Linking Artificial Intelligence and IoT in Smart Cities

IoT Week Bilbao 2018

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Smart Cities Presents Great opportunities for IoT!
Current IoT is cloud-centric
What is the problem on this?
We have a dream
a swarm of cooperating ... 

... devices!
The Swarm at the Edge of the Cloud

Edward A. Lee, Jan Rabaey, Björn Hartmann, John Kubiatowicz, Kris Pister, Alberto Sangiovanni-Vincentelli, Sanjit A. Seshia, John Wawrzynek, and David Wessel
University of California at Berkeley

Roozbeh Jafari
University of Texas at Dallas

Douglas Jones
University of Illinois at Urbana Champaign

Vijay Kumar, Rahul Mangharam, and George J. Pappas
University of Pennsylvania

Richard M. Murray
California Institute of Technology

Anthony Rowe
Carnegie Mellon University

The Cloud
Mobile access
Sensory swarm

Edward A. Lee
University of California at Berkeley

Tajana Simunic Rosing
University of California at San Diego

David Blaauw, Prabal Dutta, and Kevin Fu
University of Michigan

Carlos Guestrin and Ben Taskar
University of Washington
Our Paradigm: Edge Centric

a Swarm of smart devices!
Living specimen Swarms perform complex tasks
Cities Presents a Swarm Behaviour
SWARM Networks

- Autonomous
- Heterogeneous
- Collective Intelligent
- Spontaneous relationships
- Open networks
- Energy Efficient
Swarm OS Control Plane: An Architecture Proposal for Heterogeneous and Organic Networks

Laisa C. P. Costa, Student Member, IEEE; Jan Rabaey, Fellow, IEEE; Adam Wolisz, Member, IEEE; Max Rosan; and Marcelo K. Zuffo, Member, IEEE
Swarm Minimum Broker: an approach to deal with the Internet of Things heterogeneity

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GloTS Paper Session: IoT Enabling Technologies II

GIOTS
Paper Sessions
- Tuesday Jun 05 11:30 AM to 01:00 PM (1 hour 30 minutes)
Where: Euskalduna Jauregia Conference Center - Sala A3.1
Key challenges
Communication

Niches around standards

Interoperability

Scalability
Communication

Legend:
- **devices** in the swarm network
- **device** that starts interaction
- **device candidate** for interaction
- **device chosen** for interaction
- **direct connection** between devices
- **automatic execution** of services among devices

1. **semantic matching** functionality-based
2. **automatic service execution**
3. **automatic service composition**
MicroEconomy
Service Level Agreement
Micropayments
Reputation
Access Control
Human Interaction

Personal agents
Opportunistic user interface gathering
Interaction with a complex network
Swarm challenges
Services wrap device functionality
Broker: a communication mediator
Pursuit Swarm Applications in Cities
Example:

Finding Penny
Many sensors at Environment to help

- ar quality sensor
- garage door sensor
- smart door
- security camera
- electronic babysitter
- smart bulb
- cat feeder
Where is Penny?

- Who is Penny?
  - Her cat

- What is a cat
  - {animal, mammal, weight is between [ ] ...

- Have you seen a cat?
  - Have you heard a cat?
  - Did you sense any presence?
Semantic Computing

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  - Her cat

Where is Penny?

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Semantic Computing

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ask the network
Computer Vision

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Collective intelligence from network

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Where is Penny?
Public Transportation
Surveillance Swarm applicability

- Bus stop state on strike
- Remotely check a line
- Monitoring an area on strike
- Look for stolen cars and bikes
Swarm Flight Traffic Safety
Renewable Energy
Swarm Management
Swarms at The Edge and Smart Cities

Swarms and Cities have a lot in common:

Complex
Organic
Heterogeneous
Thank you!

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