



Embedded Sensors – Small dimensions, big differences

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Change – the only constant

- Change is occurring faster than ever before
 - Caused primarily by technology advances
- The technology treadmill



Process automation & controls

- We moved during the last 50 years
 - From pneumatic controls (some still around)
 - To electronics (vacuum tubes) to transistors to integrated circuits
 - Direct Digital Controls (DDC) gave way to Distributed Control Systems (DCS)
 - Now we have networked PC-based control systems



Discrete Automation

- Contactors relays and motor controls became programmable logic controllers offering better alternatives for control
- PLCs are now a commodity business
- Software
 - Hard-wired relay-ladder-logic became programmable
 - Programmable via PC software
 - Embedded software



New age connectivity

- Every digital and analog I/O point is getting "connected"
- Eliminating the old "islands of automation"
- Introducing visions of vast arrays of interconnected "appliances".



Smart “appliances”

- Information needed from each product
 - History, part number, where purchased, when installed, by who, key characteristics, specifications, operating instructions, diagnostics, availability of spares, replacement alternatives, repair instructions, etc.
- In the past, this information would be in printed documentation, or with trained experts.
- In the future, the I/O appliance itself will contain all of the required “knowledge”, embedded within it and always accessible



Technology Moves on

- Today large, expensive and dumb
 - Sensors lack intelligence - they simply provide measurements for remote processing
- Tomorrow tiny, cheap and smart
 - MEMS and Nanotechnology will yield tiny, low cost, low power sensors
 - Tiny is important – scattered around to measure just about everything that you can imagine.
 - Low power – won't need to carry a large battery
 - Low-cost – numbers required will be enormous.



Automation inflection points

- Wireless sensors everywhere
- MEMS - Microelectromechanical systems
- NEMS - Nanotechnology
- Complex adaptive system (CAS)



Wireless sensors everywhere

- Wireless sensor networks will soon become as important as the Internet.
- Just as the Internet allows access to digital information anywhere, sensor networks will provide vast arrays of real-time, remote interaction with the physical world.
- The process monitoring and controls business will be generating significant growth in this new arena.



Smart wireless networks

- Will soon be everywhere around us
 - Collecting and processing vast amounts data
 - not just monitoring a few isolated sensors, but literally tens of thousands of intelligent sensor nodes
 - Providing not merely local measurements, but overall *patterns* of change.



MEMS

- Microelectromechanical systems (MEMS)
 - Semiconductor fabrication techniques
 - Miniature turbines, motors, gears, moving mirrors
 - Sensors, actuators, and displays
- Size and cost bring practical utilization
 - Tremendous number of old and new applications



Nanotechnology

- Small dimensions, big differences
 - At nanometer dimensions, the classical laws of physics change
 - New materials - smaller, stronger, tougher, lighter, resilient
- Practical nanotech materials
 - Different characteristics when "assembled" at a molecular level
 - Carbon nanotubes - strongest and most conductive fibers
 - Nano-structured membranes for efficient filtering of pollutants
- New gadgets galore
 - Today's supercomputer – tomorrow's wristwatch or PDA
 - Tiny, inexpensive nanosensors - wireless networks, medical diagnostics, chemical and biohazard detection
- Carbon nanotube transistors
 - Smaller than any possible silicon transistor, better performance
 - New ways of storing information



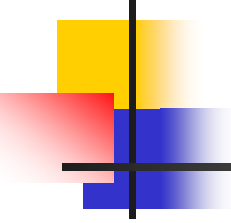
NEMS

- Nanotechnology - products at atomic-scale
 - Nanoelectromechanical systems
 - Next step beyond MEMS
- Old-style metal bending, grinding and cutting will become obsolete
- Build-to-order
 - Materials with flawless internal structures
 - Stronger and lighter, less wear
- Electronics will get smaller and faster
 - Atomic-scale quantum effects – computing performance beyond today's wildest dreams



Complex adaptive systems

- New self-organizing, peer-to-peer networks
 - Intelligence resides directly in sensors and actuators
 - Eliminating large, complex, and ineffective centralized control systems
 - Today's PLC and PC-based controls & software will seem ineffective, expensive, and even archaic
 - CAS provides a level of effectiveness and robustness that is unprecedented
 - Old deterministic control architectures will disappear.



New functions & applications

- Within the next few years, significant new technology will provide completely new functions
 - Optimize widely spread processes
 - Provide vast productivity and quality improvements in process systems.



Related Links

- The Pervasive Internet & its effect on industrial automation:
<http://jimpinto.com/writings/pervasive.html>
- Wireless Sensor Networks:
<http://jimpinto.com/writings/sensornetworks.html>
- Network Choices - the Wireless Revolution:
<http://jimpinto.com/writings/networkchoices.html>
- Pervasive Networks:
<http://jimpinto.com/writings/pervasivenetworks.html>
- Near-term Nanotechnology:
<http://jimpinto.com/writings/nearnanotech.html>
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