Technology Innovation

The Future of Handsfree Mobility: Head-Mounted Displays

MOTOROLA

KOPIN

Technology Innovation

The Future of Handsfree Mobility: Head-Mounted Displays

By Nicole D. Tricoukes (Motorola), Jeff Jacobsen (Kopin Corporation), et al.[1]

The use of Head-Mounted Display (HMD) systems continues to rise in enterprise applications, as the technology has evolved from an interesting concept to a deployable application with tangible business benefits. Companies – including global retailers, pharmaceutical and grocery distributors, parcel handling giants and even healthcare organizations – realize that HMD systems can empower workers to achieve new levels of efficiency, productivity, and accuracy in package handling and warehouse applications. However, choosing the correct HMD system can be a challenge. This paper helps demystify the process by examining key criteria for evaluating HMD systems and exploring the ways enterprise organizations can ensure they reap maximum benefit from their investment.

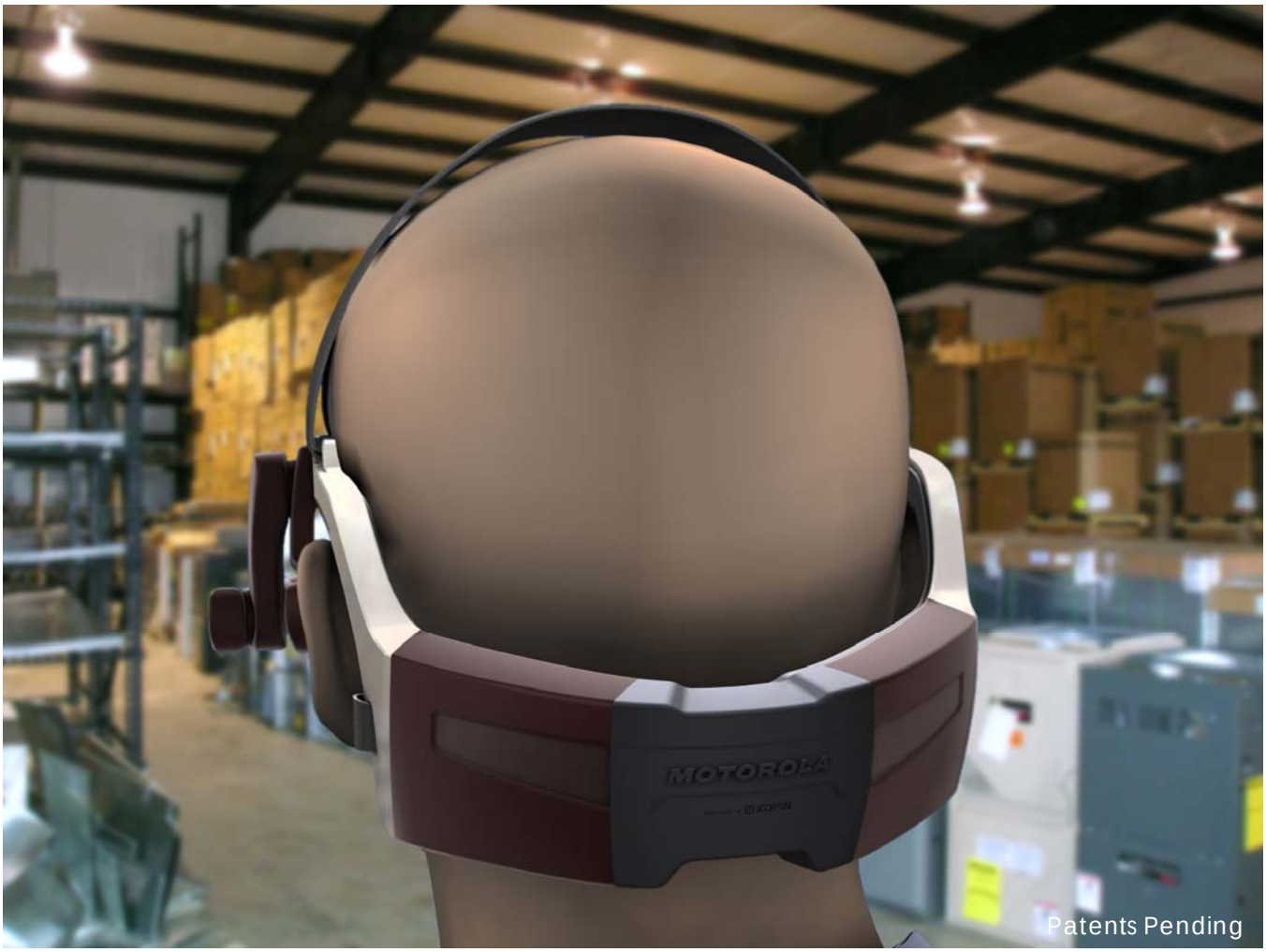
In applications that demand the constant use of hands, HMD systems give workers the hands-free convenience to handle more tasks, while keeping the technology needed to further improve productivity and accuracy right at their fingertips – including bar code scanning and mobile computing. The advantage of freedom of movement is clear. Without having to constantly juggle a handheld computer, workers' hands are always free and ready to pick the next item or package – resulting in fewer disruptions to workflow. Companies involved in transaction-intensive applications like picking, cross-docking, receiving, and replenishment can achieve real improvements in daily productivity.

