Virtual Touch Screen in the Air Using RF Signals
Technology #16879

Applications

The inventors have developed a device that tracks the location and detailed trajectory of radio frequency sources (e.g. RFIDs) moving in 3D space. This device can transform any plane or surface into a virtual touch screen, whereby users can interact with a desired computing device by gesturing or writing commands in the air. This interface can be used to interact with a remote screen, to send commands to a cellphone without touching it, or to communicate with small devices (e.g., sensors) that do not have space for a keyboard.

Problem Addressed

RF-based positioning has become the next frontier for innovation in mobile computing, business analytics, and human-computer interaction. Advancements in RF-based technology to-date have enabled the localization of RF sources to an accuracy of tens of centimeters. However, little has been done to further accurately track an RFID’s motion trajectory. This detailed, real-time motion tracking is critical for application of RF technology for gaming and gesture-based interfaces and requires a resolution several-fold higher than what existing RF-based localizing systems can offer.

Technology

The inventors have developed RF-IDraw, a novel technology to accurately trace the trajectory of an RFID. This system offers tracing capabilities accurate enough to transform any plane or surface in space into a virtual touch screen, enabling human-computer interfacing without physically touching a screen. RF-IDraw allows a user to input commands on any surface by writing, scrolling and swiping using an RFID attached to a pen or finger splint. RF-IDraw can reconstruct the RFID’s trajectory and interpret the user’s writing and gestures as input to the desired computing device.

RF-IDraw’s technology leverages multiple antennas to yield a significant improvement in both tracing and localization accuracy. The device measures the phases of the received signals at the different antennas and uses knowledge of the antenna positions to create a geometric model for estimating the RF source’s position and tracing its detailed trajectory. The beam steering capability of the antenna array is utilized to pinpoint the direction and location of the source. To obtain a high level of accuracy, RF-IDraw pairs these antennas with differing levels of separation: the pairs with larger separation have narrow beams and provide resolution in the positioning system, while the pairs with smaller separation work as filters to eliminate ambiguity in the system. This technology also offers real-time processing functionalities integrated with handwriting recognition features.

Advantages

- Device can be used to turn virtually any surface into a touch screen capable of human-computer interfacing
- Technology can be applied to multiple users with one or multiple RFIDs
System works even if the user is occluded from the device

**Categories For This Invention:**

- Computer Sciences & Information Technology
- Artificial Intelligence
- Human Computer Interactions

**Intellectual Property:**

Radio frequency localization
Issued US Patent
9,958,529

**Inventors:**

Dina Katabi
Deepak Vasisht
Jue Wang

**Publications:**

- **RF-iDraw: Virtual Touch Screen in the Air Using RF Signals**
  ACM SIGCOMM Computer Communication Review
  2015
- **RF-iDraw: Virtual Touch Screen in the Air Using RF Signals**
  Proceedings of the 6th Annual Workshop on Wireless of the Students, by the Students, for the Students
  2014

**External Links:**

- Computer Science & Artificial Intelligence Laboratory
  [https://www.csail.mit.edu/](https://www.csail.mit.edu/)
- Networks @ MIT
  [http://groups.csail.mit.edu/netmit/wordpress/](http://groups.csail.mit.edu/netmit/wordpress/)

**Image Gallery:**