ELE Times: Technology, Modernisation and Innovation of Semiconductor IC sensors.

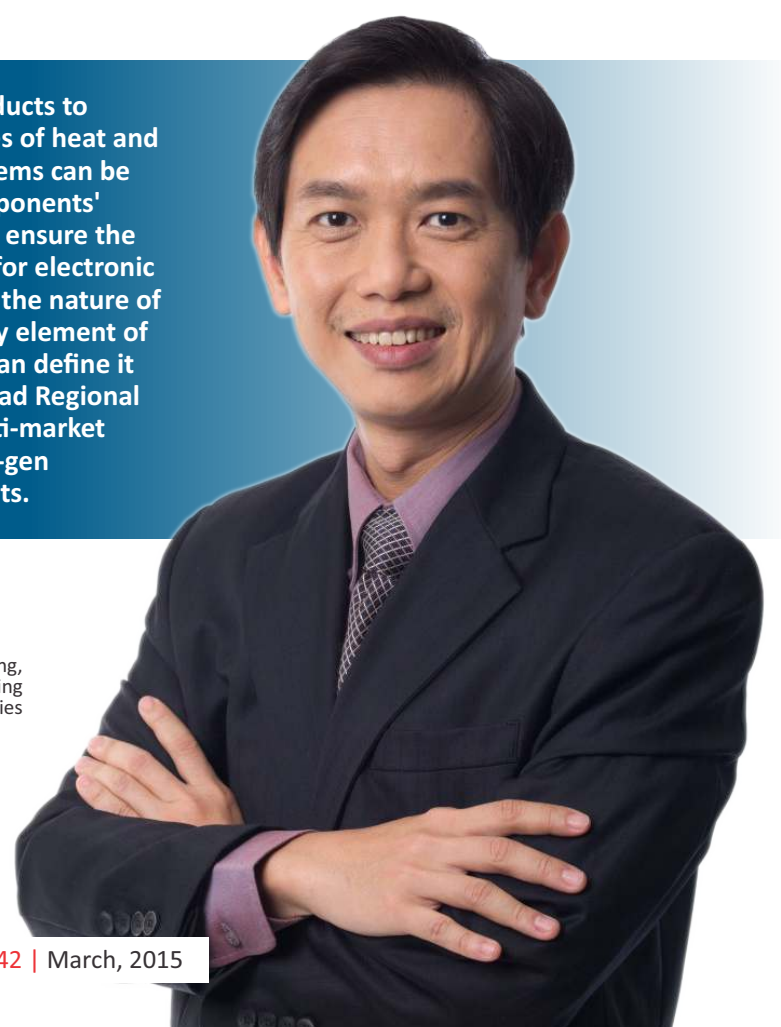
Andy Wong: Sensors transform physical readings such as barometric air pressure, car tyre pressure or various magnetic fields into electronic signals, which can then be processed further. To do this, the sensors have to be in direct contact with the outside world, often functioning as standalone satellites that are not part of a protected circuit board. Subjected to the harsher conditions they remain exposed significantly to harsher mechanical, environmental, chemical and electrical forces than the conventional semiconductor devices. The ability to withstand these environments calls for special packaging technologies, dedicated silicon processes and robust sensing elements – making sensor ICs complex and challenging devices to manufacture.

ET: What is driving demand for miniaturized sensors?

AW: Consumers' appetite for smarter mobile gadgets is driving demand for miniaturized sensors. The prolific growth of mobile 'Apps' for lifestyle, utility, gaming and personal well-being, as well as trends on smart home, smart factory, smart car and the IoT universe are building the case for a wide range of sensing applications that call for thinner and tinier form factor, more sensitive and robust sensing best met by semiconductor IC sensors. Some examples

Energy efficiency is key to diminish global industrialization impact on environment

All electronic systems, from portable consumer products to precision industrial devices, are affected by extremes of heat and cold. If not protected, the components in these systems can be damaged by temperatures that fall outside the components' operating ranges. Several strategies have evolved to ensure the maintenance of safe temperature operating ranges for electronic systems. The best protection technique depends on the nature of the system and its most sensitive components. A key element of any technique, though, is the sensing device. Who can define it better as ELE Times catches up with Andy Wong, Head Regional Marketing, Automotive Division, industrial and multi-market segment in Infineon Technologies illustrate the next-gen technology of the Semiconductor Sensor ICs. Excerpts.



Andy Wong,
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of advanced sensor technologies enabling the development of smarter applications:

Indoor Navigation and Assisted Location Systems

An indoor navigation tool is able to provide for example a new floorplan on the user's mobile device as the user moves from one floor to another. Both GPS and wireless connectivity have their limitations in addressing indoor navigation especially within a multi-storey building. Indoor navigation requires accurate height information of the transient state, referring to a person moving from one floor to another. The accurate height change can be calculated from data of a barometric air pressure sensor. The temperature changes during the measurements can be compensated by calibration.