Military

HMD systems while previously the sole purvey of the combat arms – pilots, tank operators – are now finding a place with the military's logistical and maintenance departments. The U.S. Department of Defense is investigating the possibility of equipping their support personnel with wearable technology to help with both the training and operational aspects of maintaining its force posture. In a recent meeting with the Assistant Secretary of the U.S. Army Logistics and Technology (ASALT) group, Kopin Corporation briefed the ASALT team regarding usage of industrial-grade (not military-grade) HMD systems in the areas of non-combat field logistics and maintenance. The ASALT team in conjunction with the Defense Advanced Research Projects Agency (DARPA) has more than 40 open requests for information regarding the application of HMD systems for differing uses by the military.

Logistics and Distribution

HMD systems combined with mobile handheld computers can significantly enhance the performance and productivity of warehouse and distribution enterprise users, such as order pickers, material handlers, forklift operators,



handcart operators, inventory control clerks, and shipments checkers.

Companies are often forced to reopen, rework and repackage older goods to identify misplaced inventory or to replace with updated products. An HMD system working in conjunction with Motorola's mobile handheld scanners and mobile computers is able to leverage existing customer facility wireless and computing infrastructure to provide real-time notification to workers and the facility system on the location of materials and goods. The system with its integrated 6-axis head tracking technology can also be electronically monitored, as warehouse and distribution center employees perform their routine tasks to improve workflow and efficiencies in real-time.

The HMD system Bluetooth technology also allows for the streaming of training or informational videos on demand to any employee that is available on the company servers.

Field Mobility

HMD systems promise hands-free mobility with full-screen outdoor viewing for many PC-based applications which require larger displays for accessing information-rich content.

Recently, companies have begun purchasing laptop computers for their "engineers on the streets" to provide these workers with access to critical job information. Both the heavy weight of the laptops and the non-sunlight viewable

screens make the computers unsuitable for most field mobility workers; as a result workers are not taking them out of their vehicles. Using a HMD system, it is now possible to replace laptops with an MC75, an enterprise-class mobile computer from Motorola. The mobile terminal plus HMD accessory form a hands-free wearable computing system which connects over WAN bandwidth to provide real-time data for the field engineers. The headset provides better accessibility to large page views and is visible outdoors due to the shielding of the optical pod and the ability to force light through its small micro display.

Several companies have already expressed interest in replacing their laptops with a larger screen, mobile and lower cost solution using "the latest world-class mobile technologies" to increase business efficiencies and worker productivity. These companies' field engineers require on-the-job access to workforce management automation (or key customer stats using field service mobile software), and service and repair instructions to read maps and schematics diagramming their proprietary network grid.

