Indoor Location, Tracking, and Routing

Wolfgang Hall, Esri
Tobias Donaubauer, Infsoft
Robert Garrity, Esri
Michael Healander, GISi indoors
Agenda

- Indoor Logistics Overview
- Indoor Mapping (Esri)
- Indoor Positioning (Infsoft)
- Indoor Routing (Esri)
- Indoor Application Development (GISi indoors)
- Q&A
GIS Indoor Logistics Overview

Wolfgang Hall, Esri
Indoor Logistics

• Find my own or other’s location indoors
• Perform geo-analysis on location
  - Geo-trigger based on geo-fenced areas
  - Find closest (room, person, etc.)
  - Route to location
• Safety
• Emergency management
• Space planning based on occupancy
• Asset management
• Indoor pattern analysis
Indoor Logistics is used in many places

- **Asset Management**
  - Workforce tracking and optimization
  - Asset tracking

- **Healthcare (RTLS)**
  - Infection tracking
  - Resource optimization

- **Emergency Management/Security**
  - Positioning of victims
  - Indoor routing of rescue teams
  - Indoor tracking for safety/security
Wolfgang: I am here! Myles, Where are you?

Myles: Dude, someone hijacked our room!
RFID Industrial Complex Tracking (Oil and Gas)
Correction Facility Sample App
Ingredients of an indoor logistics solution

- Map
- Positioning Technology
- Analysis
- Application
Esri’s Indoor Logistics
High-level GIS functions for indoor logistics

- Mapping
- Locating
- Tracking
- Routing
- Pattern Analysis
- Facility Data Model

Indoors App

ArcGIS
Project Challenges
Remote teams

8 weeks to complete project with team spread across the globe.
UC Indoors Components

Mobile App

Dashboard App

Infsoft

WiFi Locating

Online

Basemap

GeoEvent Processor

Network Analyst

Map Services

Server
GIS Indoor Mapping

Wolfgang Hall, Esri
Planning
Noise Modeling
Space Management
Safety
Energy Management
Infection tracking
Emergency route
Indoor Positioning

Tobias Donaubauer, Infsoft
About Infsoft

- Tobias Donaubauer, CEO
- German company
- Founded 2005
- Indoor navigation & indoor positioning
- FOCUS: Software development
Technology

- Uses all sensors of device
- Offline available
- Position is calculated on the device
- Seamless indoor and outdoor positioning
- No Hardware installation
Setup

1. MAPS
2. WIFI CALIBRATION
3. VALIDATE DATA & UPLOAD TO LIVE SERVER
4. INTEGRATE IN EXISTING APP
Define calibration routes
Calibration
Data Validation
Data Validation
Integrate in existing App

```java
public class MainActivity extends Activity implements LocationListener {
    private LocationManager locationManager;

    @Override
    public void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);

        // get the location manager
        locationManager = locationManager.getService(this);

        // request location updates
        locationManager.requestLocationUpdates(this, 2000, 1, this);
    }

    @Override
    public void onLocationChanged(Location location) {
        // release location manager
        locationManager.removeUpdates(this);
    }
}
```
Erri User Conference (UC)
Indoor positioning
UC Facts and Stats

- About 2,500 WiFi access points used for positioning
- About 30,000 WiFi references point measures
- Samsung S3 and Motorola Razor
- 4 people within 4 hours
- Size of calibration map: 0.5 MB
Tobias Donaubauer
CEO

Phone +49 8407 939 680 0
tobias.donaubauer@infsoft.de
Indoor Routing

Robert Garrity, Esri
Walkways
Web App from 2010 UC
ESRI UC2013: Indoor Navigation App

- Android App by Geographic Information Services, Inc.
- Indoor positioning
- Route from anywhere to a room
Data for Routing

- Network dataset?
  - Models possible paths
  - References point and line feature classes
  - ArcGIS Network Analyst extension
Digitizing the Network
Walkways

- Room-to-room routing
  - Main walkways
Purple lines: Main Walkways
Purple lines: Curves on Main Walkways
Digitizing the Network

Transitions

- Room-to-room routing
  - Main walkways
Digitizing the Network
Walkways

- Anywhere-to-room routing
  - Catching input points
Digitizing the Network

Walkways

- Anywhere-to-room routing
  - Catching input points

Wide Hallway

Narrow Hallway
Digitizing the Network

Walkways

• Anywhere-to-room routing
  - Catching input points
Digitizing the Network

Walkways

- Anywhere-to-room routing
  - Catching input points

Exibit Hall
Digitizing the Network

Walkways

- Anywhere-to-room routing
  - Catching input points
  - Fishnet
Fishnet--Snapping
Shortest routes on a fishnet
Shortest routes on a fishnet

