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Sensor Market Trends

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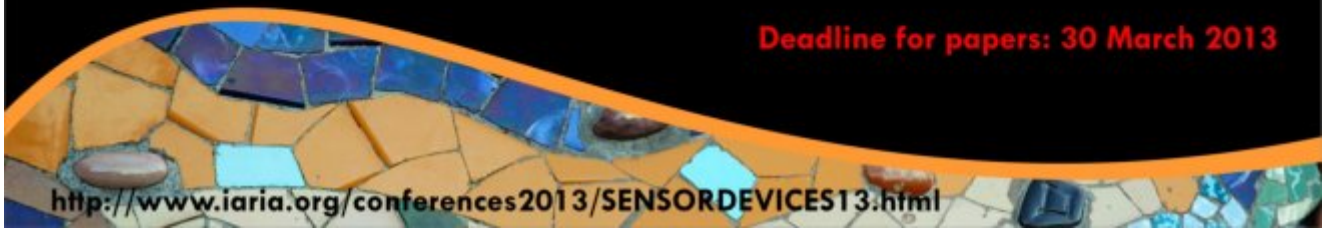

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Constantly Evolving Smartness, Intelligence and Innovation Ensure Seamless System Integration

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1. Overview

The use of sensors is growing in most end-user applications. With the increased level of accuracy, the reliance on sensors is on the rise as never observed before. The reasons for increased use of sensors are attributed to:

- Achieving desired quality;
- Reduce energy consumptions;
- Enhance system efficiency;
- Ensure alleviated control system;
- Have ability to meet increased demand.

To achieve these multiple goals, sensor manufacturers and automation companies are constantly striving to improve sensitivity of sensors. They are increasingly striving for:

- Industry collaborations;
- Developing common standards;
- Developing alternatives;
- Maximizing compliances of common standards / alternatives;
- Maximizing higher accuracy and control.

In order to maximize the systems return on investment, high-level of accuracy, instant response time, and assured lifetime performance are expected to be the main end-user selection criteria for sensor systems.

2. Technology Response

To achieve the challenges, technology needs to orient to changing needs. Newer application and continuous product development drive sensors to effectively brace such challenges. Multipronged strategies by sensor manufacturers, research organizations and universities continued to invest in innovative development of new products and technology. This gave rise to newer applications too. The first step of this strategy has been to improve and upgrade existing products, as well as perfect existing technologies in order to achieve:

- Improved component functionality;
- Ensure system integration;
- Improved monitoring and control.

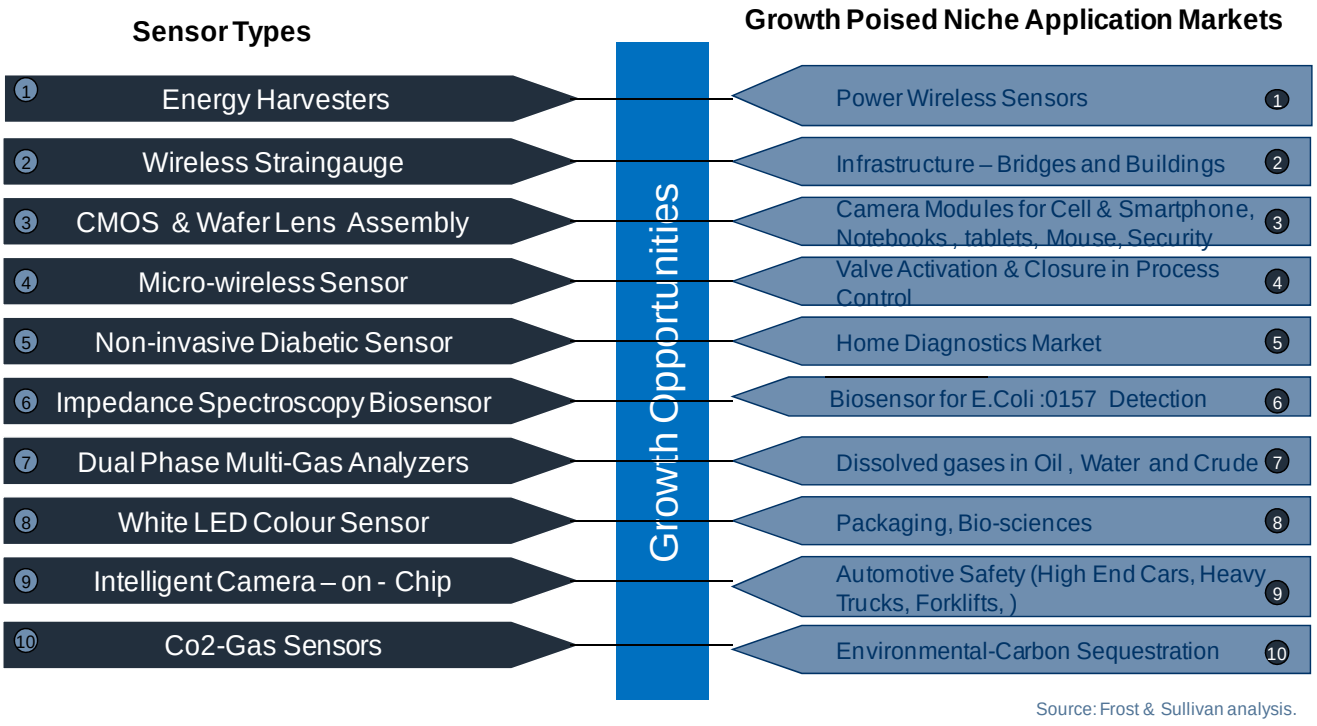
As the device and component functionality started improving, the next natural step is to achieve system integration for effective monitoring and control at all levels, which includes at the device, sub-system and system levels, specifically below the distributed control system (DCS) and programmable logic controller (PLC) levels. These efforts have resulted in the increased use of sensors and sensor-based instruments. Sensors are experiencing larger deployments in both process and discrete sectors in the manufacturing space. In addition, this integrated monitoring and control approach has got replicated systems used in other sectors like service, infrastructure, environment, security, test, smart grid and research and development. The inbuilt functional flexibility of sensors that lead to strict monitoring and improved control in manufacturing resulted in improved yields, higher productivity, reduced down time and cost reduction.

