FOREWORD

I am happy to know that our students are bringing out a magazine for the department "SMARTIN". The wide-spectrum of articles in different sections gives us a sense of pride that our students and teachers possess creative potential and original thinking in ample measures. Commendable job has been done by the Editorial Board in planning for and producing the news letter. I convey my congratulations to the team who took the responsibility for the arduous task most effectively. The EIE Department has a vision to evolve as a department with a difference in terms of quality and innovation. I request all my students to concentrate on studies, co-curricular and extracurricular activities by the vision in mind and bring laurels to the department. My Heartfelt Wishes to all.

Dr. A. Senthil Kumar,
Professor and Head,
EEE/EIE

PREFACE

The young bud (just two years old) of Dr. MCET, the EIE Department, has now launched its first ever technical magazine, SMART-IN. We congratulate all the students of EIE for their constant involvement and collective effort in making this dream come true.

All that you are being taught and studying in colleges are theories. After the successful completion of your course when you join an industry you are not at ease in understanding the industry-life problems and the latest technological applications. You would not feel at home, albeit you know all the work related basics and fundamentals. A combination of practical and theoretical knowledge alone could help us immensely to perform better.

This magazine attempts to bridge the gap between the theoretical knowledge possessed by the students and the real applications in the industries. As we know **SMART** stands for **Self-Monitoring, Analysis and Reporting Technology**, this magazine, SMART-IN proposed to be released once in every semester, will serve its purpose with updates of latest technological information and recent applications in SMART Instrumentation.

Mr.Balaji Madhavan,
AP (SS) /EIE Dept.

FROM EDITOR'S DESK

Please delight your way through our exciting columns in this magazine. We invite our leaders to respond to us with valuable suggestions, so that we can genuinely shape our forthcoming editions.

We also take this opportunity to applaud the vibrant plotters of SMARTIN. We also thank Mr. K. Arul Kumaresan, Coordinator, Career Planning & Guidance, Dr. MCET for the guidelines and support in bringing out this magazine. We believe this prodigious magazine on behalf of Electronics and Instrumentation Department would be a milestone in our career.

We seek all your blessings and supports for our future endeavours.

Welcome, dear readers

To

SMARTIN-2013

INDEX

ELINSTA

The association of our department, ELINSTA (ELectronics and INSTrumentation Students' Association) of Dr. Mahalingam College of Engineering & Technology is proud in organizing itself and jubilant always in working for the welfare of the students, since its inception on 12th of July 2012.

Our ELINSTA was inaugurated by Er.S.Chandrasekar, of Robert Bosch, Coimbatore. We found the lecture given by him very useful and his speech lifted our morals and sprits. The inauguration was presided by our honourable Principal, Dr.S.Chenthur Pandiyan Since then, until now 7 members have been inducted in our association. We were, we are positive in our approaches and are destined to work hard for the welfare of our students, in turn enriching our technical and administrative skills.

ISA

ISA, International Society of Automation, having its roots spread globally, serving and caring for engineering students. ISA affiliates its authorization to colleges with *well-equipped* infrastructure tailoring the demands of instrumentation engineers from the industries. We, at MCET are proud to be a part of ISA, and MCET chapter of ISA was inaugurated on 1st September 2012, by Mr.Vijayaragavan, president of ISA, South Asia.

The lecture given by him gave the students the real moral support and courage in their hearts and threw bright light in finding their future foot-steps.

RECENT TRENDS IN SMART AND WIRELESS INSTRUMENTATION

A National seminar, "**Recent Trends in Smart and Wireless Instrumentation",** sponsored by BRNS, was organized by our department in association with ICE department

in our college on 4th and 5th Jan, 2013. It was on various topics by various experts. There were speeches on 'Wireless Technology, Wireless protocol, Wireless Sensors with Networks Demonstration' by Mr.N.Aravindan, Mr.N.Rakesh Sharma, Dr.J.Prakash, Dr.V.Natrajan and Mr.VeeraKiran Kumar.

Our college technical experts Prof. K.N. Natarajan and Prof. D. Ganesh Kumar and Mr. S. Anthony Jesudurai spoke about Load cell Instrumentation System, LabVIEW in Wireless INstrumentation and Control Networks. Faculty members and PG Students from both our college and other colleges attended this National seminar. Participants felt that the seminar was very useful to them to take some decisions on their career path. Valedictory function was held on the evening of 5th Jan, 2013 and Certificates were issued to the Participants.

SMART In Action

1. HART PROTOCOL WITH SMART INSTRUMENTATION

- **Introduction**

HART Field Communications Protocol is widely recognized as the industry standard for digitally enhanced 4-20 mA smart instrument communication. Today use of the technology which is growing rapidly, virtually all major global instrumentation suppliers offer products with HART communication.

The HART protocol provides a uniquely backward compatible solution for smart instrument communication as both 4- 20 mA analog and digital communication signals are transmitted simultaneously on the same wiring. HART provides many benefits promised by field bus, while retaining the compatibility and familiarity of existing 4-20 mA systems.

