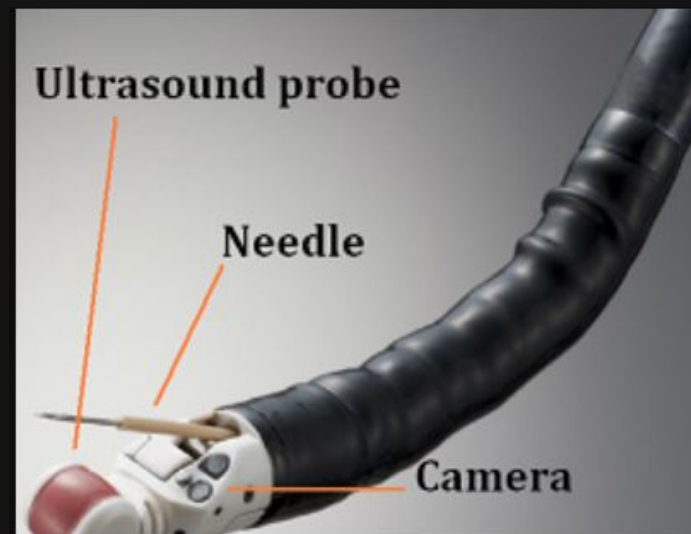


# Medical Field

## Conventional Endoscopy

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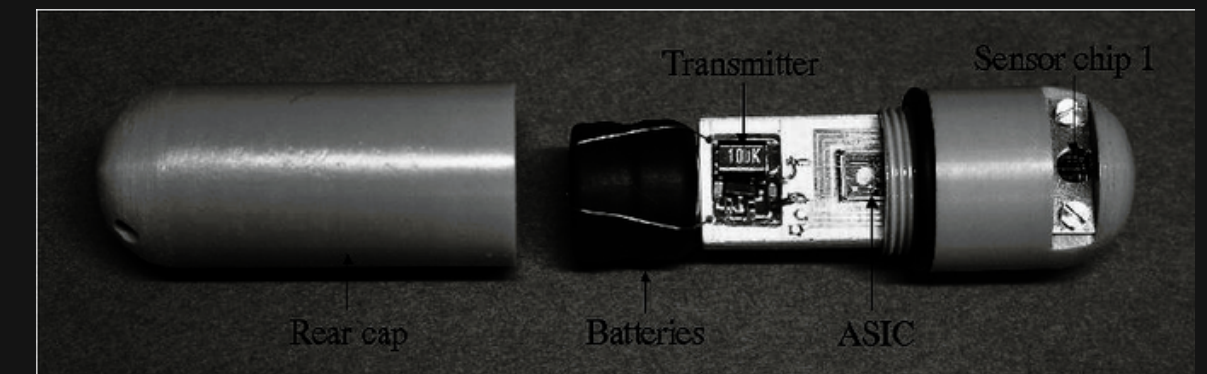
- Can be used only to the views the limited part of the small intestine
- Requires sedation of patient
- Is an uncomfortable procedure



## "Lab on a Pill" (IoT Based Smart Capsule)

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- Can show a view of the entire small intestine
- Requires no sedation
- Can aid in early detection of colon cancer



<https://www.iothub.com.au/news/smart-pill-brings-iot-to-digestive-health-413887>

