

Dirty Bomb Detection and Localization in a Crowd

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Large scale IPSN demonstration in the Vanderbilt Football Stadium

We plan to showcase three exciting technologies in an integrated demonstration. The demo scenario is as follows: a "policeman" will walk around the stadium with a cell phone-integrated radiation detector. The person will also carry an XBow XSM mote that we will continuously track using an enhanced version of the radio interferometric positioning technique introduced at SenSys last year. We will have 10-12 XSMs acting as infrastructure nodes deployed at known positions to enable tracking with ~1m accuracy throughout the stadium. When the radiation detector is in close proximity to a source, it sends an alarm using the mobile phone network. This causes a remote controlled camera to automatically zoom in on the position of the policeman. The large Jumbotron displays in the stadium will be used to show the video.

The tracking will be done using radio interferometry. The tracked node will select a neighbor and the pair will act as transmitters. They will emit radio waves in the 400MHz band that have ~350Hz separation. All other infrastructure nodes will measure the phase of the low frequency envelope signal that is the result of the two signals interfering. The relative phase offset of pairs of nodes provides information on the relative location of the four nodes involved. It is possible to determine the position of one node if at least four other nodes at known positions participate in the measurement. Additional nodes will be used to provide better coverage of the large area and to compensate for errors introduced by RF multipath effects.

The radiation detector is a small, battery-powered gamma detector connected to a mobile phone running a Java application reading the detector output. The output is sent nearly continuously over the phone's mobile data network to a server which checks the received gamma count for a threshold crossing. If an elevated gamma reading is seen, the server interfaces with the XSM system to determine the current location of the policeman and sends an alert to an OGC Sensor Alert Service (SAS) server.

The camera system consists of a controller unit communicating with one or more cameras via a wireless network using the IEEE 1451 protocol. The system can be used to point the camera(s) on demand, based on alert conditions. The controller unit accepts position commands to slew, zoom, and focus a camera on a specific location. The locations are specified as latitude, longitude, and altitude as well as "radius of view," which determines the zooming degree of interest. Additionally, each camera's pan, tilt and zoom capabilities can be directly accessed and controlled over the network.

This integrated demonstration showcases important technologies and potential applications of sensor networks: highly accurate positioning and tracking, sophisticated detection capabilities with clear application to homeland security, and a technique of bridging alarms/data from a remote WSN deployment to a central location.