3. Key Achievements

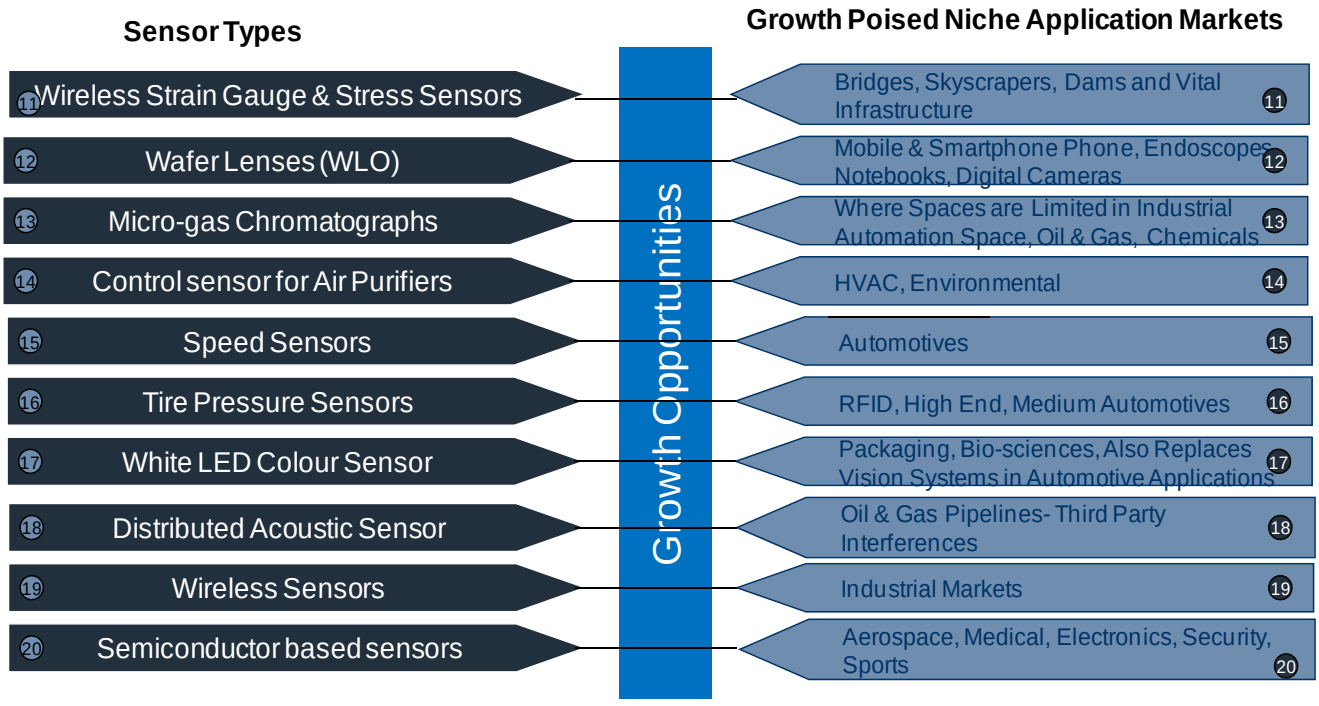
Keeping in mind main end-user selection, criteria high-level of accuracy, instant response time and assured lifetime performance have been the main stay of technology platforms achieved so far. Small footprints and miniaturization along with increasing level of intelligence in sensors are trends that are expected to continue to dominate for a long time to come. To ensure that even the sensors that are deployed in difficult to reach areas stay connected, increasingly sensors with wireless compatibility are developed; however users are still guarded in while adopting these sensors. To ensure the continuous power supply to these wireless sensors, low power energy harvesters have been developed. This development of energy harvesters is still at the nascent stage as they still only meet mini and micro power requirements. Software and encapsulations have been developed to ensure wireless network security. Soft sensors and algorithms are taking over some of the physical functions and this reliance on soft sensors is on the rise. The use of wireless sensors and network technology still has to deal with certain challenges. Another important development has been embedded sensors and circuits that are strengthening. Most embedded sensors are expected to move toward chip-level integration and have diagnostic capabilities. Currently sensors impart intelligence to systems, which enable them to diagnose any issues and take corrective action for uninterrupted production.