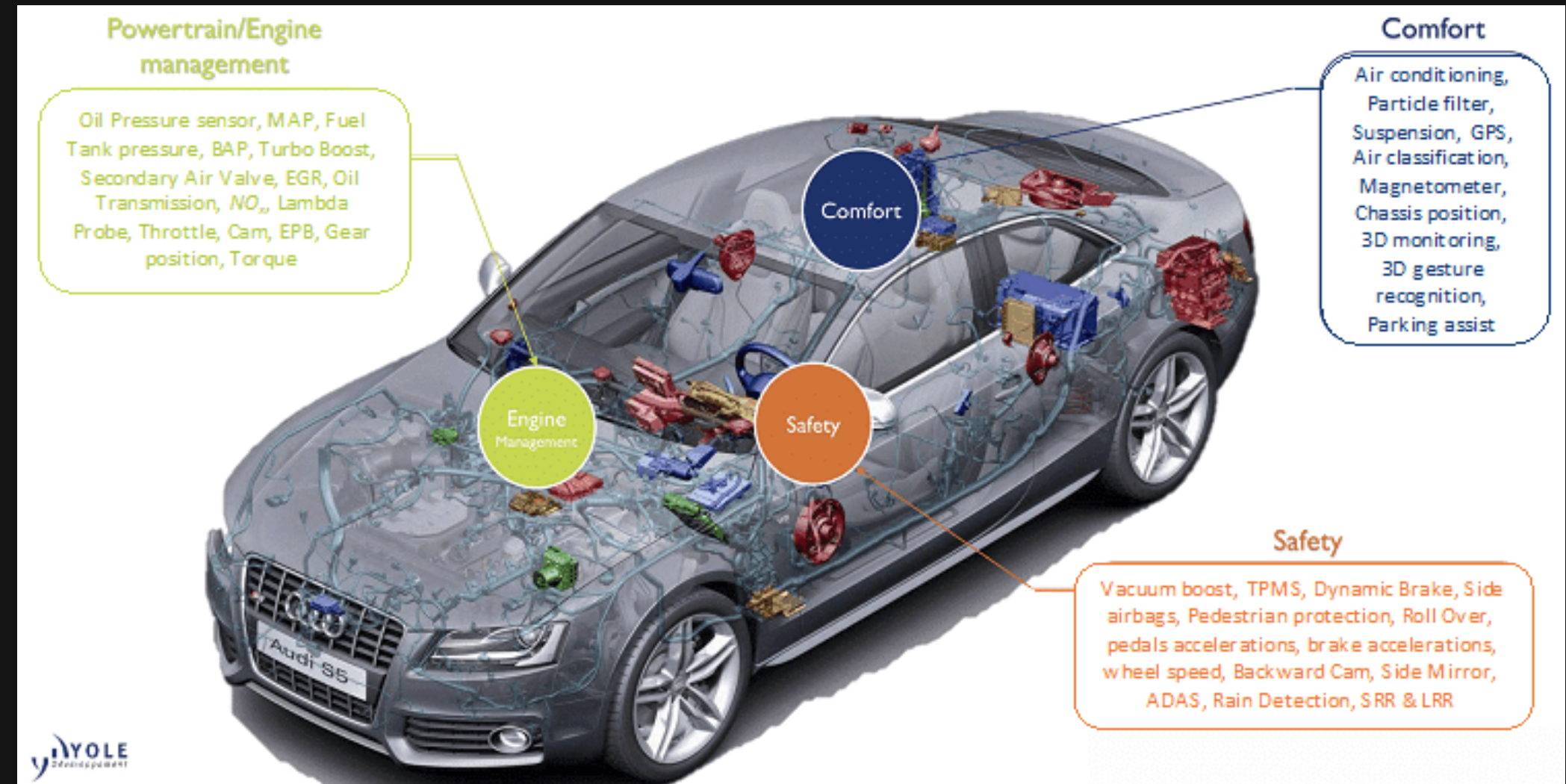
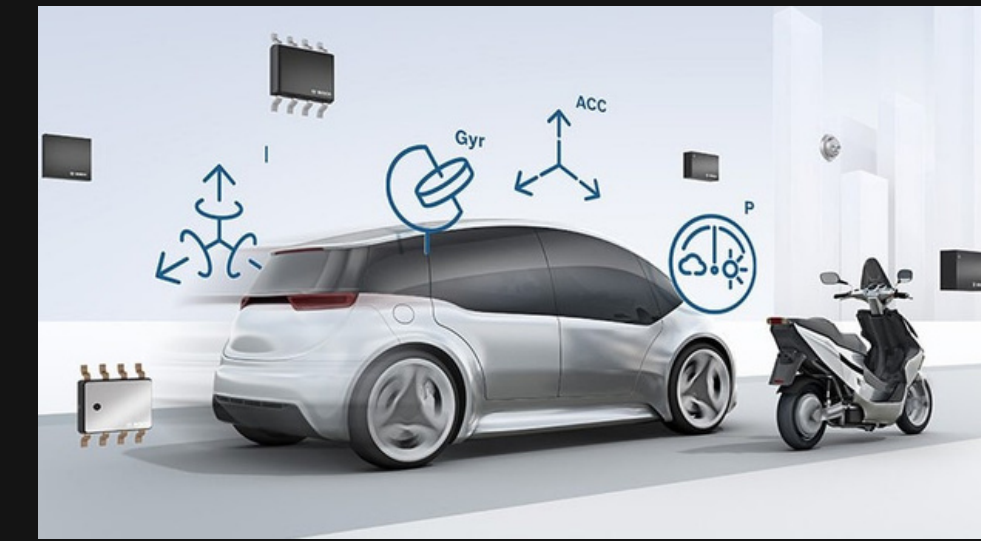
<https://health.usf.edu/medicine/internalmedicine/digestive/eus>



