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Strategies and Tools for Navigating and Thriving in Uncertain Times

The Enormous Potential of Smart Sensors

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Smart sensors perform analysis on the data they collect by means of on-board miniature microprocessors. This technology has the potential to revive key American economic sectors and improve others, including automotive, aerospace and defense, industrial, medical and homeland security applications.

Much of the attraction of smart sensors lies in their ability to provide real-time measurements of complex phenomena; for example, the clearance of a turbine blade tip and casing in an aircraft engine, the movement of an automobile entering a skid, or the formation of a weld seam by a robotic welding machine. These data are typically processed by custom-designed algorithms — often proprietary to the sensor designer — that will convert it to useful information that can improve processes, cut costs and, in some cases, save lives. Incidentally, the software is not always designed by the sensor manufacturer; a number of companies have worked with software developers to tailor new products that match the needs of the smart sensors' end users.

Currently depressed industries can leverage smart sensors to reverse their fortunes. An example is car makers, who can employ these intelligent instruments to improve vehicle safety by incorporating the devices in the skid prevention system. Simply, this system will increase or decrease the support of the power steering to support the driver performing the appropriate steering maneuver to correct a given situation. Smart sensors form the heart of anti-rollover systems that alert sleepy drivers if they are swerving. The devices can help automakers improve driver comfort in their vehicles through the development of smart heating, ventilation, and air conditioning systems, and make them more energy efficient to boot, extending battery life.

Industrial manufacturers are on a constant quest to monitor and control multiple parameters to maintain the highest quality on their production line. The factory floor environment, for example, near a furnace, is hostile to traditional wired sensors, but smart sensors with on-board microprocessors and wireless communication can link multiple intelligent instruments through a production line, reducing maintenance downtime, scrap rates, and improving a manufacturer's production bottom line.

For example, a smart sensing system can follow the parameters of a welding seam, adjusting a robotic welder to optimize the weld, and improve throughput and efficiency of the manufacturing process. Advanced technology manufacturing, such as photolithography, can use smart displacement sensors to enable ultraprecision engineering and make lower cost products that can build a larger market for themselves.

Medical instrument makers can use smart sensors to address an aging population that has increased the number of patients that need monitoring continuously for medical purposes, particularly men and women recovering from cardiac or cancer surgery or other procedures. Medical equipment makers can use smart sensors to design compact, low-cost alternatives to the bulky, expensive equipment typically used to monitor these patients, and deliver critical data to physicians or emergency responders, if necessary. A good example would be a tiny, implantable sensor to monitor blood pressure and heart rate in patients.

Manufacturers of heating, ventilation and air conditioning (HVAC) systems are acutely aware that their products are the major consumer of energy in buildings. With a greater emphasis on less energy consuming technologies, HVAC makers can incorporate smart sensors in their systems to optimize their performance to create the electricity in the first place.

The anticipated surge of up to 30,000 American troops in Afghanistan presents an opportunity for smart sensors in defense applications. Even in the 21st century, some 10% to 15% of wartime casualties are caused by our own weapons. Smart radar tag sensors can be installed on military vehicles or carried by ground troops to identify friendly forces to attack aircraft or artillery.

Here at home, there is another industrial sector that straddles instrumentation, transportation, security, information, defense and law enforcement: Homeland Security. Smart sensors can jumpstart instrument makers for a number of Homeland Security applications.

Wireless communication providers can incorporate smart radiation detectors into their produces to instantly detect if illicit radioactive material — that could be used to make a so-called "dirty bomb" is being smuggled in a shipping container and to alert authorities just as quickly. This will also cut down the security bottlenecks at ports and streamline the delivery of goods to market, benefiting shippers worldwide. Similarly, video surveillance camera makers can incorporate such sensors into their products at ports of entry and border crossings to detect radiant material. They can employ chemical and biological-based smart sensors to detect those threats in similar installations.

As smart sensors' potential is realized in these various industries, the general population, too, will benefit from better, safer vehicles, improved medical devices and more sophisticated protection at home and abroad. In short, the enormous potential of smart sensors extends beyond American industries — these tiny devices have the potential to drastically improve our quality of life.