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Improving Health Care Practices Through Human Factor Engineering Methods

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Improving health care practices through human factor engineering methods

Think of it as using technology to help human beings take care of other technology that in turn helps to take care of human beings.

Kai Yang, professor of industrial & systems engineering in the College of Engineering at Wayne State University, recently received a \$400,000 grant from the U.S. Department of Veterans Affairs (VA) as part of the organization's effort to become a leader in using emerging technology to improve health care.

The funding follows a \$350,000 grant last year to develop Interactive Visual Navigation (IVN) software, which provides an automated, dynamic work flow process that incorporates systems with human factor engineering principles to increase the efficiency of VA technicians.

Yang's current grant will allow him to enhance and extend the use of IVN, including the integration of real-time equipment-locating systems, and implement IVN at the Ann Arbor VA Medical Center.

Yang said IVN software reduces errors in reprocessing medical equipment, provides automated data collection, supports quality management requirements and reporting, and provides better, safer care for veterans — all of which are ways VA officials say they will measure the success of the department's transformation.

Yang's IVN software uses touch-screen technology to enhance technicians' ability to achieve the top priorities of reprocessing reusable medical equipment, he said. Those priorities include traceability of equipment, cases and patients, as well as reprocessing histories.

Yang has devoted much of his research to the VA's initiatives. In 2009, the VA reached out to engineering colleges at all U.S. universities to help establish Veterans Engineering Resource Centers (VERCs), which are intended to serve as showcases for integrating engineering methods and tools into the fabric of health care delivery. Wayne State helped establish one of just four VERCs nationwide. The local VERC is a joint effort between Wayne State, the University of Michigan and Indiana University-Purdue University Indianapolis.

The VA's transformation initiative, Yang's IVN software and creation of the VERC all stem from the same basic need, he said.

"Everyone knows U.S. health care is in trouble," he said. "It costs too much and doesn't give good enough service. We spend the most money on health care of any country, but the type of service we get is less than many other countries, even though other countries pay less."

Yang says experts believe health care lags other sectors, such as manufacturing, that take advantage of industrial engineering principles.

"Health care has been slow in using industrial engineering techniques to improve the cost, access and productivity of care," Yang said.

But the IVN software is helping to do just that, he said. It first was used at the John D. Dingell Detroit VA Medical Center to help technicians navigate endoscopes, though he said it will support any other management of reusable equipment or work flow process procedure, including preventive and corrective maintenance.

Yang said endoscope reprocessing was his first target area because the devices are expensive — each costs more than a new car — and must be cleaned and disinfected after each use. "It's a very labor-intensive process," he said. "It's quite easy to get it wrong."

In developing the IVN software, Yang through observation determined that technician memory lapses, difficulty in reading standard operating procedures and not following set procedures were some reasons for errors in reprocessing.

Yang believes the future looks bright for IVN, referred to recently by one VA official as the "home run" of the four VERCs. Phase two of his project already is under way with the use of IVN at the Detroit VA Medical Center and its planned implementation at the Indianapolis VA Medical Center, perhaps as early as September, before eventually going nationwide.

Four new projects comprise the rest of phase two. The first extends use of IVN technology beyond endoscopes to other equipment that requires similarly detailed care.

The second involves integrating real-time locating badges or tags into medical devices. Functioning like a Global Positioning System unit, the tags allow health care personnel to identify all items in a given location, types or models of equipment and their locations within a facility, and a given type within a given location. Real-time locating tags also can be used to track activities of employees and patients.

The third phase, implementing the IVN at the Ann Arbor VA Medical Center, is relatively simple, Yang said, but a fourth, to be funded by a



About Dr. Kai Yang:

Dr. Yang received a B.S. in electrical engineering from the East China Petroleum Institute in Shandong Province, China, and M.S. and Ph.D. degrees in industrial and operation engineering from the University of Michigan. He joined Wayne State University's College of Engineering in 1990.

