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 <u>look</u> or cannot <u>see</u>
- 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 <u>Head Pose</u> 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



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