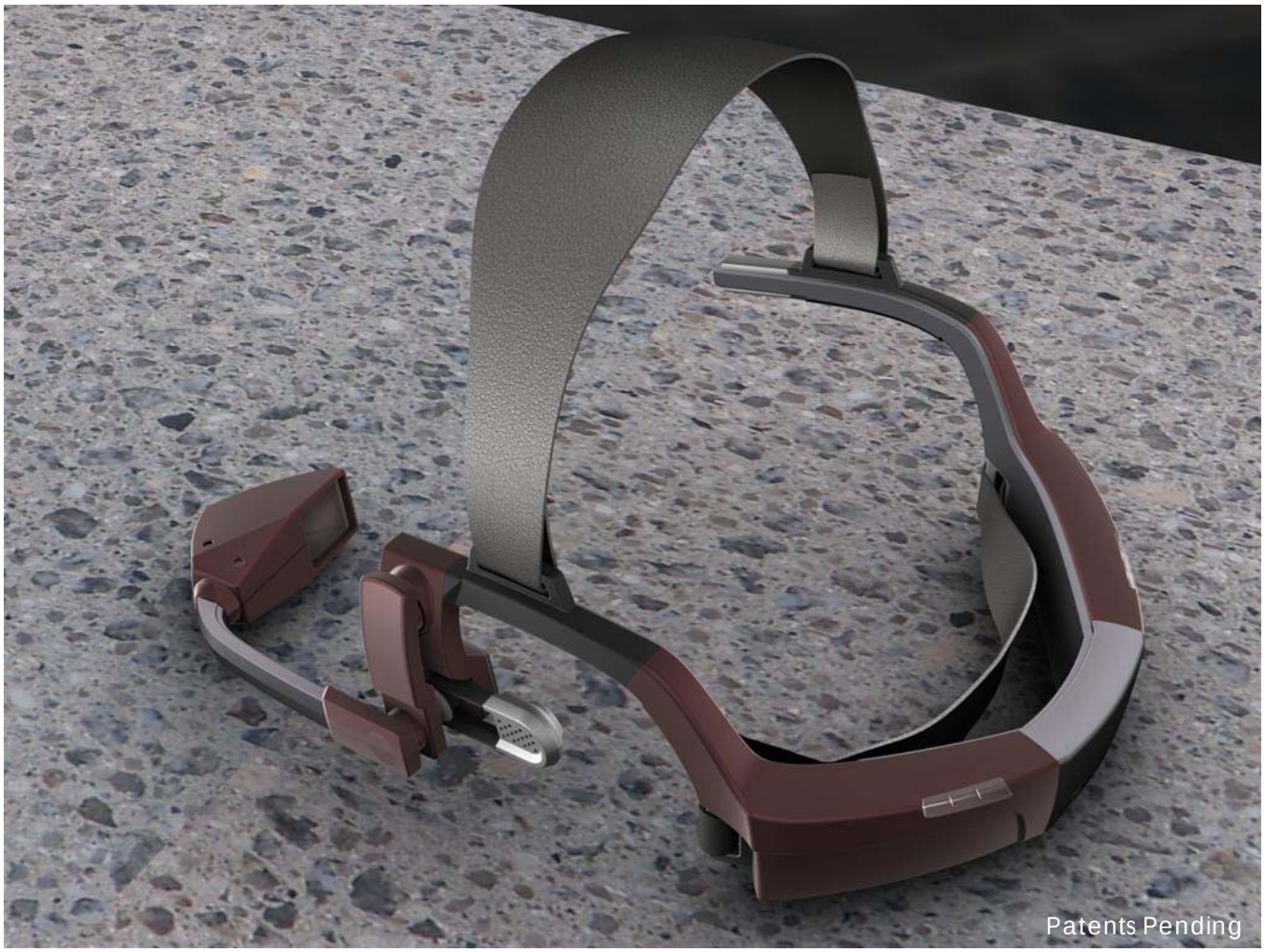
A mobile terminal plus HMD system gives field workers across industrial sectors access to data sheets, best practices, case histories, white papers, relevant customer information, compliance specifications, evaluation processes, maintenance, service and repair information, and 3D tools. This approach opens new channels and enterprise market opportunities in aerospace (e.g., aircraft building and

wiring), architecture, automotive, consumer packaged goods, energy, engineering, high-tech, industrial construction, industrial equipment, life sciences, pipelines, ship building, and in other industrial areas.

Healthcare

Medical institutions have described an immediate need for a hands-free, speech driven wireless PC, monocular device for use in multiple hospital applications, including full-screen viewable access to patient medical charts and records, and medical procedures.

Several of the world's major medical organizations are requesting to test head-mounted display technologies.



Kopin HMD Program: Golden-i®

Kopin Corporation has developed a head-mounted display system called Golden-i which is designed to remotely (wirelessly) command and control other devices and networks, up to seven independent devices or networks at a time while mobile. The system, designed to be light-weight, low-power and compact, is intended to seek out and wirelessly leverage the hardware capabilities, features, software applications and processing capabilities of other remote devices and networks. The performance of Kopin's Golden-i technology is ultimately limited by the host system chosen for connectivity and the bandwidth of the

wireless interface. With Golden-i in remote wireless command and control of another device, the user can now use all functionality, features, software applications and computation capability of the host device.