- **Analog + Digital Communication**

For many years, the field communication standard used by process automation equipment has been a milliampere (mA) analog current signal. In most applications, the milliampere signal varies within a range of 4-20 mA in proportion to the process variable being represented. Virtually all installed plant instrumentation systems use this international standard to communicate process variable information.

HART Field Communications Protocol extends the 4-20 mA standard to enhance communication with intelligent measurement and control instrumentation. A major step in the evolution of process control, the HART protocol is fostering significant innovation in process instrumentation capabilities. The enhanced communication characte-

ristics of this important technology are reflected in the protocol name, HART which stands for “Highway Addressable Remote Transducer”.

➢ **Simultaneous Analog + Digital Communication**

The HART protocol enables two-way digital communication with smart instruments without disturbing the 4-20 mA analog signal. Both the 4-20 mA analog and HART digital communication signals can be transmitted simultaneously over the same wiring. Primary variable and control signal information is carried by the 4-20 mA (if desired), while additional measurements, process parameters, device configuration, calibration, and diagnostics information is accessible through the HART protocol over the same wires at the same time. Unlike other “open” digital communication technologies for process instrumentation, HART is compatible with existing systems.

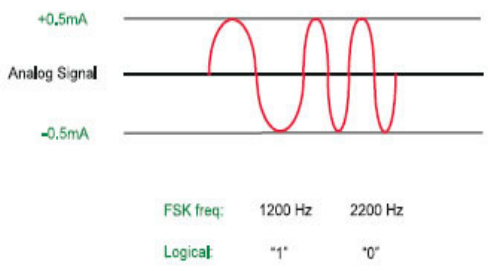


Figure 1. HART uses Frequency Shift Keying to encode digital information on top of the 4-20 mA analog signal

➢ **The HART Technology**

The HART protocol makes use of the Bell 202 Frequency Shift Keying (FSK) standard to superimpose digital communication signals at a low level on top of the 4-20 mA. Since the digital FSK signal is phase continuous, it does not interfere with the 4-20 mA signal. A logical “1” is represented by a frequency of 1200 Hz and a logical “0” is represented by a frequency of 2200 Hz.

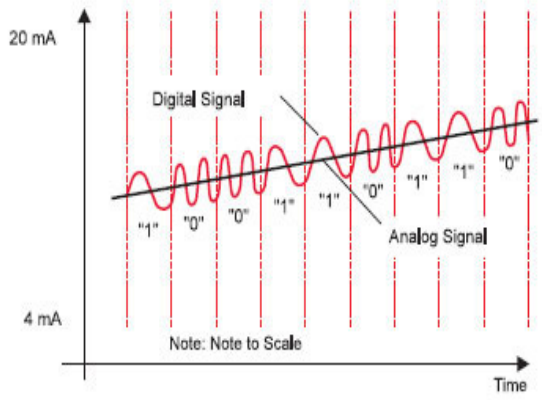


Figure 2.HART digital communication signal superimposed on the 4-20 mA analog signal

The HART FSK signaling enables two-way digital communication and makes it possible for additional information beyond just the normal process variable to be communicated to or from a smart field instrument. The HART protocol communicates at 1200 bits per second without interrupting the 4-20 mA signal and allows a host application

(master) to get two or more digital updates per second from a field device.

➢ **Flexible Application**

HART is principally a master/slave protocol which means that a field (slave) device speaks only when spoken to by a master. Two masters (primary and secondary) can communicate with slave devices in a HART network. Secondary masters, such as handheld communicators, can be connected almost anywhere on the network and communicate with field devices without disturbing communication with the primary master. A primary master is typically a DCS, PLC, or computer based central control or monitoring system. A typical installation with two masters is shown in Figure 3.

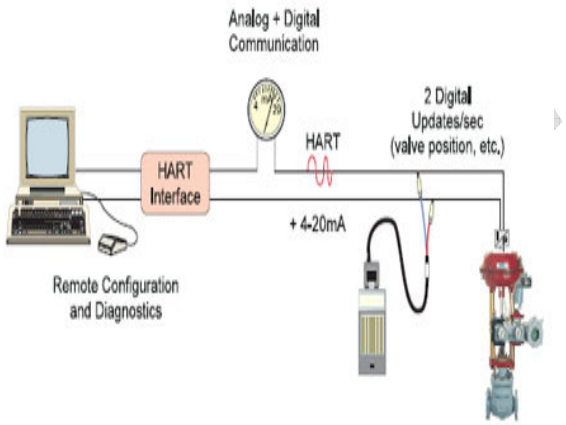


Figure 3. The HART protocol allows two Master devices to access information in Slave (field) devices

The HART protocol can be used in various modes for communicating information to/from smart field instruments and central control or monitoring equipment. Digital master/slave communication simultaneous with the 4-20 mA analog signal is the most common. This mode, allows digital information from the slave device to be updated twice per second in the master. The 4-20 mA analog signal is continuous and can still carry the primary variable for control.

