LED lights point shoppers in the right direction

26 January 2012

Looking for an item in a large department store or mall can be like searching for a needle in a haystack, but that could change thanks to a hybrid location-identification system that uses radio frequency transmitters and overhead LED lights, suggested by a team of researchers from Penn State and Hallym University in South Korea.

"LED lights are becoming the norm," said Mohsen Kavehrad, W. L. Weiss Chair Professor of Electrical Engineering and director of the Center for Information and Communications Technology Research at Penn State. "The same lights that brighten a room can also provide locational information."

To locate an item in a mall, the system would not need to transfer large amounts of data. Kavehrad and his team envision large stores or malls with overhead LED light fixtures, each assigned with a location code. At the entrance, a computer that is accessible via keyboard or even telephone would contain a database of all the items available. Shortly after a query, the location or locations of the desired item would appear.

"The human eye can't see beyond 15 on and offs of a light per second," said Kavehrad. "We can get kilobytes and megabytes of information in very rapid blinking of the LEDs," he told attendees at the SPIE Photonics West 2012 conference today in San Francisco.

But LED-transmitted locational information alone will not work because light does not transmit through walls. Kavehrad, working with Zhou Zhou, graduate student in electrical engineering, Penn State, designed a hybrid LiFi system using a Zigbee multihop wireless network with the LEDs.

ZigBee is an engineering specification designed for small, low-power digital radio frequency applications requiring short-range wireless transfer of data at relatively low rates. ZigBee applications usually require a low data rate, long battery life, and secure networking.

While a ceiling light can have communications with anything placed beneath its area, light cannot travel through walls, so a hybrid system using light and RF became the practical solution.

The system consists of the location-tagged LEDs and combination photodiode and Zigbee receiver merchandise tags. The request for an item goes from the computer through the many jumps of short radio frequency receivers and transmitters placed throughout the mall. The RF/photodiode tag on the merchandise sought, reads its location from the overhead LED and sends the information back through the wireless network to the computer.

Even when merchandise is moved from room to room, the accurate location remains available because a different LED overhead light with a different location code signals the tag.

While ideal for shopping applications, this hybrid model is also useful in other situations. LED-transmitted information is useful in places like hospitals, where radio frequency signals can interfere with equipment.

Modern Geographic Positioning Systems, such as those in cell phones, can easily locate people outside, but they do not work within buildings. A hybrid system in a high-rise office building, for example, could not only tell the system someone was in the building, but could identify the floor where the person was at that time. In museums or hospitals, navigation systems could guide people through large buildings by reading the final destination signal from a hand-carried photodiode device and initializing lights or other indicators to show the proper path.

Kavehrad notes that Zigbee devices are designed to be inexpensive, as are the photodiodes also

required for the system. Not every identical item would need a tag and the tags are reusable.

Also working on this project were Yong Up Lee, professor of electronics, Hallym University, Chuncheon, Korea, currently at Penn State on sabbatical, and Sungkeun Baang and Joohyeon Park, masters degree students at Hallym University.

Provided by Pennsylvania State University