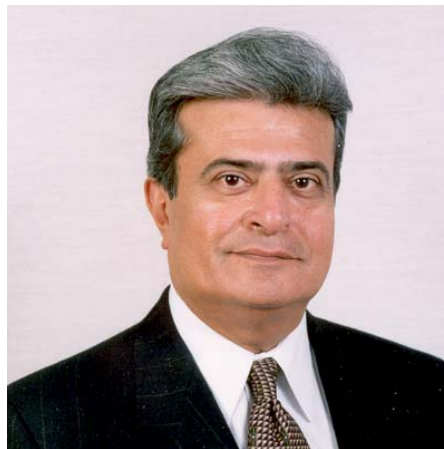




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***Smart Configurable Wireless Sensors and Actuators for
Industrial Monitoring and Control***

by

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ABSTRACT

Intelligent wireless sensor-based controls have drawn industry attention on account of reduced costs, better power management, ease in maintenance, and effortless deployment in remote and hard-to-reach areas. They have been successfully deployed in many industrial applications such as maintenance, monitoring, control, security, etc. This presentation focuses on research that addresses the issues faced by instrumentation systems and predictive maintenance industrial applications and presents a design solution to cater to the issues faced by these applications.

Instrumentation systems are either open or closed loop control systems formed using sensors and actuators with the objective of controlling certain parameters, or state of the system. The system elements are always in communication with each other, typically, requiring real-time performance and built-in fault-tolerance for communication/node failure – to return to a safe-state in a deterministic amount of time.

Predictive-maintenance involves tracking physical state of equipment or machine, and to take action, if an acceptable or allowed state(s) is violated. Predictive-maintenance applications are not active all the time in order to conserve energy. The sensors are either periodic or event-based; they wake up, check status and go back to sleep. In case of any violation, they raise an alarm or record the digression. They are very useful in keeping machine down-times low and help locate the problem before the machine breaks down.

Typical systems employ different types of sensors (e.g., position, accelerometers, gyros, etc.) and actuators (e.g., motors) often deployed within the same network, having different capabilities, interfaces, and supporting different protocols for data and communications. Formation of systems from such diverse distributed sensor elements entails versatile control modules, which understand different sensor protocols and utilize them. In addition, the operational challenges are exacerbated when different RF links have to be used to satisfy the requirements of bandwidth, payload, delay, jitter, range, noise immunity and others (including cost) for communication.

The Smart Sensor Platform discussed in this presentation is an attempt to develop a generic platform with ‘plug-and-play’ capability to support hardware interface, payload and communications needs of multiple inertial and position sensors, and actuators/motors used in instrumentation systems and predictive maintenance applications. Communication is carried out using a RF link (Wi-Fi, Bluetooth, Mote or RFID), in a point-to-point topology. The design also provides means to update operating and monitoring parameters, and thresholds as well as sensor and RF link specific firmware

modules 'over-the-air'. It is composed of two main components – a sensor-wireless hardware interface and system integration framework, which facilitates the defining of interaction between sensors/actuators based on process needs. The intelligence necessary to process the sensor signals, monitor the functions against defined operational templates, and enable swapping of sensor and RF link resides on the microcontroller of the hardware interface. A variety of industrial motion sensors like gyroscopes, Inertial Measurement Units (IMU), linear position sensors, absolute and incremental encoders and Brushless DC motors, have been interfaced and successfully tested with the platform.

ABOUT THE SPEAKER:

Asad M. Madni is past President and Chief Operating Officer (1992-2006) of BEI Technologies, Inc., located in Sylmar, California. Prior to joining BEI he was with Systron Donner Corporation (A Thorn/EMI Company) for 18 years where he served in various senior level technical and executive positions, eventually as Chairman, President and CEO. He received the A.A.S. degree from RCA Institutes, Inc., B.S. and M.S. degrees from University of California, Los Angeles and the Ph.D. degree from California Coast University, all in electrical engineering. He is also a graduate of the Certificate Program in Engineering Management at the California Institute of Technology, the Executive Institute at Stanford University and the Program for Senior Executives at MIT Sloan School of Management. Dr. Madni is an internationally recognized authority with over 30 years of experience in “intelligent” system design and signal processing. He is credited with over 100 refereed publications in archival journals, conference proceedings and book chapters; over 100 research reports and internal publications; over 100 keynote addresses, invited lectures, chairs and panels; and 65 issued or pending patents resulting in numerous “industry firsts”. He has served as a director on the board of six technology companies and on the advisory boards of several professional and academic organizations. He is currently serving on advisory boards at California State University Northridge, College of Engineering and Computer Science, UCLA Henry Samueli School of Engineering and Applied Science, USC Viterbi School of Engineering, and the Journal SENSORS. Dr. Madni is also the recipient of numerous awards and national honors including, the 2005 IEE Achievement Medal, the 2004 Alumnus of the Year Award from the UCLA Henry Samueli School of Engineering and Applied Science, the 2004 Distinguished Engineering Achievement Award from the San Fernando Valley Engineers' Council, the 2003 George Washington Engineer of the Year Award from the Los Angeles Council of Engineers and Scientists, the 2002 UCLA Professional Achievement Award Medal, IEEE Third Millennium Medal, Joseph F. Engelberger Best Paper Award at the 2000 World Automation Congress, California Coast University Distinguished Alumni Award, Association of Old Crows Gold Certificate of Merit, and is listed in all the major Who's Who publications including Who's Who in America. He is a Chartered Engineer, Fellow of the Institute of Electrical and Electronics Engineers, Fellow of the Institution of Electrical Engineers (UK), Fellow of the Institute for the Advancement of Engineering, Fellow of the New York Academy of Sciences, Fellow of the American Association for the Advancement of Science, Fellow of the Society of Automotive Engineers, Lifetime Associate Fellow of the American Institute of

Aeronautics and Astronautics, and Life Fellow of the International Biographical Association. He is also a Life Member of the Association of Old Crows.