# Automotive Field

The MEMS sensors most prevalent in today's vehicles are:

- Inertial sensors (accelerometers and gyroscopes)
- Magnetometers
- Pressure sensors
- Thermal sensors
- Gas sensors
- Optical MEMS





MEMS Type	Safety	Engine Performance	Comfort	Automotive Applications
Inertial sensors	•		•	Airbag, seat belt tensioner, rollover control, stability control, anti-lock braking, tire pressure monitoring, inertial navigation, emergency call system, electronic parking brake
Magnetometers	•	•		Anti-lock braking, stability control, tire pressure monitoring, camshaft/crankshaft speed and position
Pressure sensors		•	•	Tire pressure monitoring, fuel tank evaporation, exhaust gas recirculation, engine oil pressure, transmission oil pressure, brake booster, HVAC
Thermal sensors	•	•	•	Engine temperature, climate control, night vision display
Gas sensors		•	•	Exhaust gas recirculation, HVAC
Optical MEMS	•		•	LiDAR, heads-up display, night vision display
Microphones			•	Voice-activated systems

**By 2022**, the global market for connected mobility is set to grow by almost 25 % per year. In just a few years, cars will become an active part of the IoT through the application of MEMS sensors and will be able to communicate with other modes of transportation, as well as with the smart home.

<https://atomica.com/mems-sensors-and-the-automotive-mark>

<https://www.bosch-mobility-solutions.com/en/solutions/electronic-components/mems-sensors/et/>