➢ **Innovative Application Example**

The power of the HART protocol is evident in the control diagram of Figure 4. This innovative application uses the inherent feature of the HART protocol that both 4-20 mA analog and digital communication signals are transmitted simultaneously over the same wiring.

In this application, the HART-compatible transmitter has an internal PID control capability. The device is configured such that the 4-20 mA loop current is proportional to the control output of the PID algorithm executing in the device (not the measured variable as in most transmitter applications). Since the 4-20 mA loop current is regulated by the PID control output, it is used to drive the valve position directly.

The control loop executes entirely in the field between the transmitter (with PID) and the control valve. The control action is continuous as the traditional 4-20 mA analog signal drives the valve. HART digital communication links the operator with the control loop to change set point, and read the primary variable, or valve position output. Substantial savings are possible in applications where this innovative control architecture is appropriate.

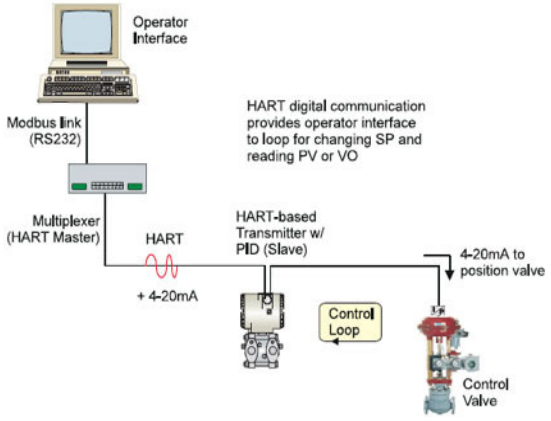


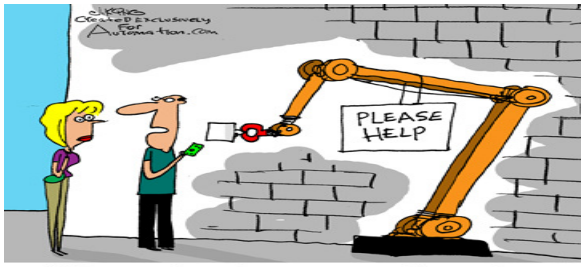
Figure 4. Some HART-based instruments include PID algorithms for implementing cost effective control

➢ Best Solution

The HART protocol provides users with the best solution and migration path for capturing the benefits of enhanced communication with smart instrumentation. No other communication technology can match the base of support or wide range of products that are available with HART today. The technology is easy to use and HART-compatible products are available from major instrumentation suppliers to address virtually all process measurement and control applications.

The emergence of field bus will not displace HART in either existing or new production facilities. HART provides users with many of the same benefits while retaining the compatibility and familiarity of existing 4-20 mA systems. HART allows the cost saving benefits of remote communication, flexible/accurate digital data transmission, field device diagnostics, and powerful multiparameter instruments to be captured without replacing entire systems.

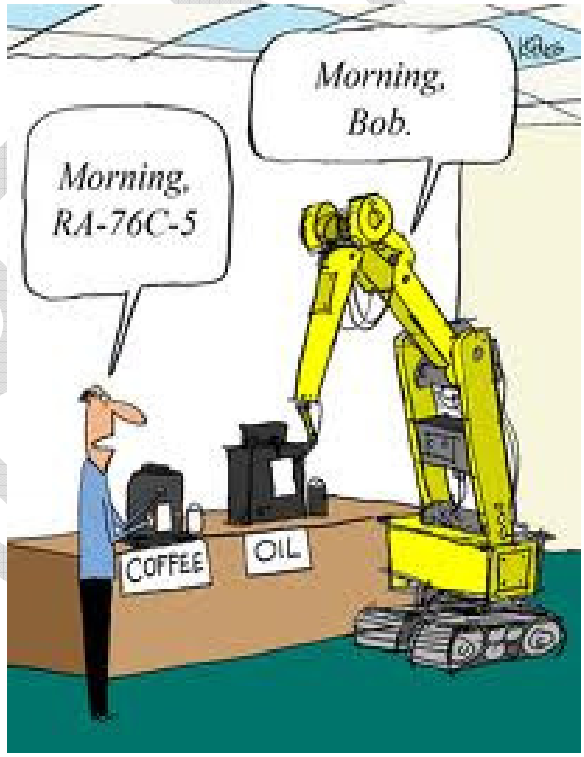
Connection to current and future plant networks is assured by the digital communication capability and large installed base (more than 5,000,000 installations and growing rapidly). Support of the HART Communication Foundation ensures that the technology will continue to evolve for serving the needs of smart instrumentation today and tomorrow.



"Yesterday there was a homeless person here. I told you automation can replace anybody."

