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Forecasts and Modern Sensors Market: Today's Revolution Changes

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1. Past Forecasts and Predictions

Any forecast and predictions in MEMS and sensors markets after the last high-technology crisis must be grounded on solid analysis of past and today's realities in order to be really useful and faithful. So, at first, lets look back through the vistas of the past.

As far back as 1961 professor P.V. Novitskiy wrote: *"... In the future we can expect, that a class of frequency sensors will get such development, that the number of now known frequency sensors will exceed the number of now known amplitude sensors...*" [1]. It has been predicted also in the technology forecast [2]: "*Many basic measurements will be related to or measured by time/frequency techniques. This situation will occur because of the increasing facility and accuracy provided through time frequency measurements… Frequency and computing counters can be expected to become smaller, lighter and cheaper, provide direct frequency readout and will be more universally used… Progress will continue in the field of time and frequency during the next five years and will contribute materially to the state of the art in electronics*". Although there are frequency (time) output sensors practically for any variables, this prognosis has not been fully justified in the full because of some objective and subjective reasons.

2. Today's Realities

As integrated circuit manufacturers continue to improve micro-electro-mechanical systems (MEMS), demand will rise for smart sensor, which are created by combining traditional sensor technologies and microchip. The promise of using MEMS for sensing, computation, and communication will open these markets to new end user groups while enticing new participants into the marketplace [3].

There are a lot of new technologies, suitable for sensors creation. But still there is a problem how to joint them and use in a frame of sensor systems. A lack of approved standard interfaces for smart sensor networking is a serious

challenge for manufactures. Implementation of standards would enable sensors to be networked in the distributed measurement and control systems used in industrial processes. Although the IEEE has proposed some standards, they are inadequate for many companies since they require integration of analog-digital converters and microprocessors into sensors [3].

"*Smart sensors are currently twice the price of traditional, analog sensors*", says *Frost & Sullivan*. These high prices are due to the specialized components that are used in their design. Despite the added benefits of smart sensors, end users will remain reluctant to use them until price are reduced.

"*Companies must develop lower cost products to increased market share and broaden their customer base*", writes *Frost & Sullivan*. For participants that can lower prices, high-volume markets await, such as automotives and consumer electronics.

According to IFSA studies, frequency-time domain sensors with frequency, period, duty-cycle, time interval, phase-shift, pulse number output take 25 % in modern sensors markets (Figure 1).

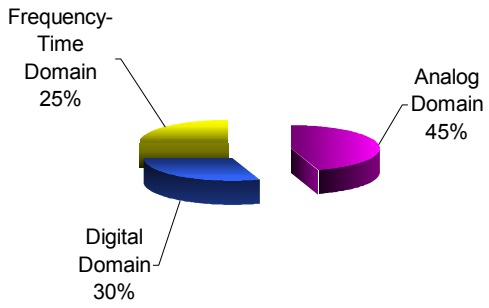

Fig. 1. *Classification in Terms of Sensors Output Signals (IFSA studies, 2004)*

3. The Future

All past predictions will become true in the nearest future due to combination of modern technologies and advanced novel conversion and signal processing methods for frequency-time domain signals and use both for sensors creation. Moving from the traditional analog (voltage and current) signal domain to the frequency-time signal domain (frequency, period, duty-cycle, time interval, phase-shift, etc.) lets achieve many benefits due to properties of frequency as informative parameters: a high noise immunity and output signal power; wide dynamic range; high accuracy of frequency standards (references); simplicity of communication, interfacing, integration and coding. No output standardization (signal unification) is necessary as in the case of analog signal domain. New advanced conversion methods play a role of bridge between many different technologies at smart sensor systems design [4].