# MEMS ultrasonic sensor: Pushing the boundaries of AR/VR technology

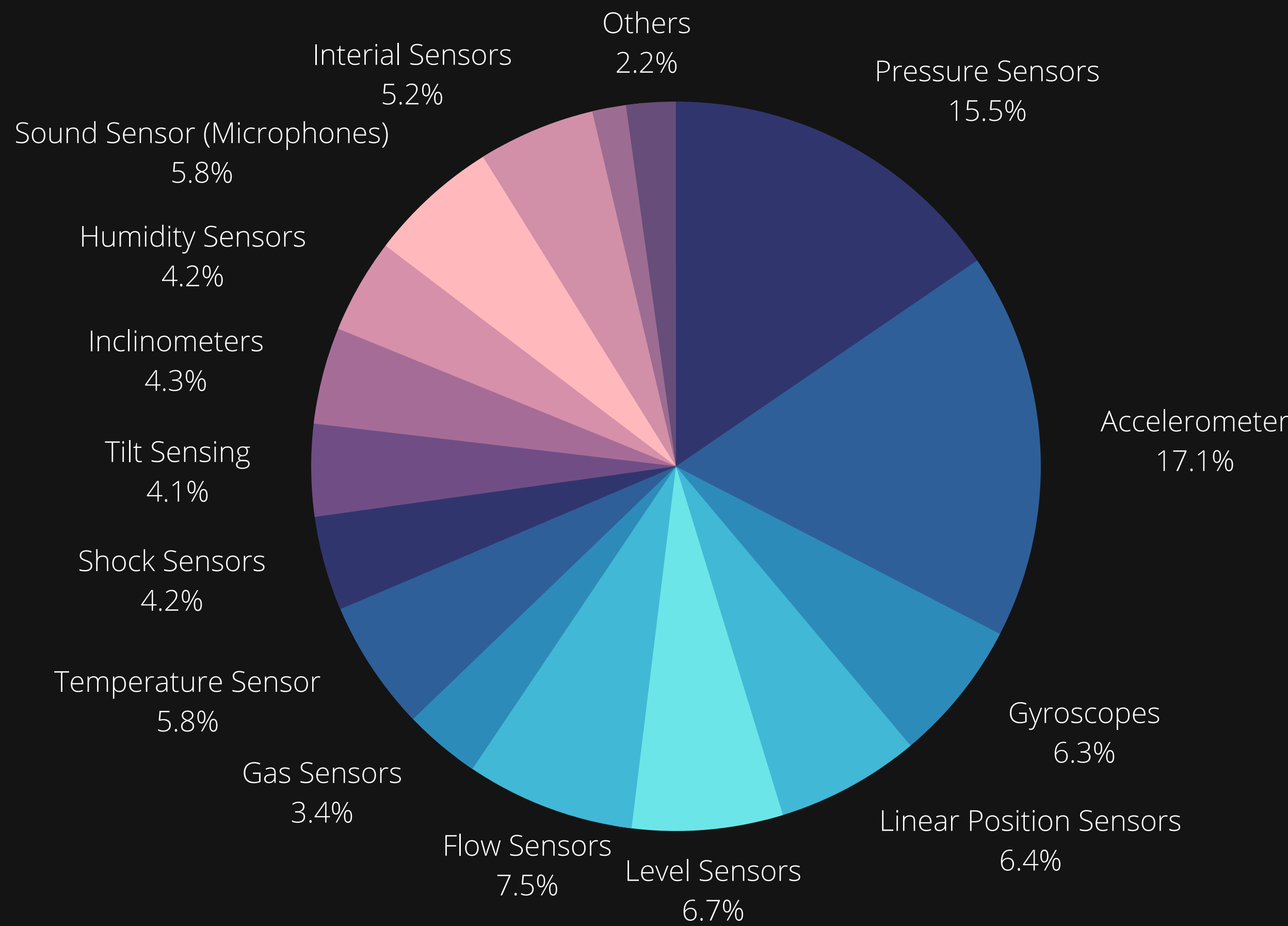
Recent AR/VR systems use Time-of-Flight (ToF) for measuring the distance to an object, and ultrasonic sensors are attracting considerable attention.

