Specifying and Verifying Location Events with Panoramic

Evan Welbourne, Magdalena Balazinska, Gaetano Borriello, James Fogarty

Motivation

- $2B+ market for real-time location by 2019
- Increasing dependence on complex events
  - ex: Hospital workflows
- Events must be customized to site needs

State-of-the-Art

- Storyboard metaphor for specifying complex events
- Pictorial icons represent people, places and things
- Word icons represent basic spatio-temporal events
- Real-time grammar checker ensures correct syntax
- Sequential structure facilitates translation
- Covers > 80% of events in survey of 100+ apps

Goals

1) Low-cost customization w/complex events
   - Web-based end-user tool
   - Quick, easy-to-understand specifications
   - Easy to verify behavior and/or debug
2) Low-cost location technology
   - Works with low-cost, unreliable sensors

Specification

Iconic Visual Language

- Timeline Overview
  - Zoomable, scrollable overview with filtering
  - Leverages users' natural understanding of temporal events
  - Clusters events vertically; shows why detection worked or did not
  - Reveals over-specification, under-specification and timing errors
- Drill-down into timeline to view trace for some window
- Map panels auto-track individual people or objects
- Helps user distinguish specification errors from sensor errors

Detection

- Specifications are translated into finite state machines
- Raw sensor data transformed into probabilistic data
- Lahar system detects events over historical traces
- Output signals are merged and filtered

Verification

- Specifications are translated into finite state machines
- Raw sensor data transformed into probabilistic data
- Lahar system detects events over historical traces
- Output signals are merged and filtered

XML Specification

translator

RFID Antenna

No Sensor Data

Particle Filter

Tag Reads

Smoothed Probabilistic Location

Event Signals

Filtered Signals

Event Manager

Lahar

Metadata / Caching

MStreams

Event Bands

Clicking Label highlights Events

Overview Bands

HOURS

DAYS

Timeline Overview

Playback Cursor

Event Thumbnail

Event Info Bubble

Event Description

Precise Timing Information

Timeline Overview

Timeline Overview

Timeline Overview