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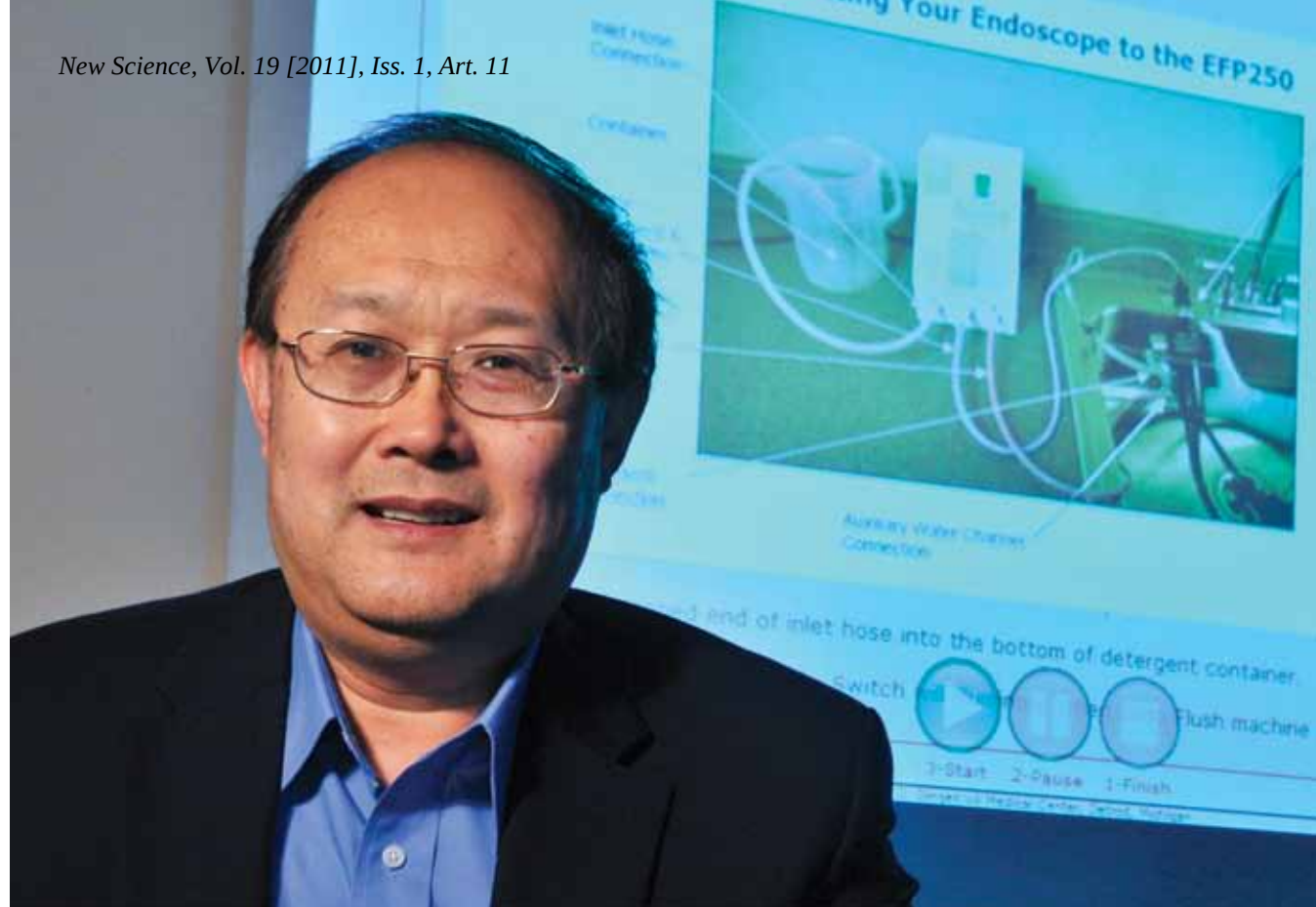
forthcoming \$100,000 VA grant, is more ambitious and addresses a key health care problem.

A big cost driver for health care systems is readmission of patients who fail to follow discharge instructions properly, he said. However, IVN technology can be adapted to track patients' conformance information, identify high-risk patients and more accurately predict who is more likely to deviate from discharge instructions. Health care personnel then can develop targeted ways to address those situations, including reminder calls or visits.

"It's kind of like you're tracking humans like pieces of medical equipment, using industrial engineering like statistical engineering and artificial intelligence," Yang said.

Current literature says health care systems can achieve higher reliability levels only by robustly characterizing management practices' impact on patient outcomes and applying valid practices based on clinical evidence.

"It is our intention to build on the interdisciplinary nature of our center to more effectively establish evidence-based management practices within VA health care delivery," Yang said.



Navigating Interactive Visual Navigation

The IVN software uses touch-screen interactive instructions, a process Kai Yang says is far friendlier than paper-based standard operating procedures, and similar to what people may see every day at grocery store checkouts.

The IVN clusters related jobs on the screen in blocks that users can absorb easily, taking into account that people tend to react negatively to too much or too little instruction. Time constraints and automatic clocks are included when applicable.

Work times are based on observed averages of how long it takes to complete a task; the software also automatically captures time spent on a given

task. Yang said this becomes a "process signature," allowing managers to identify instances in which workers may be taking less time than recommended for a particular procedure. IVN software also provides managers information of which workers are properly trained for tasks, and those who require more training.

The software's interactive screens include hyperlinks to definitions of unfamiliar terms or depictions of the pieces of equipment being used. The displays also feature ergonomic information and descriptions showing technicians how to set up work areas properly.