Sensors selectivity versus sensors orthogonality

The human being as the ultimate example of sensors fusion”

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1. SUMMARY:

2. These days, it's unusual to experience an electronic consumer product that doesn't use sensors to create new experiences for its users. Sensors are experiencing a renaissance of sorts as micro-electromechanical systems (MEMS) technology becomes less expensive and further miniaturized, in turn fueling penetration of sensors into new applications and creating new potential for the sensor market.

- Sensors are now found in a wide variety of applications, such as smart mobile devices, automotive systems, industrial control, healthcare, consumers electronics and climate monitoring. Sensors are used almost everywhere. (FIG 1) However, sensors for a single type of use are less and less favored and there is a strong trend going towards multiple applications from the same sensors or sensors set.
- For that one needs now to closely mimic the ultimate sensing machine... the human being.
- Today, the race for simple, cheap, low power selective organic gas sensors, is extremely difficult to win.
- The strategies for a winning bet are
    - orthogonality rather than selectivity via the combination of non specific sensors in oscillation
    - sensors fusion
- This approach leverages a unique fingerprint AI (a "brain") to fuse the individual data collected from multiple sensors (multivariate or not) to get a more accurate and reliable view of the data than one would get by using the data from each discrete sensor on its own.
- Sensor fusion creates a situation in which the whole is much greater than the sum of its parts.
- Sensor fusion enables context awareness, (FIG 2) which has huge potential for the Internet of Things (IoT). Advances in sensor fusion for remote emotive computing (emotion sensing and processing) could also lead to exciting new applications in the future, including smart consumers product and smart healthcare.

3. MOTIVATION and RESULTS:

Food safety, air quality , personal consumers health via wearables devices, is of the upmost importance today.

7 millions dies every year due to air quality (11 % of the total death rate in the world)

Indoor Air is 2 to 5 time more polluted than outdoor air

The World Health Organization reports as statistics that 1 in 10 people get sick every year by eating contaminated food and 420,000 people die each year

475 millions of DIABETICS in 2018 in the world and this number is expected to be multiply by 4 in the next 35 years

Therefore, there is a great need to develop techniques, economic, fast and easy to use to monitor and identify the source of contamination and to provide real-time information on the air we are breathing, on the foods you are eating or on our own health status via a non invasive approach using body fluid.

One of the most promising techniques, shown in this presentation are MOS gas sensors incorporated as arrays. However, this technology is very well known for being non specific and being therefore matric dependant. How we can sort out those issues and make them more specific, more application flexible, and less matrix dependant ?

- A human being experiences the external environment in many ways. Vision, hearing, chemical sensation (senses of smell and taste) and surface sensation (sense of touch) all provide sensory information about one's surroundings, which travels through the peripheral nervous system (PNS) to the brain. The brain then decides how to respond to a given condition or experience.
- The PNS doesn't make complex decisions about the information it transports; these decisions are made by the brain. In response to sensory input, the brain sends out motor information- a human being's response to the input
- The brain is the ultimate decision maker. However, without the peripheral nervous system's ability to bring in sensory information and send out motor information, one would not be able to walk, talk or do many of the other functions we often take for granted. The brain often uses several sources of sensory input to validate an event and compensate for a lack of "complete" information to make a decision. (FIG 3)

The presentation will show some results in the Environment or in the medical fields where the race for selectivity can only be won via the orthogonality of the sensors and the sensors fusions (FIG 4)

4. FIGURE:

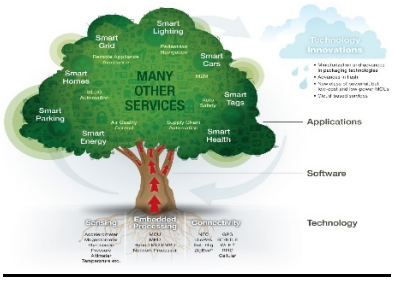

Fig. 1: the IOT world using gas sensors

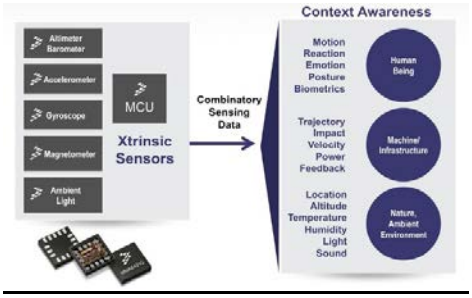

Fig. 2: environment awareness

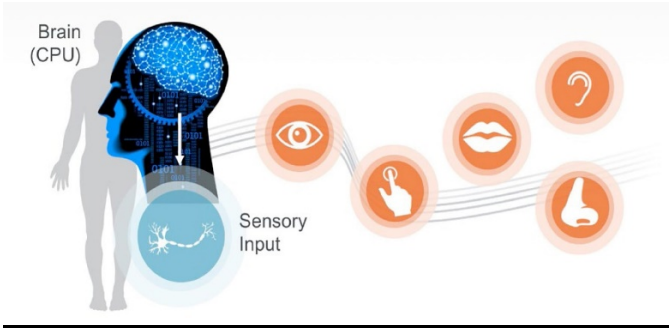

Fig. 3: The sensory fusion : the ultimate example

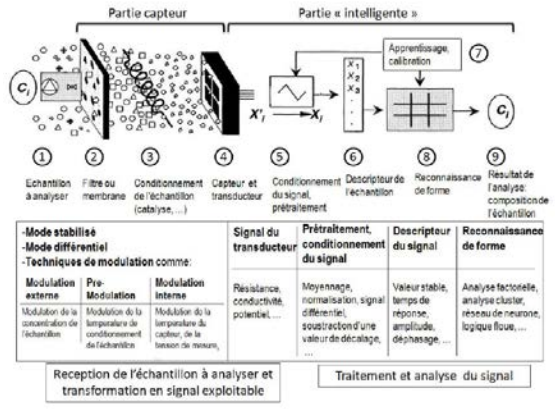

Fig 4 the various Sensors Orthogonality Steps