Golden-i has its own Microsoft OS PC processing and communications platform for the command and control of other devices and networks, but can also be used as a standalone 2-ounce mobile PC platform when required. It provides a hands-free speech recognition user interface, and use of Bluetooth wireless mouse or keyboard, user gesture control or any other host device user interface.

Kopin's head-mounted display system provides users with a virtual 15-inch diagonal full color PC screen, an 800MHz Arm 8 Cortex processor, 600MHz 32-bit TI DSP, 10 million polygon per second high-speed graphics generator, up to 16GB high-speed low-power non-volatile RAM, micro SD card slot, mini USB port, and Bluetooth 2.0 ER radios (autonomous WiFi radio to be offered soon). Golden-i currently runs the latest Microsoft WinCE 6.0 OS, and both Microsoft Windows Mobile 7 and a full kernel Linux OS can be offered in 2009.

User Interface

Users can interface with Golden-i using natural voice recognition, Bluetooth mouse or keyboard, gesture control (using user adjustable 6-axis head tracking technology), host device keyboard or mouse, audio communication (via speech recognition running on host device, network or in a cloud environment). The Golden-i platform can also be enhanced by adding an optical imager. Attitude sensing is already possible using gesture control, and a GPS receiver, laser range finder and various sensors and detectors can be added to the system.

User Access

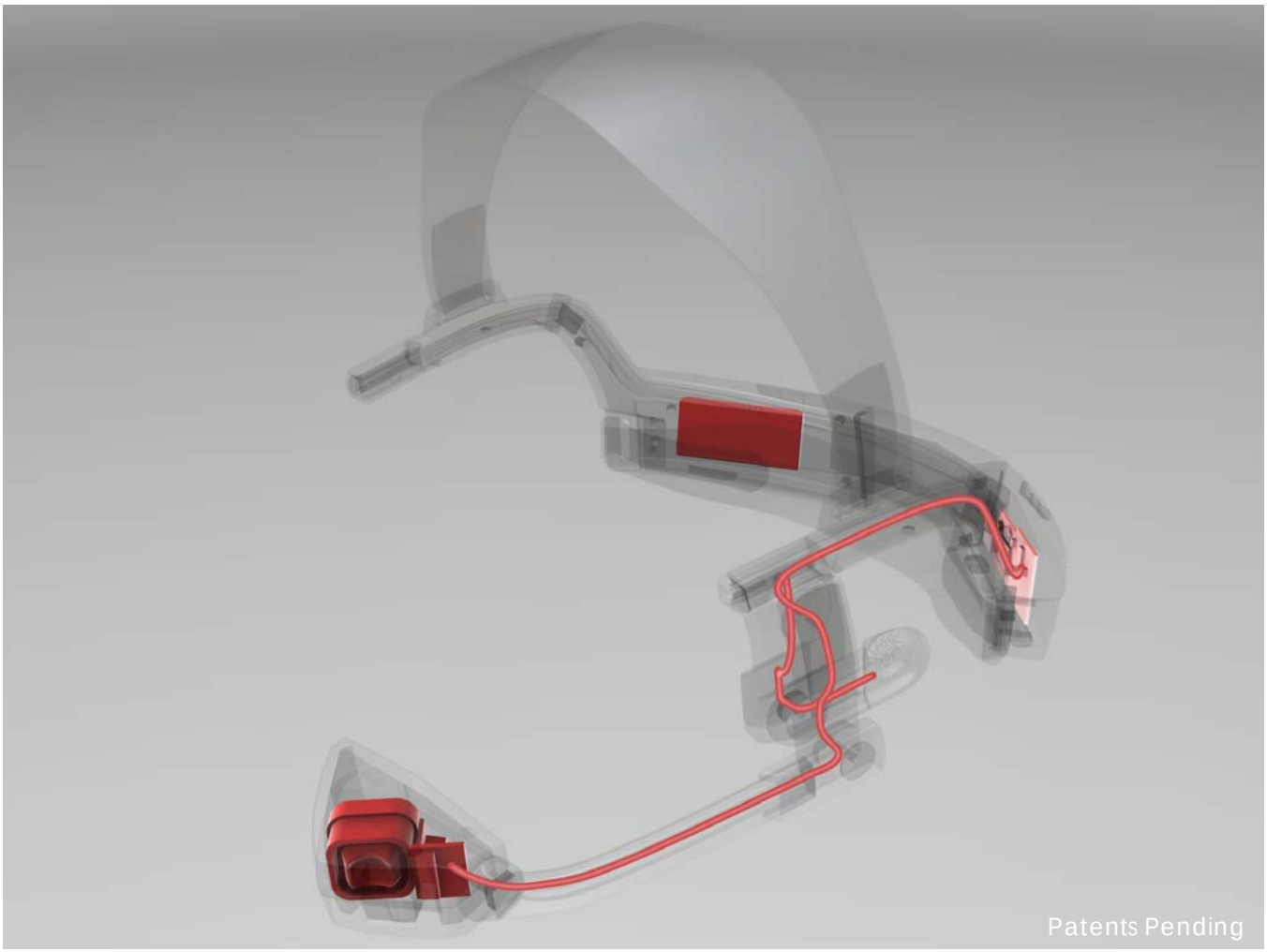
Other devices can connect wirelessly using Bluetooth, WiFi, cellular service, mini USB port, micro SD card slot, or through a host device radio or land line. Additional radios such as U.S. military SINCGARS can also be added to the system.

