The Architecture of Future Automotive Applications based on Web Technologies

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(JSI, AIFB, KSRI)
Agenda

- Motivation
- Overview
- Memory: Virtual Knowledge Base
- Interoperation Layer
- Conclusions
MOTIVATION
Motivation

- Besides reaching B from A, a driver has other goals, e.g.,
  - Adjusting delivery routes according to traffic
  - Finding cheapest petrol station along the route
  - Handling the radio and phone

Result:

Motivation

A rare example of a driver solely concentrated on driving

Motivation

A lot of assistants help out in the background with a convenient speech interface
Motivation

- Formula 1 solution is impractical for widespread use: costs of about 1,000 USD / kilometer

  source: http://www.faz.net/aktuell/sport/formel-1/was-kostet-die-formel-1-ein-teures-rennvergnuegen-1257804.html

- Our proposed solution:
  Driver assistant systems based on
  - Speech recognition
  - Virtual knowledge base integrating data from the web
  - Logical inferences
  - Statistical learning
OVERVIEW
High-level Architecture
Overview of Architecture

- **Speech I/O: Conversational interface**
  - use patterns only to help us converting text to logic
  - reasoning engine to control the conversation
  - replies: use Cyc’s reasoner logic-to-language translation
  - reasoning lets us get rid of the need for lots of prepared patterns

- **Stream I/O**
  - constant stream of data and events
  - source: car sensors, web streams, user sensors
  - representing information about car, environment, user
Data I/O: Linking Open Data Cloud

- Linked Data (RDF data accessible via HTTP lookups), 2006
- Yearly growth rates of ~200%
- Many datasets, covering descriptions of millions of entities
- Large number of interlinked distributed disparate small data sources rather than single-source single-organisation knowledge bases

source: [http://lod-cloud.net/](http://lod-cloud.net/)
Combining and Using I/O Channels

- All the data is put in a virtual knowledge base (more in a minute)
- Interoperation layer relates data from different channels (more in two minutes)

- Based on the data infer new knowledge
  - Logic reasoner (exact methods)
  - Learning component (statistical and heuristic methods)
MEMORY: VIRTUAL KNOWLEDGE BASE
INTEROPERATION LAYER
Memory: Virtual Knowledge Base

- Based on Linked Data and REST principles

- Basic abstraction: a resource
  - different representations, e.g., a POI as 3D XML, RDF, or JPEG
  - resources have references (links) to other related resources, e.g., leading to the next step in a series of operations
  - support standard operations: CRUD

- A resource has an identifier (HTTP URI)
- The identifier specifies a way to access information about the resource (performing a HTTP lookup)
- The information is in standardised format (an RDF graph describing the resource using its identifier)
Interlinking in Linked Data

- Establishing equivalencies across sources, e.g.,
  car:currentDriver owl:sameAs facebook:JohnDoe
  (car: stands e.g. for http://localhost/...)

- All statements about JohnDoe also apply to current driver
  and vice versa

- Using URIs across services, e.g.,
  car:car :location car:point
  car:point foaf:based_near wikipedia:Rome
Streams, Services and Compositions

- Streams, either (depending on frequency of updates)
  - just do not close HTTP connection and continue to list
  - pull “stream source” regularly

- Services / dynamic data / data with limited access patterns
  - integrate with Linked Data

- How to build
  - applications,
  - compositions,
  - workflows

- based on REST resources?
Linked Services

- **Linked Services:**
  - service approach based on web architecture (REST)
  - describing web resources with RDF/Notation3 aspects: input, output, relation between input and output)
  - linking between: services, descriptions, data in input and output

- **CRUD operations on resources**


Production Rules for Linked Services

- Decentralised linking between resources
- Use production rules to specify composition of resources
- Depending on current state of knowledge base (KB):
  - invoke new services (add their output to KB)
  - find links to new services in the KB

Example: navigate to gas station

Steffen Stadtmüller, Andreas Harth. „Towards Data-driven Programming for RESTful Linked Data“. Workshop PSW, ISWC 2012.
CONCLUSIONS
Conclusions

- Using web technologies to provide assistant system to driver’s at reasonable cost

- Speech interface based on logic reasoning

- Web technologies enable interoperability
  - new sources can be added on demand
  - pay-as-you go for integration
  - we can tap the long tail of sensors and data sources
Thank you for your attention.

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