4. New Developments

Sensor companies are upbeat and dynamic as they are continuously striving to improve, upgrade and innovate. Their efforts and initiatives have resulted in a number of niche applications poised for growth in the market. Recent developments truly fulfill needs of diverse end-user markets spanning from infrastructure applications to home diagnostics. Some of these developments include:



Source: Frost & Sullivan analysis.



Source: Frost & Sullivan analysis.

In addition to the above mentioned developments, multiparameter monitoring sensors are increasingly being developed, such as combined sensors. Temperature and humidity sensors are combined and pressure and flow sensors are conjoined in such a way that sense and monitor both of these parameters simultaneously with a high level of accuracy. Sensor developers and manufacturers are also exploring improvements in non-contact technologies encouraged by an increasing use of such technologies. Non contact technologies such as infrared, ultrasonic, optical and acoustics are increasingly explored to replace the existing contact technology applications selectively and improve them to meet newer applications. Sensor technologists are exploring to use particular sensors in a very different way than for what they were developed. For example, distributed temperature sensing systems (using temperature sensors) have been very effective in detecting leakages in oil pipe lines. Likewise,

acoustic waves using fiber optic sensor cable is another platform that has recently been developed for detecting pipeline leakages applications. Sensors technologies are increasingly explored for such diverse applications.

5. Future Expectations and Challenges

Sensors are capable to provide solutions to most difficult problems in the industrial, consumer and service markets. Reliance on sensors is on the rise ensuring seamless integration at the manufacturing plant control systems and monitoring systems from consumer products to infrastructure and service sectors. Emphasis on green initiatives, security monitoring and making consumer electronics more meaningful are challenges with the exceptions to increasingly find sensor solutions.

Sensors are likely to be vital to drive efficiency and operational improvements for green initiatives such as carbon dioxide sequestration applications. Future key opportunities are likely to be in water footprint, effluent treatment, greenhouse gas reduction and waste management infrastructure.

Increased deployment in coal and gas based power generation plants below the PLC level in order to maximize coal calorific value use and increase power output. Greater reliance on sensors is likely to be observed in order to minimize power transmission losses (smart grid) and improve consumption efficiency at the consumer's end.

Large scale investment opportunities in alternative energy sources, particularly in wind, solar, biomass, geothermal and biofuels, is likely to stimulate development and large scale use of sensors.

With zero tolerance for any unwanted intrusions, the extensive use of sensors in surveillance, security and safety has already begun. These applications are experiencing sensor fusion by using input from diverse sensors like image, RFID, dog noses, biosensors and a host of unattended sensors. Sensor fusion is likely to experience large scale use in the future in the security space.

Infrastructure monitoring of bridges, dams, water treatment plants and commercial buildings provides a large growth opportunity for sensor proliferation into this important sector.

Noninvasive biosensors are likely to make their presence felt in medical applications both in point of care and diagnostics.

While Image sensors and biosensors are expected to strongly penetrate into the defense, security and environmental markets.

An extensive use of sensors in consumer electronics, such as cell phones, laptops and tablets are likely to enhance their utility value. In fact, sensors are liable to proliferate heavily into these consumer products.

Finally, Wireless sensor compatibility is expected to permeate through all sensor types and vertical market applications.

6. Conclusion

The sensor market is very dynamic with both revenue growth rates and unit shipments growing due to an increasing annual rate. Sensors are also proliferating into almost every end-user market, from the automotive sector to consumer and industrial. The reliance on sensors is increasing throughout these

various sectors- even human interface with sensors is on the rise. Sensors truly are unique enablers that no other product can match.

For more information or any questions on this article, you may also contact Jeannette Garcia, Frost & Sullivan Corporate Communications Associate at Jeannette.Garcia@frost.com or tel.: 210.477.8427.