Ultra-small sensor which is one-thousands in volume of traditional types



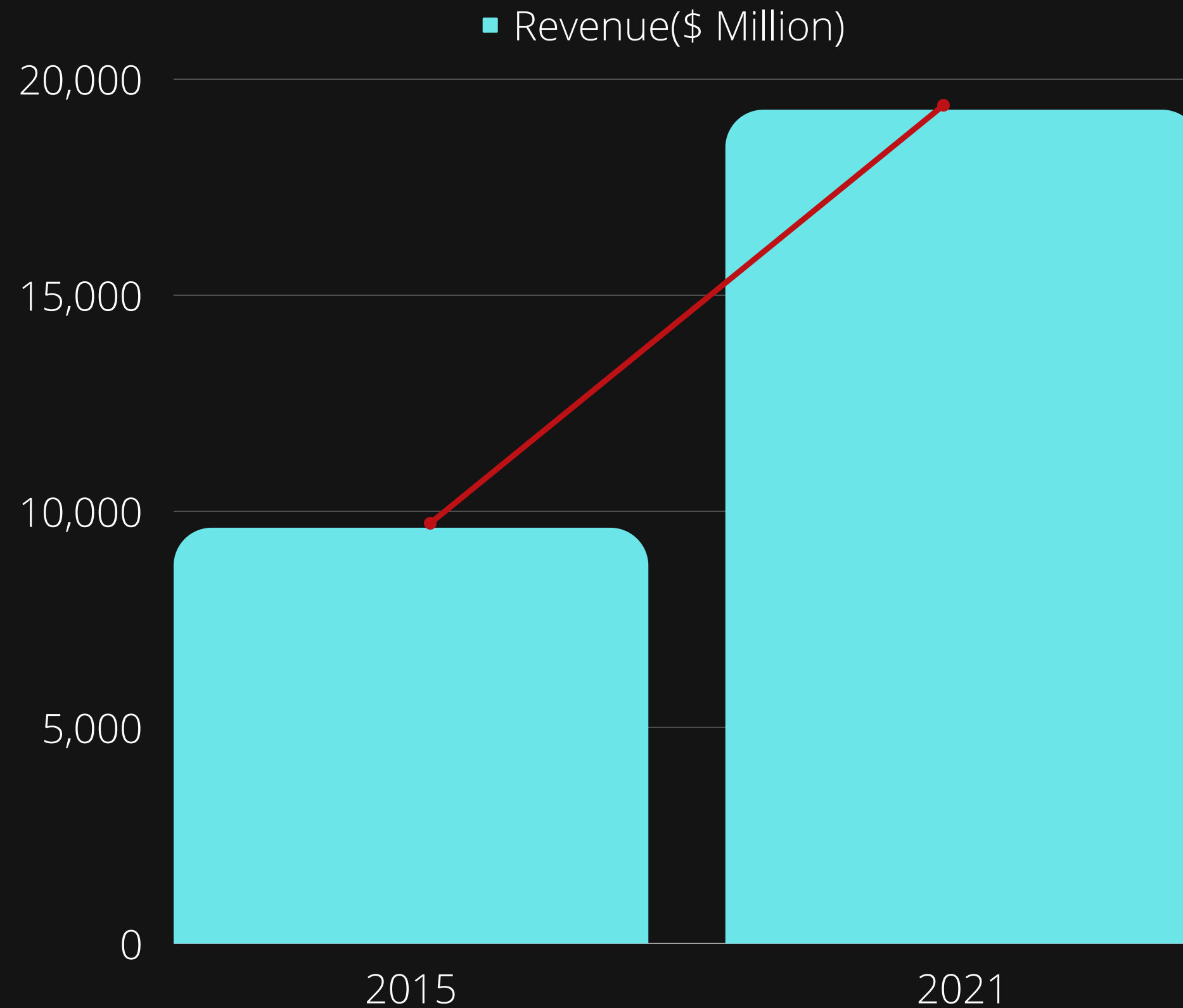
CH-101 combines PMUTs, a power-efficient DSP (digital signal processor), and a low-power CMOS ASIC in a small-sized package measuring 3.5 x 3.5 x 1.25 mm, with one-thousandth the volume of a traditional ultrasonic ToF sensor.

# Total MEMS Sensors Market





# MEMS Sensors Market: Revenue Forecast, Global, 2015–2021



**The advance of technology  
is based on making it fit in so  
that you don't really even notice  
it, so it's part of everyday life.**

**BILL GATES**

# References

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- Ms. Santoshi Gupta, MEMS and Nanotechnology IJSER, Vol 3, Issue 5, 2012
- Stephen Beeby, MEMS Mecanical Sensor, PP. 7



**Thank You!**