2. DISCRETE WIRELESS

Industrial wireless is proving valuable for automation professionals in many areas of industrial automation with products and standards emerging. People are comfortable with wireless since they use it in their daily lives with cell phones, personal computers, security monitoring, and other devices. Wireless standards to date have focused on analog sensors, but there is growing interest and adoption of wireless for discrete monitoring and for controlling digital output points. Discrete monitoring and control points significantly outnumber analog input and outputs in automation systems and are the largest installation cost on most projects. Discrete points monitor contact closures from a wide range of sensors and use contact outputs to control a wide range



of devices, including motors, two position valves, and solenoids. If wireless cost and reliability improve to compete with hardwiring, this would be a real improvement in automation systems. Today, wireless sensors are being applied to select applications that have a high return on investment as a low-cost means for monitoring hard-to-reach locations and deploying new innovative

applications. Examples include connecting far distant sensors that are too expensive to wire, such as tank monitoring/control, and as an alternate to electromechanical slip rings on rotating machines connecting electrical signals from a stationary to rotating structure.

There are a number of proprietary industrial wireless offerings in the US and Canada and other countries, and many operate in the 900MHz band or lower frequency, providing a strong signal that allows communication through walls and other structures. Legal frequencies for these applications vary by geography. Common ISM (Industrial, Scientific and Medical) bands for industrial commercial applications are:

- 220-MHz band in China
- 433-MHz band in Europe and some other countries
- 869-MHz band in Europe
- 900-MHz band in North America and some other countries
- 2.4-GHz and 5.7-GHz allowed in the most parts of world

As radio waves travel, the radio signals gradually lose energy. The higher the frequency of transmission, the quicker the radio wave will lose energy down to a point where it cannot be detected by a receiver. Higher frequency waves also lose energy more quickly when trying to penetrate walls, trees, or other obstructions. If both a 900-MHz radio and a 2.4-GHz radio had the same output power and receiver sensitivity and were compared side by side, the 900-MHz radio would get almost twice the range of the 2.4-GHz radio.

This article is from the column ”Factory Automation” in the technical magazine ‘Intech’ that was published during Nov-Dec, 2012 under the topic “DISCRETE WIRELESS” by Bill Lydon.

BRAIN TEASER

A man and a son were driving home one rainy night. They had an accident. The father died on the spot. The people who were nearby took the son to the emergency room. The surgeon refused to operate on the boy, saying "I cannot operate on him, he’s my son!" How is that possible?

ANS: The surgeon was his mother.

3. INDUSTRIAL WIRELESS SENSOR NETWORKS:

TRENDS AND DEVELOPMENTS

World's 2012 survey shows continued growth and new opportunities for wireless sensors

By Mareca Hatler

Despite a challenging economy, the industrial Wireless Sensor Network (WSN) market has doubled over the past two years. A recently completed ON World survey of 216 industrial automation professionals, in collaboration with ISA, HART Communication Foundation (HCF), and the Wireless Industrial Networking Alliance (WINA), points to increasing WSN adoption and expanding markets. When ON World started researching industrial wireless sensing 10 years ago, deployments of more than 20 nodes were rare. Today, network densities are increasing, and several sites have deployments of more than 3,000 nodes. What is responsible for much of this growth? The 2012 survey indicates this is a result of increased education, reliability of today's WSN systems, maturing wireless mesh solutions, and a rapid migration to industry standards, such as Wireless HART and ISA100.11a.

Within the next five years, installed wireless industrial field devices will increase by 553% when there will be nearly 24 million wireless-enabled sensors and actuators, or sensing points, deployed worldwide. By 2016, 39% of deployed nodes will be used for new applications that are uniquely enabled by WSN technology. WSN is impacting industrial automation by disrupting wired automation, extending wired sensor networks, and driving new sensing and control solutions.

CAN U SOLVE ?

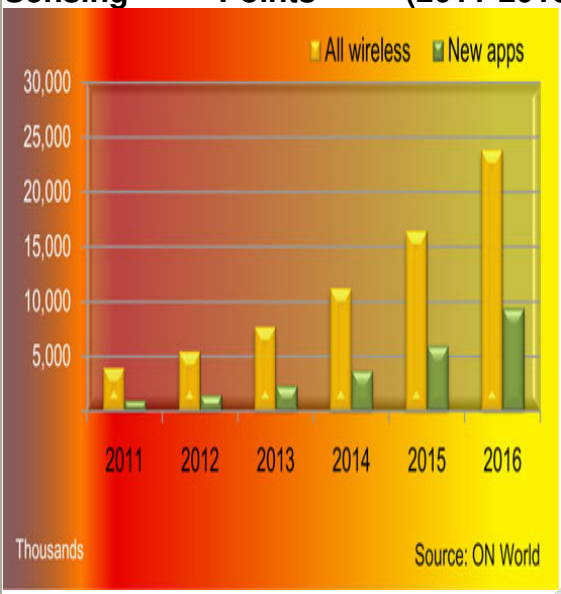
What number should replace the question mark?

			14	
	22			
			34	
41				
		53		?

Ans: 55.

Sol.
Each number indicates its position in the grid.
55 indicates row 5 columns 5.