Display Image

Kopin's micro display can project a 15-inch diagonal in 24-bit full color with DVD quality video, creating a virtual display image that appears 18 to 22 inches in front of the user when viewed. The range of 18 to 22 inches in front of the user varies because there is a +3 diopter user focus adjustment. Negative diopters magnify the image, while positive diopters reduce the size of the image being viewed. The +3 diopter adjustment covers more than 90 percent of users requiring focus adjustment to achieve a sharp display image. The display image viewed is focused at infinity, since natural human vision focuses at infinity on objects and scenes four feet and beyond user's eyes. Human eyes are in a relaxed state when focused at infinity. In general use for mobile applications, a display image focused at infinity will allow the user to navigate through facilities and work sites, without the user's eyes having to refocus from display to reality. A display image focused at infinity also allows the use of a virtual display image for prolonged periods of time without causing eye fatigue.

Computing and Communication Electronics

On-board data processing is handled by a state-of-the-art 45nM CMOS Texas Instruments OMAP 3530 mobile dual processor (a flexible 400MHz to 1GHz ARM Cortex 8 with a flexible 32-bit 300 to 600MHz DSP) with a ball grid package-on package (POP) high speed, low power nonvolatile



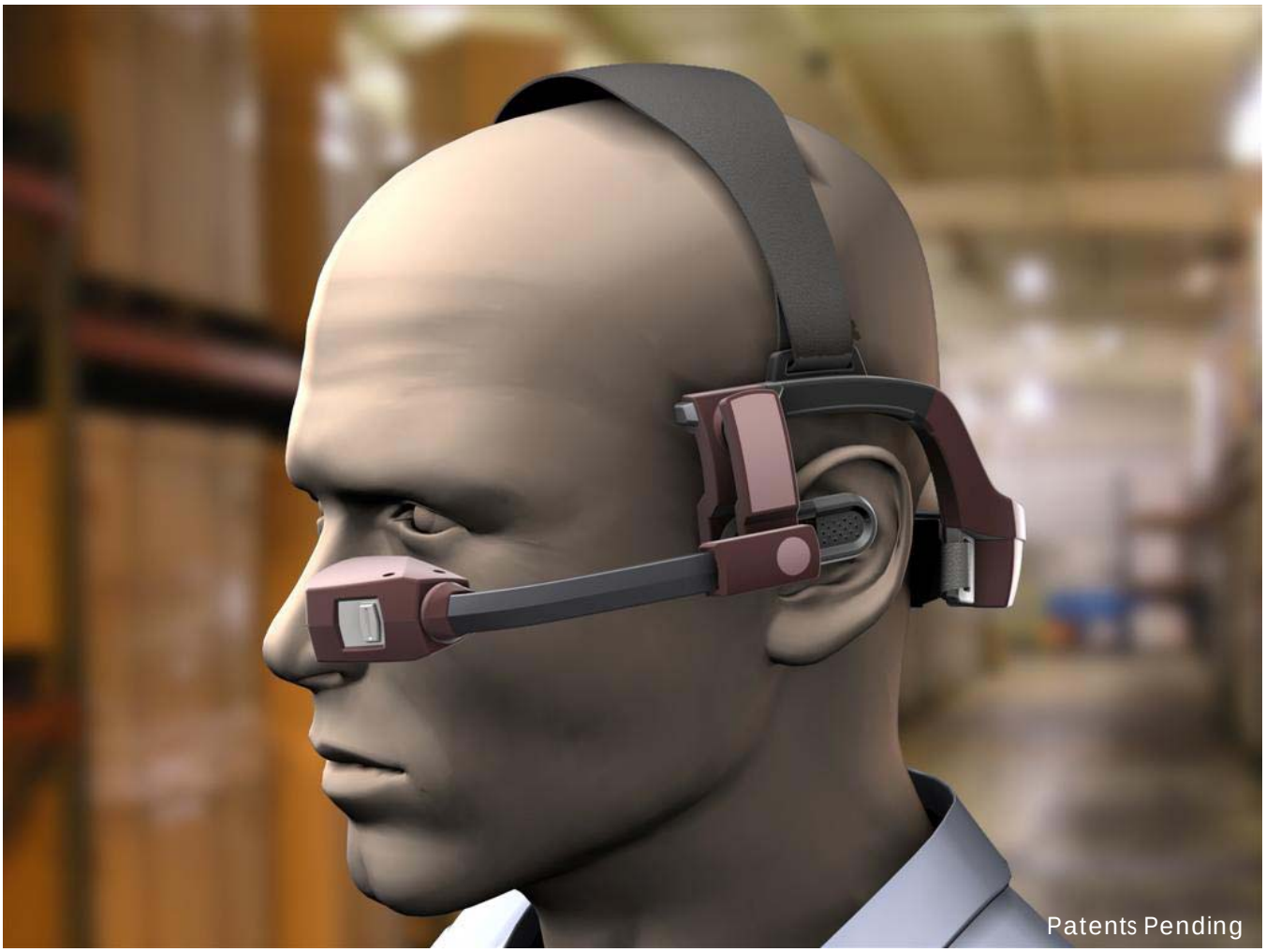
memory and either: a) 2Gb NAND, plus 1Gb mobile DDR RAM, b) 2Gb NAND, plus 2Gb mobile DDR RAM, or c) 4Gb NAND, plus 2Gb mobile DDR RAM). Golden-i has a micro SD card slot, currently capable of supporting removable micro SD cards with 256MB to 16GB of low power non-volatile RAM. The TI OMAP processor provides numerous onboard I/O control for peripherals and industry standard I/O bus configuration: LED monitors, cameras, sensors, stereo audio, microphones, touch screens, displays, I2C, SPI, USB, Bluetooth, WiFi, etc.