Still 40% Longer
Shortest routes on a triangular lattice
5% Longer

Shortest routes on a triangular lattice
Shortest routes on a triangular lattice

10% Longer
Putting the triangular lattice indoors
Cover the extent of your study area with the lattice
Routes on the overlay
Modeling walls
Reconnecting at doorways
Danger: Stragglers
Danger: Stragglers
Finished Lattice for One Floor
Routes ‘Bounce’ Off Diagonal Wall
Adding Hallway Centerlines
Lines Need Type Attribution
Network Dataset Can Avoid Lattice Lines
Other Walkway Attribution

- 3DLength/Shape_Length
- WalkTime (sec)*
- Level
- BuildingID
- Z
Floor Transitions
Digitizing Transitions
Transition Attribution

- TransitionType
- 3DLength
- WalkTime (sec)*
- FromLevel
- ToLevel
Network Dataset
### Connectivity Groups:

<table>
<thead>
<tr>
<th>Source</th>
<th>Connectivity Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>FloorTransitions</td>
<td>Any Vertex</td>
</tr>
<tr>
<td>Walkways</td>
<td>Any Vertex</td>
</tr>
</tbody>
</table>

### Elevation Model:

- None
- Using Z Coordinate Values from Geometry
- Using Elevation Fields

Any Vertex Connectivity & True-3D Elevation Model
### Network Dataset Properties

Specify the attributes for the network dataset:

<table>
<thead>
<tr>
<th>Name</th>
<th>Usage</th>
<th>Units</th>
<th>Data Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>AvoidLatticeLines</td>
<td>Restriction</td>
<td>Unknown</td>
<td>Boolean</td>
</tr>
<tr>
<td>AvoidSecondaryLines</td>
<td>Restriction</td>
<td>Unknown</td>
<td>Boolean</td>
</tr>
<tr>
<td>Length3D</td>
<td>Cost</td>
<td>Meters</td>
<td>Double</td>
</tr>
<tr>
<td>UseWheelchair</td>
<td>Restriction</td>
<td>Unknown</td>
<td>Boolean</td>
</tr>
<tr>
<td>WalkTime</td>
<td>Cost</td>
<td>Minutes</td>
<td>Double</td>
</tr>
</tbody>
</table>
Geoprocessing Model
Geoprocessing Model To Solve Routes

- Takes a Route layer
- References a script tool capable of changing UseWheelchair restriction
- Adds locations or locations.
  - Feature set as input.
  - Always removes existing locations
- Solves Route
- Get all the source features (lines)
Challenges

• Join GP tool was slow.
  - Solution: Used ... instead
• Slow locating on dense network.
  - Solution: Search tolerance < 7 meters
• Bug with locating stops on the ends of 3D lines.
  - Located on junctions instead.
• Working remotely
  - Memory, base maps, aerial photos, street view
Indoor Application Development

Michael Healander, GISi Indoors
Tag You’re It: Zombies
Consumer Mobile Apps
Indoor Navigation
Indoor Navigation Apps
Consumer Mobile App
Indoor Analytics
Indoor Consumer Mobile App Analytics
Indoor Business Analytics

Anonymous
Indoor Business Analytics System
Map, search, routes, triggers
AND MORE!
How does it all fit together?
GeoEvent Processor Difficulties

It’s Beta!
GeoEvent Processor Difficulties

Field mapping
GeoEvent Processor Difficulties

Floor Level
GeoEvent Processor Difficulties

AGOL Sync
The GeoEvent Processor GeoFence Model
Exiting, Entering, Dwelling in a Geofence
Geofence Management
The GeoEvent Processor AGOL Model
Gymnastics
Analytics Display?
Operations Dashboard
Indoor Analytics
Crafted. Indoor. Experiences.

Mapping, positioning, analytics. We hand-craft products & services to create actionable insight around your indoor people, places, & things.

http://www.gisiindoors.com
Summary

W. Hall
GIS Indoor UC app

- Mobile App
- Dashboard App

- Infsoft
  - WiFi Locating

- Online
- Server
- Basemap
- GeoEvent Processor
- Network Analyst
- Map Services
Q & A

All