

Wireless Personnel Localization System (WIPLS)

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Abstract

The WIPLS team has designed and built a system for wireless localization of personnel, which can quickly be deployed into a variety of scenarios without need for preparations. Such a system has a wide range of applications ranging from tracking the location of first responders in an unknown building to military operations conducted in areas with obscured satellite coverage. Knowing the position of a person in an unfamiliar environment can be crucial. One problem currently facing emergency workers is the lack of GPS connection available inside of a building or any covered area. WIPLS' design proposes using several RF sensing trackers to triangulate the position of the target within a building.

To use WIPLS, the target of interest carries a small RF beacon operating in 400MHz, which continuously transmits a signal to the trackers. A minimum of two trackers can be placed around the target area. Each of the trackers features a high gain directional receiving antenna which captures the signal from the beacon. The antenna continuously sweeps back and forth collecting data using a software defined radio (SDR) which is then processed using a BeagleBone Black. Using a magnetometer, the BeagleBone matches the perceived signal strength with the corresponding angle and determines a maximum power angle. The magnetometer alone can only determine the position of the beacon relative to the tracker itself. Therefore to determine the true position it is necessary for the WIPLS trackers outside of the target area to have a GPS signal. Once all of the data has been collected, the BeagleBones communicate with one another in a mesh network using XBee radios. Also connected to the mesh network is a laptop base station which collects the data from the trackers and runs a triangulation algorithm before overlaying the data on a Google Maps graphical user interface (GUI). The GUI wirelessly sends a variety of commands to the trackers including start, stop, and alignment. The triangulation works by pairing the trackers and looking for the intersection point of the vector taken from the maximum power angle. If more than two trackers are used, the points of intersection will create a polygon on the map which indicates that the target is within the shaded area.

For testing and validation, three fully operational trackers and a transmitting beacon were built from the ground up. Testing was conducted in a variety of locations around the Northeastern campus, both with the transmitter inside of buildings and exposed in open areas. The results indicated that the method of triangulation was valid and the trackers could locate the beacon within the polygon created by the GUI reliably. However, the level of precision was unsatisfactory as the magnetometer sensor proved to be ineffective for determining a consistent and accurate angle measurement. It is the belief of the WIPLS team that if a more reliable method for the determination of the antenna angle could be implemented the WIPLS trackers would be a practical and easy to implement solution to the problem of poor GPS reception within a building.