The best modern approach for smart sensors creation is to use both modern technologies and advanced methods for signal processing and conversion. Many type of sensing elements and read-out circuitry can be merged by this way on a single chip or in SoC. *International Frequency Sensor Association (IFSA)* has initiated such kind of research with the aim to establish precise frequency-time measurements with all its benefits as an alternative to traditional analog measuring procedures in the area of sensor technology, and to exploit the great potential for application in the industry [5]. In additional such approach gives an opportunity to create new self-adaptive smart sensors.

To target at a cost-driven industrial market, a low-cost high-performance highly flexible universal Frequency-to-Digital Converter (UFDC-1) IC has been developed. It can be used for any frequency-time domain signal like standard ADC for analog signal domain. Sensors manufacturers will be able simply integrate the UFDC-1 in microsystems and digital sensors in order to produce a serial output or bus capability. Device's applications are numerous: any frequency-time domain sensors including smart sensors (due to the programmable accuracy and non-redundant conversion time); high-end, mid- and low-range ABS; desktop and handheld multifunctional frequency counters for industrial measurements; multimeters for frequency-time parameters of signals; tachometers and tachometric systems;

DAQ systems (boards) for frequency-time parameters and virtual instruments (Figure 2).

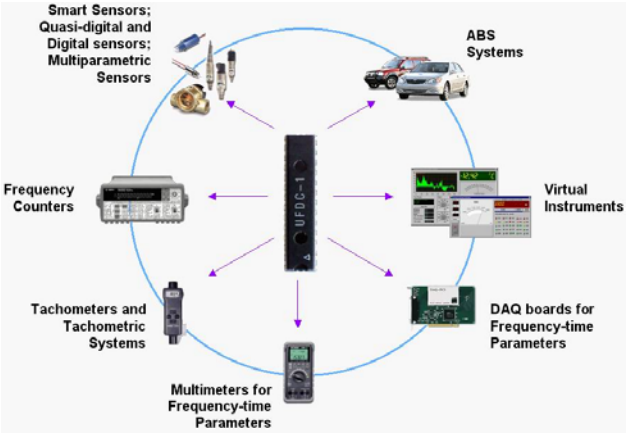

Fig. 2. *The UFDC-1 Applications*

Driven by rapid advances in technology and design and by new commercial applications, the market for sensors and related technologies will be expanding at a phenomenal rate. By 2008, the worldwide sensor market is expected to exceed $ US 50 billion [6]. It will be the next wave of infotech innovation and sensors will completely reshape the information landscape by enabling interaction between the digital and analog worlds [7].

According to *The Freedonia Group* the USA market for sensor products (sensors, transducers and associated housing) is projected to increase 6.7 % per year through 2006 to US $ 13.4 billion. The fastest growths will occur in sensors based on advanced, sophisticated technology – especially MEMS and optoelectronics – and/or used in dynamic applications such as automotive telematics and information technology. Also holding good prospects are imaging sensors [8].

Based of the forecast, the following predictions for the nearest future can be done:

- Frequency-time domain sensors become more and more popular among users and system integrators;
- Its part (and digital output sensors on its basis) in the sensor market will be significantly increased during the next 4-5 years and share more 80 % (Figure 3) in comparison with today's 55 % (Figure 2);

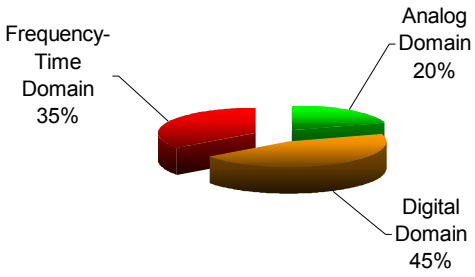

Fig. 3. *Classification in Terms of Sensors Output Signals (IFSA forecast for 2008)*

- Many manufactures will continue to produce sensors and transducers with combined (digital and analog) output;
- Sensor systems will be more accurate and multifunctional;
- Smart self-adaptive sensors will also have a good market niche due to the sensors price reduction;
- The UFDC-1 chip will enable fast prototyping of modern, novel sensor systems, using low-cost components, as well as for sensor systems that will be designed in the future.

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