Near error-free wireless detection made possible

January 23 2014

E-Passport Logo. Credit: tom_bullock via Flickr

(Phys.org) —A new long-range wireless tag detection system, with potential applications in health care, environmental protection and goods tracking, can pinpoint items with near 100 per cent accuracy over a much wider range than current systems.

The accuracy and range of radio frequency identification (RFID) systems, which are used in everything from passports to luggage tracking, could be vastly improved thanks to a new system developed by researchers at the University of Cambridge.

The vastly increased range and accuracy of the system opens up a wide range of potential monitoring applications, including support for the sick and elderly, real-time environmental monitoring in areas prone to natural disasters, or paying for goods without the need for conventional checkouts.

The new system improves the accuracy of passive (battery-less) RFID tag detection from roughly 50 per cent to near 100 per cent, and increases the reliable detection range from two to three metres to approximately 20 metres. The results are outlined in the journal *IEEE Transactions on Antennas and Propagation*.

RFID is a widely-used wireless sensing technology which uses radio waves to identify an object in the form of a serial number. The technology is used for applications such as baggage handling in airports, access badges, inventory control and document tracking.

RFID systems are comprised of a reader and a tag, and unlike conventional bar codes, the reader does not need to be in line of sight with the tag in order to detect it, meaning that tags can be embedded inside an object, and that many tags can be detected at once. Additionally, the tags require no internal energy source or maintenance, as they get their power from the radio waves interrogating them.

"Conventional passive UHF RFID systems typically offer a lower useful read range than this new solution, as well as lower detection reliability," said Dr Sithamparanathan Sabesan of the Centre for Photonic Systems in the Department of Engineering. "Tag detection accuracy usually degrades at a distance of about two to three metres, and interrogating signals can be cancelled due to reflections, leading to dead spots within the radio environment."

Several other methods of improving passive RFID coverage have been

developed, but they do not address the issues of dead spots.

However, by using a distributed antenna system (DAS) of the type commonly used to improve wireless communications within a building, Dr Sabesan and Dr Michael Crisp, along with Professors Richard Penty and Ian White, were able achieve a massive increase in RFID range and accuracy.

By multicasting the RFID signals over a number of transmitting antennas, the researchers were able to dynamically move the dead spots to achieve an effectively error-free system. Using four transmitting and receiving antenna pairs, the team were able to reduce the number of dead spots in the system from nearly 50 per cent to zero per cent over a 20 by 15 metre area.

In addition, the new system requires fewer antennas than current technologies. In most of the RFID systems currently in use, the best way to ensure an accurate reading of the tags is to shorten the distance between the antennas and the tags, meaning that many antennas are required to achieve an acceptable accuracy rate. Even so, it is impossible to achieve completely accurate detection. But by using a DAS RFID system to move the location of dead spots away from the tag, an accurate read becomes possible without the need for additional antennas.

The team is currently working to add location functionality to the RFID DAS system which would allow users to see not only which zone a tagged item was located in, but also approximately where it was within that space.

The system, recognised by the award of the 2011 UK RAEng/ERA Innovation Prize, is being commercialised by the Cambridge team. This will allow organisations to inexpensively and effectively monitor RFID tagged items over large areas.

More information: Sabesan, S.; Crisp, M.; Penty, R.; White, I., "Wide Area Passive UHF RFID System using Antenna Diversity Combined with Phase and Frequency Hopping," Antennas and Propagation,*IEEE Transactions on Antennas and Propagation* , vol.PP, no.99, pp.1,1. DOI: 10.1109/TAP.2013.2290114