Global installed industrial Wireless Sensing Points (2011-2016)

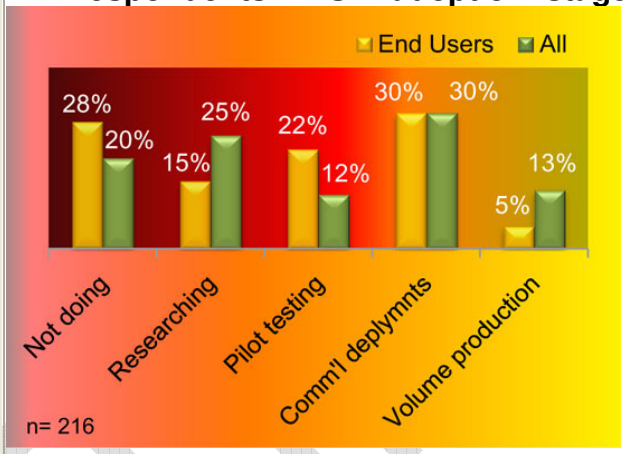


In 2016, there will be 24 million wireless-enabled sensing points. At this time, 39% will be new applications, uniquely enabled by WSN.

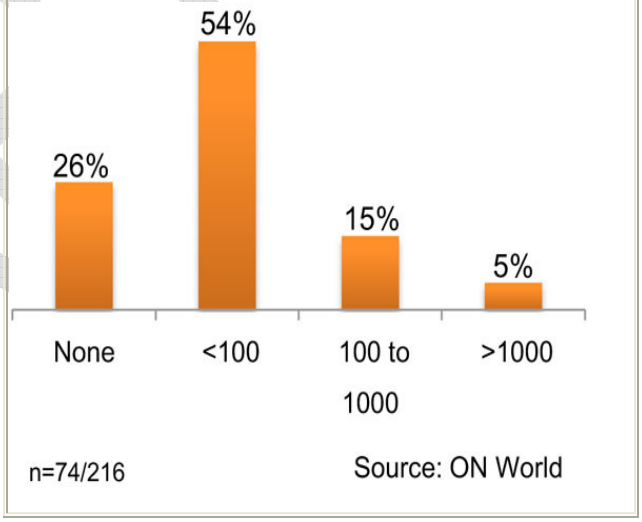
Industrial WSN drives production

Seventy percent of the surveyed industrial end users are planning WSN applications within the next 18 months, and most of these are planning a standards-based platform. Over half (57%) of the end-user respondents are currently using or pilot testing WSN systems, and 20% have deployed more than 100 wireless field devices. This is up from our previous survey from two years ago when only 7% of the end users had deployed over 100 wireless field devices. Five percent of the end users have installed at least 1,000 wireless field devices across multiple locations.

All respondents: WSN adoption stage



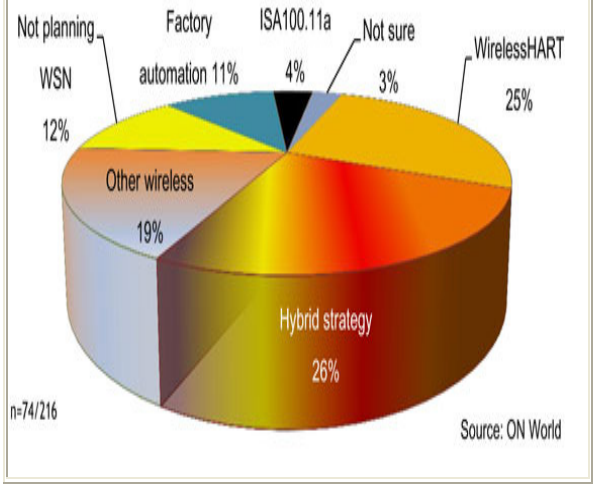
End users: Total wireless field devices



Standards migration

Over the past two to three years, there has been a rapid migration to wireless mesh standards. Nearly an equal number of industrial end users prefer WirelessHART or a hybrid strategy that combines WirelessHART and ISA100.11a.

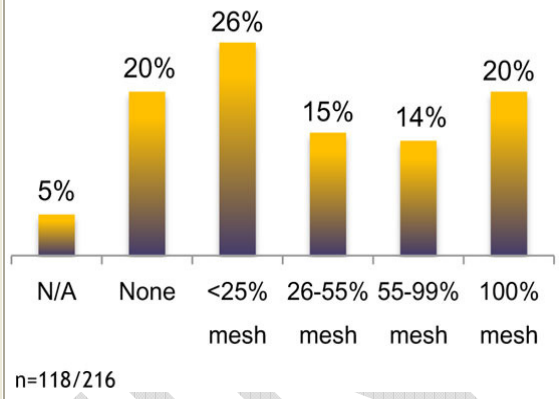
End users: Preferred standards approach



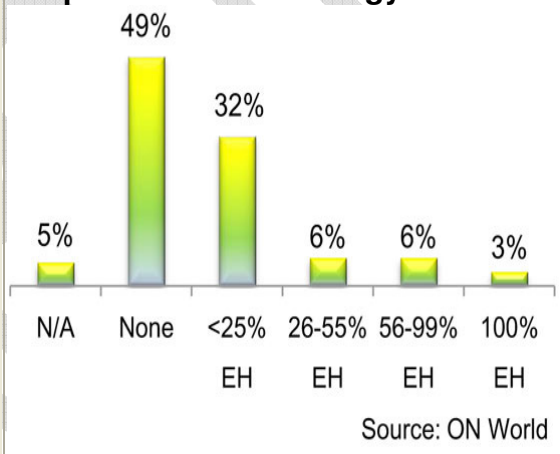
Increasing demand for wireless mesh, energy harvesting

