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Autonomous Indoor Localization via Field Mapping Techniques, with Agricultural Big Data Application

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This joint collaboration between the library, the Mechanical Engineering department shows the current research of localizing an Android smartphone using big data collection and sensor fusion techniques. Our original work is "Autonomous Indoor Localization via Field Mapping Techniques which primarily designed as indoor fire and safety aid.

For Agricultural Big Data Use, the Android smartphone is being applied to indoor greenhouse fire, safety and data knowledge design. Such may aid big data tool value to greenhouse fire and safety design and any data that may be important fieldwork considerations.

Our indoor agricultural mapping application may be application to greenhouses in indoor growing labs that promote educational and resource management capacity.

For Big Data management we intend to utilize the CRIS (Figure 1) scientific workflow system and Purdue ionomic information management systems design by Benjamin Branch, Peter Baker, Jia Xu, Elisa Bertino.

Indoor Smartphone Applications

We have shown cell phone geolocation to within 20cm indoors using a magnetic field map, and the magnetometer and inertial sensors available on all smart phones. Our results are from a corridor in the Purdue ME building. Our method is novel and uses the disturbances in the indoor magnetic field vectors—caused by iron in construction, furniture and appliances—as beacons for pin pointing position. Our method is applicable to areas where the magnetic map does not change faster than it can be mapped, i.e., any indoor space where spatial concentrations of ferrous materials remain static such as libraries, offices, or hotels. Our algorithms have clear mathematical properties in that geolocation errors depend only on the resolution of the sensors and the size of magnetic disturbances in the environment.

GIS application:

In prior work, funded by Google Inc., we had to manually construct the map by taking a magnetometer to every square foot of the space, something inconvenient for large scale application. We have developed algorithms to automate this map construction, using only data from cell-phone users—various sensor measurements from cell phones including inertial data, magnetic fields, and wireless signal strength from both cell towers and Wi-Fi access points. They need a lot of testing both in single user and multi-user scenarios to understand the efficiency of real-time map building in practice. Our algorithms use a combination of virtual pedometry [1], ranging to wireless transmitters, and magnetic field measurements (as in references [2] and [3]).

Current geolocation algorithms:

- received signal strength (RSS), error 3-5m
- time difference of arrival (TDOA), error 2-3m
- radio frequency identification (RFID), error 3-5m
- our algorithm (Magnetic map), error 1.5-2m

Future Considerations: Include Google’s Tango Project where we are working to bring into our toolset for application and discovery

References:

