Sensing the Wireless Future

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Wireless sensors are applicable for a variety of applications, whether it be smart cities (smart parking, smart lighting, waste management), industrial control (M2M applications, indoor air quality, temperature monitoring), eHealth (fall detection, patient surveillance, ultraviolet radiation) and many more. For each application, the sensor needs to function effectively, be small in size and low in cost. Sensors enable engineers to establish wireless techniques that will ensure the reliability of data transmission, eliminate disturbance by other wireless devices, ensure data security (and safety), and lower the power consumption and price.

Sensors are becoming more commonplace and technologically advanced as it relates to the wireless industry. Just recently a home security representative came to the house of a good friend of mine who was having some work done. The installer fully intended to take the old wires and re-connect them on the sensors and turn the system on. As it turns out, it was quicker and more cost effective (no incremental cost) to simply install a new wireless receiver and install wireless sensors on each door/window instead of re-connecting the existing wires. Sensor technology has come a long way from being ahead of its time and expensive, to being cost effective and practical.

We talked with some industry icons about the current state of wireless sensors in the industry, and what they think the technology has in store for the future.

What are the high-growth segments within the sensor industry?

Bruce Ulrich, Wireless Product Line Director, ams: One of the most exciting trends in the sensing industry is the move to energy harvesting and, in particular, passive sensing. Coupled with wireless networks, passive sensing enables freedom of implementation for autonomous sensing.

Karthi Gopalan, Sensor AFE Marketing Manager, Sensor Signal Path Products, Texas Instruments: Environment sensing is growing exponentially with increasing pull from markets that are demanding greener, smarter and safer infrastructure. To alleviate the energy crisis and government regulations about safety, the building automation and air quality markets are demanding more and more sensing and control expertise.

How are you altering your sensor designs to address the needs for industrial applications?

Bruce Ulrich, Wireless Product Line Director, ams: We have developed optimized semiconductor processes that enable low-power products. We will continue to focus on improving our unique semiconductor processes to achieve the highest performance at the lowest power. These processes need to support the

power, operating temperature, and reliability needs of the industrial market while achieving best-in-class performance.

Karthi Gopalan, Sensor AFE Marketing Manager, Sensor Signal Path Products, Texas Instruments: The world is analog and the ability to precisely capture these diverse vectors is critical for energy efficiency, better decision making and safety. The variety of real world sensors are typically voltage output types such as temperature, RTD, load cell, and pressure sensors as well as current output types such as gas, thermopiles, photo diodes and electro-chemical sensors just to name a few. The analog technical challenges and sources of errors that affect a precision design such as sensor impedance, bias currents, noise, voltage offsets and drift, grounding and guarding are ubiquitous. For even the most experienced analog designer, this is a very time consuming task. TI recognizes this and wants to help the system designer develop hardware solutions as quickly as possible so that time can be spent on differentiating the end product from the competition. TI's sensor AFE devices process and convert these signals with great precision and less effort on the part of the design engineer.

The integrated solutions incorporate the right application features that enable, for example:

- Longer battery life.
- More time between calibrations.
- Compensation over temperature.
- Less interference with hand radios.

Are you finding that you need to customize sensors for different applications? If so, how?

Bruce Ulrich, Wireless Product Line Director, ams: We have seen a migration of sensors from the industrial to the consumer space. Similar to how DSP migrated from defense to consumer, we are seeing sensor technologies that were refined in industrial applications find new homes in portable devices. These new applications increase the need for low power as well as no load on the microcontroller. This requires sensors designed for each application to include the unique microcode required to operate independently in that application. In other words, smart sensors.

Karthi Gopalan, Sensor AFE Marketing Manager, Sensor Signal Path Products, Texas Instruments: Let's take the toxic gas detection. For these multi-sensing applications the sensor AFEs offer advantages over traditional custom designs where multiple gases need to be sensed with the same instrument. The detectors have varying dynamic range of the currents to be detected depending on the end application and type of toxic gas (30+ gases) being detected. Some toxic gas sensors have a full-scale range of 600 µA and a sensitivity of 10 nA/ppm, while others have a full-scale range of 10 µA and a sensitivity of 1 nA/ppm. Another example is the fixed safety instruments that are wall powered and wireless, which are very different from the personal safety portable gas detectors that are never

fully powered down due to the long turn-on time constants of the sensors. It is critical to provide multiples modes of operation for the later. During normal operation, the gas sensor is being monitored and power consumption is 10 µA. In standby mode, where the sensor is still being biased to allow for a quick recovery time (seconds vs. hours) but no actual measurements are made, the power consumption is 6 µA. With the configurable sensor AFEs, the system designer is able to dynamically adjust the vectors of the signal path depending on the end application needs.

Conclusion

Wireless sensing is a new, promising field in sensor technology. Measuring data using wireless transmission is by no means new to the industry, but does have enormous potential that has recently become very apparent. For both, industrial and consumer industries, the applications are endless. The benefits do however bring a number of challenges, which is why adoption has developed slowly up to now. With continuous developments in this area, however, many challenges have been faced and overcome. One example in particular is lack of reliability. End users are increasingly accepting new applications, and are beginning to put much more trust in sensor-enabled systems. Sensors have exploded into new application spaces and are continuously proving their ability to solve real everyday problems. Sensor technologies, hand-in-hand with new applications, are advancing at a rapid rate, and have infinite opportunities.

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