Operating System

Golden-i currently offers the Microsoft Windows CE 6.0 operating system. In 2010, Kopin anticipates offering customers either the Microsoft WinCE 6.0 or the Microsoft Mobile 7 operating systems. Although the first generation Golden-i platform provided a full kernel Linux operating system, there is no current plan for Kopin to offer Golden-I with a Linux operating system at this time.

Wireless Radios

Today, Golden-i provides a Bluetooth 2.0 EDR radio. By fourth quarter 2009, the system will incorporate both Bluetooth 2.0 EDR and WiFi radios. The TI 3530 OMAP processor is based on the TI 3430 processor which incorporates internally cellular phone radio circuitry. The 3430 processor was developed specifically for the largest cellular handset manufactures; e.g., Nokia, Motorola, and LG. In the near future, if Golden-i replaced the TI 3530 with the 3430



processor, Golden-i would immediately have a stand-alone cellular radio on-board, as well as the Bluetooth 2.0 EDR and WiFi radios.

Wireless Radio 128-bit Encryption and Packet Delivery

Golden-i uniquely provides a Bluetooth 128-bit encryption and full packet delivery solution.

On-board Mini USB Port

Golden-i provides internal USB host support, as well as USB on-the-go plug and play mini USB port support.

About the Authors[1]

Contributions to this paper are credited to the following technology associates in the Motorola Enterprise Mobility Solutions division: Franklyn Falby, Patrick Riechel, Thomas K. Roslak, Nicole D. Tricoukes, and Jeffrey Weissman. Contributions are also credited to Jeffrey Jacobsen of Kopin Corporation, Dr. Chris Parkinson of Integral RFID, and Jorg Schlieffers of Thinkable Studio.

For more information about Golden-i® or handsfree mobile enterprise systems, please contact nicole.tricoukes@motorola.com or jeff_jacobsen@kopin.com.