Development of the System for Wearable Audio Navigation (SWAN): An Interdisciplinary Challenge

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Motivation for SWAN

- System for Wearable Audio Navigation
- Wayfinding tool for those who cannot *look* or cannot *see*
- Accessibility applications (blind)
- Tactical applications
Wayfinding via Auditory Display

- Determine user’s location
- Figure out what’s around them (parks, curbs, poles, buildings, benches, etc.)
- Represent each object with unique sounds
- Listener learns what a location “sounds like”
- Also add audio waypoints along a path to destination
Attach Sounds to Objects: How?

- **Accurate** Head Pose required
  - 6DOF Needed!
  - GPS can’t do it alone

- Transform Object location into head-centered coordinates

- 3D Sonification
Interdisciplinary Requirements

• Electronics/Computer Engineering
  – Sensor array, devices, hardware

• Computing
  – Merging the sensor data, extracting location and 6 DoF pose
  – Producing 3D audio, rest of SWAN proper

• Psychology
  – Perception, cognition, action, map-making
  – Evaluation, usability/performance testing

• Music, Design, HCI
  – Auditory and Visual Interfaces
SWAN System Overview

Sensors
- GPS1
- GPS2
- Compass
- iCube
- Temperature
- Time
- Etc.

VRPN → MERGE → POSE → SWAN

Camera processing

Local cache
GIS
Server
Localization via Sensor Fusion

• Multiple Sensors, Sensor Fusion Required
  – Cameras
  – Maps
  – GPS
  – Compass
  – Head tracker
  – Thermometer
  – Light meter
  – Clock, calendar
  – etc.
Sensor Fusion via Particle Filters

• Samples approximate 2D pose probability density
Include Map-based Priors

- Maps fetched from GIS
- Biases particle filter to stay on course