Seventy-five percent of current WSN adopters—including vendors, suppliers and end users—indicate they are using a wireless mesh protocol for at least some of their wireless field devices, and 20% are only using wireless mesh systems. Over half of the WSN adopters are using energy harvesting for at least a few wireless sensor nodes, and 9% use energy harvesting to power the majority of their wireless field devices.

WSN adopters: % wireless mesh field devices

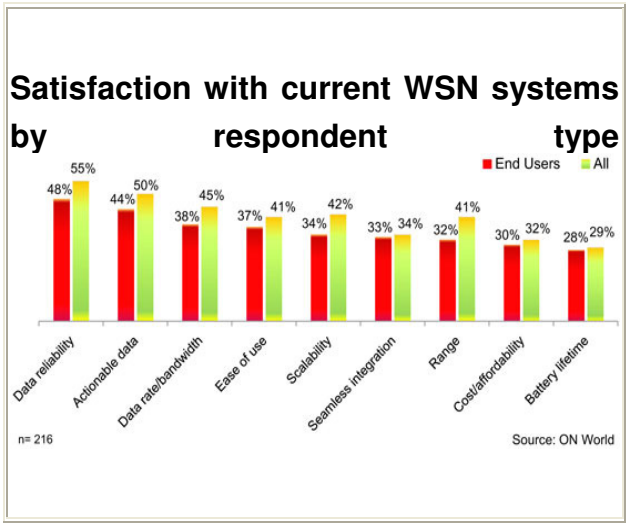


% powered with energy harvesting

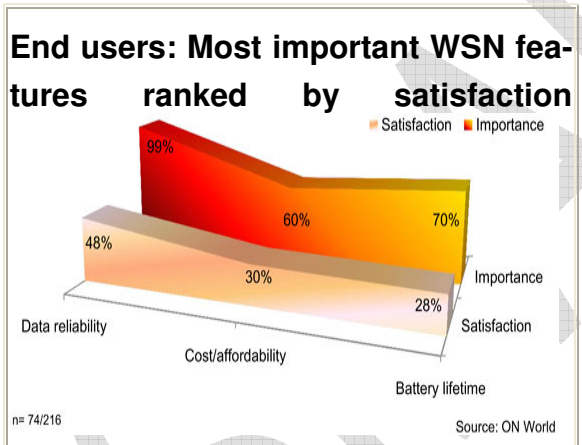


End user satisfaction with current WSN systems

Although they rank lower satisfaction compared with all respondents, end users are somewhat satisfied with today's WSN systems with about a third to half indicating they are satisfied with most features.



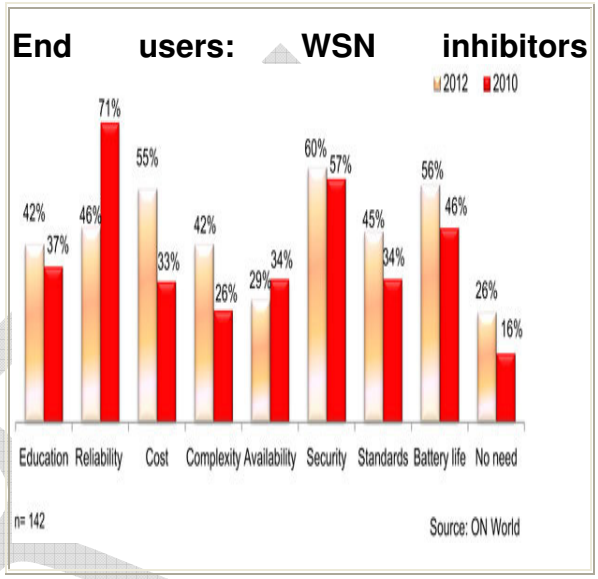
There is still a significant gap between end users' satisfaction level compared with their rank on the importance of key features such as data reliability, cost, and battery lifetime.



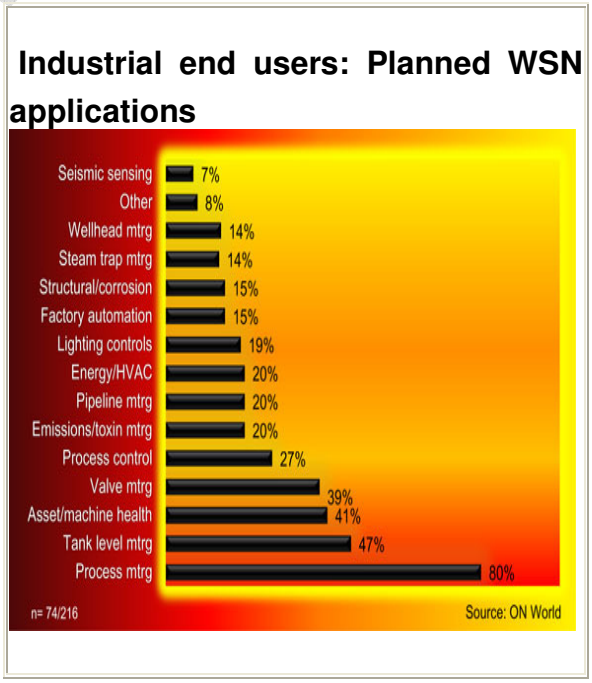
% "satisifed" or "most satisifed" and % indicating each is "important" and "most important"

Adoption drivers and inhibitors

Compared with ON World's previous survey in 2010, data reliability has dropped to only about two-thirds as much of a concern compared with the previous 2010 survey. Costs, battery life, and standards confusion are ranked slightly higher as inhibitors in our current survey compared with the previous survey.



Seventy percent of end users indicate they are planning WSN or additional applications.



Future of industrial wireless sensing

Looking forward, there will be many more wireless sensing applications and technology variations for industrial automation. In addition to wireless mesh systems, non-mesh products based on IEEE 802.15.4 are emerging, targeted at the process and discrete industries.

Adoption for point-to-point and point-to-multipoint wireless sensor systems is accelerating for oil and gas exploration and production. In addition, interest in simpler, lower-cost wireless sensors, such as “passive wireless sensors,” is a growing innovation area.

The survey respondents from ISA, HART, and WINA believe most WSN technology advances over the next 5-10 years will be focused on reducing equipment costs, improving communications, and finding better power source solutions such as energy harvesting. One thing that is certain is wireless sensing solutions will continue to play a pivotal role for industrial automation.

ABOUT THE AUTHOR

Mareca Hatler is the director of research for ON World, a global research firm that focuses on smart technology markets.

4. LATEST INVENTIONS:

❖ **Digital Infrared Video Thermometer** OS-VIR50

The OS-VIR50 video infrared thermometer is capable of making non-contact (infrared) and contact (thermocouple) temperature measurements with a 2.2" TFT 320 x 240 pixels LCD display. The built-in camera offers still image and video capturing functionality for documenting measurement locations. It has an repeatability of ±0.5% or 1.8°F / 1°C, accuracy of ± (1% of rdg + 4°F/2°C), resolution of 0.1°F/°C and an emissivity of 0.10 to 1.00 adjustable. It weighs about 494 g with dimensions 189 x 152 x 57 mm (7.4 x 6.0 x 2.2"). Power supply is given by a Lithium ion rechargeable battery with 4 hours of battery life. The meter includes a micro SD card slot for offloading still images and video. The built-in laser pointer increases target accuracy with laser convergence distance of 127 cm

and infrared temperature ranges from -50 to 2200℃ (-58 to 3992℉).

❖ **Wireless Bench top Meter, Scanner and Controller**

MDSwi8 Series

The z Series wireless monitoring and control system features meters and scanners compatible with a large and growing number of wireless sensors:

- **UWTC "Universal Wireless Thermocouple"** Type J, K, T, E, R, S, B, N, and C
- **UWRTD "Universal Wireless RTD"**
- **z Series Wireless End Devices** with sensors for temperature

The z Series 1/8 DIN panel meter and controller can monitor up to 8 wireless sensors. The compact instrument connects directly to an Ethernet network like Standards Compilance IEEE 802.3 10 Base-T and the Internet. It supports protocols like TCP/IP, ARP, HTTPGET. Alternatively, the wi8 meter-controller can instead be connected to the USB port of a single computer with a "USB Ethernet Adaptor" that are inexpensive and widely available. It has a 4-digit, 9-segment LED display with operating temperature from 0 to 55±C (32 to 131±F).

BRAIN TEASER

A murderer is condemned to death. He has to choose between three rooms. The first is full of raging fires, the second is full of assassins with loaded guns, and the third is full of lions that haven't eaten in 3 years. Which room is safest for him?

ANS: The third room, since the lions would be dead.

STUDENT'S COLUMN

❖ **GROWTH OF PLC:**

1969-Acquires information instruments

1970-Introduction of first PLC

1971-First manufacturer with dedicated training facility

1972-1973-First computer interface for programmable controllers introduced read and write programmable controllers

1974-1975-First PLC with parallel processing

1976-1977-Introduction of remote input and output

1978 - Introduction of PLC 2 and 1771 I/O product

1979 – Introduction of Data-highway Industries in first plant floor network

1981- Introduction of PLC-3 controller providing more processing power

1985- Introduction of IBM-compatible programming terminal integrated part to create communication in slot based computer

1986-1987- Links PLC to personal computers and created PLC-5 family for highly adaptable controllers

1988-Since Dec developed first system to integrate information processing with plant floor control

1989 –License node adapter technology serve growing customer basis

1991- Introduction of SCC 500 small processors

1992-Development of low cost networked block I/O

1993-Introduction of Ethernet and TCP/IP

1994-Launch of device net open standard network

1995-Introduction of control net high speed, high performance, network ships millionth of PLC.