Sensors & Transducers Journal

Guide for Contributors

Aims and Scope

Sensors & Transducers Journal (ISSN 1726-5479) provides an advanced forum for the science and technology of physical, chemical sensors and biosensors. It publishes state-of-the-art reviews, regular research and application specific papers, short notes, letters to Editor and sensors related books reviews as well as academic, practical and commercial information of interest to its readership. Because of it is a peer reviewed international journal, papers rapidly published in *Sensors & Transducers Journal* will receive a very high publicity. The journal is published monthly as twelve issues per year by International Frequency Sensor Association (IFSA). In additional, some special sponsored and conference issues published annually. *Sensors & Transducers Journal* is indexed and abstracted very quickly by Chemical Abstracts, IndexCopernicus Journals Master List, Open J-Gate, Google Scholar, etc. Since 2011 the journal is covered and indexed (including a Scopus, Embase, Engineering Village and Reaxys) in Elsevier products.

Topics Covered

Contributions are invited on all aspects of research, development and application of the science and technology of sensors, transducers and sensor instrumentations. Topics include, but are not restricted to:

- Physical, chemical and biosensors;
- Digital, frequency, period, duty-cycle, time interval, PWM, pulse number output sensors and transducers;
- Theory, principles, effects, design, standardization and modeling;
- Smart sensors and systems;
- Sensor instrumentation;
- Virtual instruments;
- Sensors interfaces, buses and networks;
- Signal processing;
- Frequency (period, duty-cycle)-to-digital converters, ADC;
- Technologies and materials;
- Nanosensors;
- Microsystems;
- Applications.

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Articles should be written in English. Authors are invited to submit by e-mail editor@sensorsportal.com 8-14 pages article (including abstract, illustrations (color or grayscale), photos and references) in both: MS Word (doc) and Acrobat (pdf) formats. Detailed preparation instructions, paper example and template of manuscript are available from the journal's webpage: http://www.sensorsportal.com/HTML/DIGEST/Submition.htm Authors must follow the instructions strictly when submitting their manuscripts.

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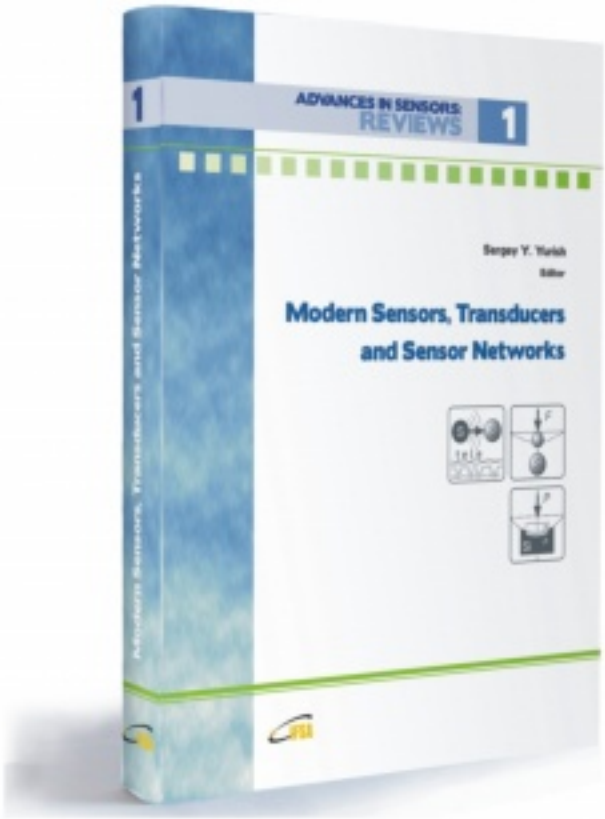
ADVANCES IN SENSORS: REVIEWS 1

Sergey Y. Yurish
Editor

Modern Sensors, Transducers and Sensor Networks



Modern Sensors, Transducers and Sensor Networks is the first book from the Advances in Sensors: Reviews book Series contains dozen collected sensor related state-of-the-art reviews written by 31 internationally recognized experts from academia and industry.

Built upon the series Advances in Sensors: Reviews - a premier sensor review source, the *Modern Sensors, Transducers and Sensor Networks* presents an overview of highlights in the field. Coverage includes current developments in sensing nanomaterials, technologies, MEMS sensor design, synthesis, modeling and applications of sensors, transducers and wireless sensor networks, signal detection and advanced signal processing, as well as new sensing principles and methods of measurements.

Modern Sensors, Transducers and Sensor Networks is intended for anyone who wants to cover a comprehensive range of topics in the field of sensors paradigms and developments. It provides guidance for technology solution developers from academia, research institutions, and industry, providing them with a broader perspective of sensor science and industry.

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