Activity Tracking and Sports

Similarly, information gathered from activity tracking for sports or well-being is more realistic with the availability of temperature compensated, accurate height information. With sensor fusion, height information from a barometric air pressure sensor combined with motion information from accelerometers and gyros can be analysed by a set of algorithms to provide more accurate monitoring of a user's activity level and calorie burn rate.

Miniaturized digital barometric air pressure sensors based on MEMS semiconductor process and capacitive sensing technologies offer a new level of accuracy, precision, low current consumption and small form factor well suited for indoor navigation, activity tracking and weather station applications on mobile and wearable devices. Aaccurate height and location information is also one of the prerequisites of seamless device to device communication in IoT universe.

Gesture recognition in 3D space

Gesture recognition simplifies and enhances the way people interact with machines. Gesture recognition will dramatically change the way people control computing and consumer electronic systems, changing user experience and enhancing productivity the same way that the mouse did decades ago with the PC. It is made possible by fast and reliable tracking of finger movements and hand gestures that can be accomplished with 3D image sensor chips.

3D image sensor chips require a high level of integration including the photosensitive pixel array, sophisticated control logic, digital interfaces with ADCs (Analog-to-Digital Converters) and digital outputs. This high level of integration enables the design of very compact and accurate monocular systems for gesture recognition applications in computers and consumer electronics devices. The chips are delivered as bare die for integration with camera lens and Infra-Red (IR) illumination source in a camera module.

ET: What are the Innovations Moving through the Automotive Sensing Innovations?

AW: Robustness and Redundancy are key drivers of automotive sensing innovations. In the automotive world, sensors are used in mission critical applications to ensure the safety of the occupants. A typical electric power steering (EPS) system needs two sensor chips for reliable and precise sensing of the steering torque. These are the Hall Effect torque sensors and GMR/AMR (Giant Magneto Resistance / Anisotropic Magneto Resistance) angle detection sensors. With increased ISO 26262 requirements for safety critical applications, sensor redundancy is of particular interest for new generations of EPS systems. Conventional side-by-side sensor methods detect different magnetic fields. This means the magnetic field must be stronger than the one detected with single sensor. This leads to larger packages, the need for stronger more expensive magnets, and field variations due to the distance between the two sensing elements. Using larger, more expensive magnets also results in design effort needed for exact magnetic field trimming.

The dual-sensor package integrates two linear Hall sensors or two angle sensors. Both sensors have separate power supply and separate signal outputs. They are electrically independent due to galvanic isolation. Both the sensors work independently thus increasing the reliability of the system. These smaller, less expensive magnets can skip the effort on magnetic field trimming, reducing system cost. These advantages are not only in EPS, but repeated in throttle control, pedal position and brushless DC motor control in such areas as EPS motors, transmission and clutch actuators.

ET: Taking on the note for environment friendly electronics; sensor systems key role on to devote a next eco-friendly smart world?

AW: Energy efficiency is key to diminish global industrialization impact on environment. Innovative and connected sensor systems are an essential component for the detection of air quality in modern building management systems. One of the focuses of research and development is on new low-power connected sensor systems, based on semiconductors and heterogeneous 3D integration for the detection of environmental parameters such as CO2, CO or humidity. The first applications targeted will be those that require highly reliable information about environmental conditions in order to deduct measures that help to reduce the use of energy. Hall switches and magnetic angle sensors, for example, are ideal solutions for current commutation in brushless drives (BLDC). Many applications require conventional block commutation – and Hall Switches are the perfect fit here. Efficiency levels can be raised further by directly measuring the rotor angle. This saves energy and eliminates vibrations, which in turn cuts noise levels and ensures smoother integration.

Another example is the Tyre Pressure Monitoring System (TPMS) which not only helps to raise car safety levels by warning drivers of any loss in tyre pressure, but also improve energy efficiency. A car with tyres that are not fully inflated consumes more fuel and the tires wear down more quickly.

ET: Infineon expertise in the sensor applications and its reach through the market?

AW: Infineon is a strong partner for sensor applications and as a broad line supplier, Infineon draws upon 40 years of experience in sensor design and production and the broadest magnetic sensor portfolio in the market. The company sold more than two and a half billion integrated magnetic and pressure sensors over the past ten years. Infineon is number one in wheel speed sensors and number one in pressure sensors for side airbags as well as for tire pressure monitoring systems. On average, 20 magnetic and low pressure sensors are used per car, today. Four of these are provided by Infineon. In EPS Infineon also ranks number one with a market share of about one third. As strong partner, the company provides more than one million sensors per day to the automotive market.