V.Logesh

(First Year, EIE)

❖ GSM BASED AUTOMATIC POWER CONTROL SYSTEM

ABSTRACT

One of the main problems in today's scenario is "POWER CUT". This is not only due to shortage of power production, but also due to wastage of power due to various reasons such as running of streetlights even in day times & etc. These wastages can be avoided by **"Automatic power control system".** The switching of the electrical and electronic equipments or other similar equipments that runs by electricity or by battery can be done through our mobile phone anywhere in the world.

This is not only be used for a single device, it can also be used to control the whole power supply of a house or

industry. In many houses the electricity wastes are more since the user may forget to switch off (eg: Light, fan) before leaving the home**.** We can switch off the whole power supply in home, except for few devices that has to run even when the person is not in home (eg: Refrigerator).

After leaving the home just send a message or give a missed call to the number that has been mounted on the system. It will switch off the whole electricity that has been supplied to our home except for few devices and this "ACPS" will **send a message (indication) after switch off and switch on the loads**. Hence ,even if the person forgets to switch off the devices ,no need to worry .In similar way after returning to our home just give another missed call or message to the system ,it will put on the whole power supply. Hence electricity is saved

WORKING

Whenever the process needs to be started, just give a missed call to the number mounted on the control system. This wills ON the vibrator, voltage to the vibrator is redirected to the DC motor, which in turn runs a DC motor. DC motor here acts as a switch to put ON the relay circuit. Then the relay circuit uses the energy from the 5 volt power source for its working.

Figure. 5. Working model of the Project

This is the simple mechanism created by my own to switch ON the relay without any microcontroller The relay will close contact of the external circuit; hence the work will be done by any devices such as pump, Street light etc connected to the project.

The same process can be repeated to switch off the system and this time the DC motor switches off the relay circuit instead of ON .Hence the contact will open the external device connected to the project. We can use 230V and maximum of 10A load.

P. S. Muthamil Selvan,

M. Arjun Prakash,

II Year EIE

FACULTY COLUMN:

Mr. J. Manivannan:

The evolution from simple pneumatic to sophisticated smart instruments has been driven by demands for better performance, higher efficiency, reduced cost of production, lower energy use, easy maintenance, less downtime and higher quality. It simplifies the operations of accessing process parameters, identifies the problems and also determines the possible solution. The instrument's measurements outputs are assessed against the calibration standards to conform the quality of the measurement information via calibration against a traceable standard as smart instruments evolve to transmit large amounts of data digitally at high speed they become truly intelligent, delivering more benefits to users through plant control and monitoring along with simpler deployment and operation.

Mr. K. M. Manu:

Instrumentation engineers are responsible for the design, construction and maintenance of instruments and entire instrumentation system. Instrumentation engineers have their career scope in R&D units of public and private sectors, steel plants, sugar refineries and so on and so forth. They will develop skills in specific control disciplines such as Advanced Process Control (APC), Distributed Control Systems (DCS), Programmable Logic Controllers (PLC) and Supervisory Control and Data Acquisition (SCADA).

Ms. S. Sathya:

The definition of Smart Instruments has evolved over the past decades. Older dumb instruments were 3-15 psi pneumatic based devices that performed control through single-loop controllers. Information was shown locally, often with gauges and generally recorded manually with pen & paper. A degree of intelligence was next added to the instruments which evolve the smart instruments. Smart instruments are embedded systems and use a hardware architecture strategy. They use sensors to make physical measurement, a microprocessor to partially analyze sensor data, on-board memory to hold parameters and intermediate results, and input-output capabilities to report results to the next level of automation.

Ms. S. Durga Devi:

Smart instrumentation provides a direct control of process, variables and allows instrumentation engineers to keep track of all data changes. In wireless sensor network, smart sensor and field network have made network of

smart transducer a very attractive and economical solution for wide range of measurements and control applications. Wireless technology holds enormous potential for the process industry. To meet their testing demands while maximizing potential at reduced cost with less constrained infrastructure.

Ms. P. Hemalatha:

Smart instrumentation creates the foundation for smart interconnectivity. It takes data from smart sensors, actuators and other data streams to create smart systems for households and businesses, putting people in control of their technology. Capability of smart instruments is that it provides predictive maintenance and the power of online diagnostics.

Ms. B. Nithya:

I am happy that our students of EIE have produced the magazine "SMARTIN" which paves the way to enhance their technical skills and innovative ideas. I congratulate them for their tireless effort, they have invested in the preparation of the magazine. My hearty wishes to all the students for their future endeavours.