Towards a distributed discovery of smart services in the Social Internet of Things

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workplan

Problematic
& Objectives

Prototype

Context

Proposal
solution

Future
works

Context

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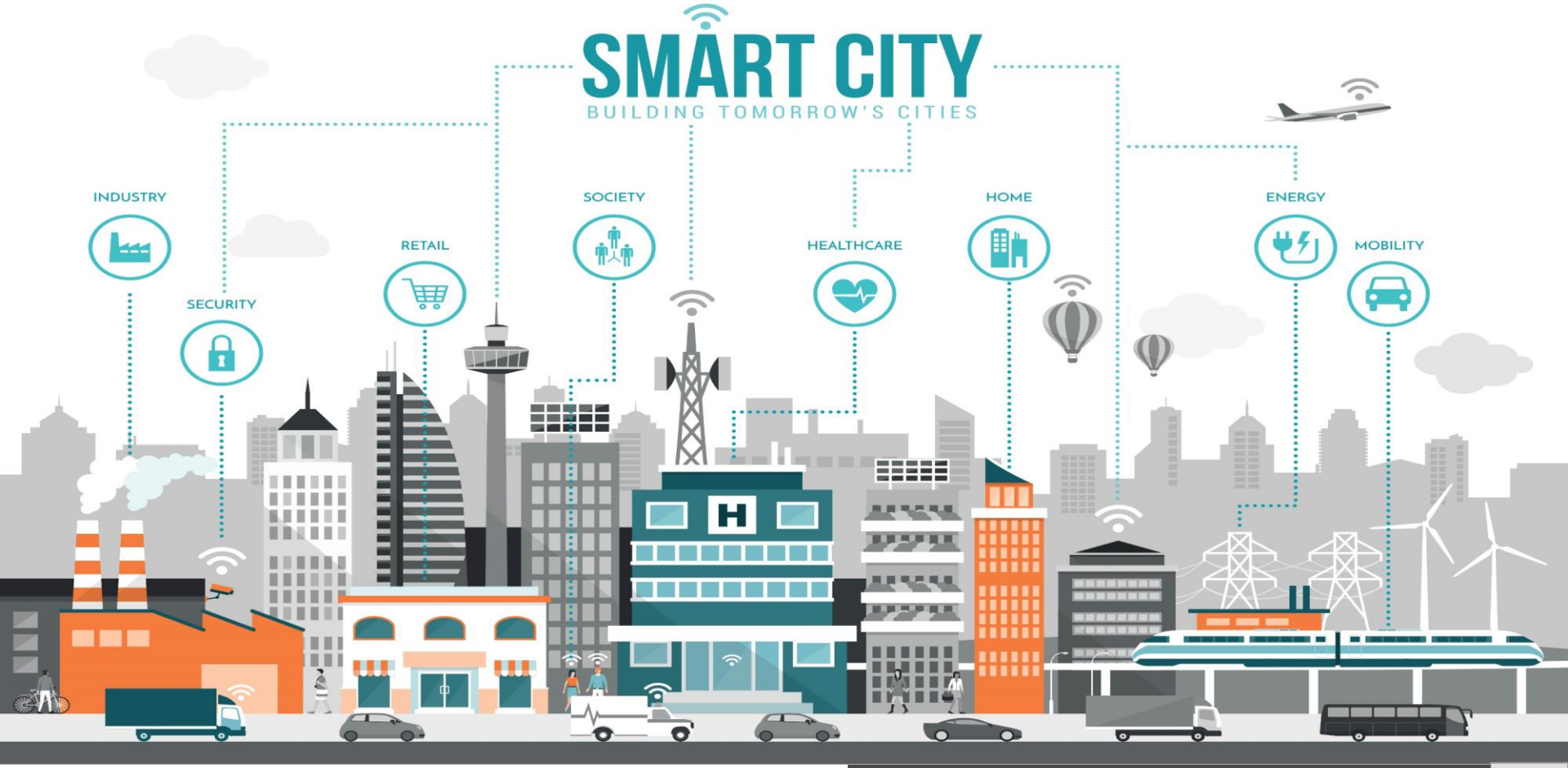
SMART CITY
BUILDING TOMORROW'S CITIES
INDUSTRY
SECURITY
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Problematic & objectives

- Heterogeneity of IoT devices and their communication technologies.
- Enormous number of IoT objects are connected together → a search for the exact service from an object is difficult, and hence the issue of scalability arises.
- Connected vehicles applications are sensitive to the context of their environment and latency → propose adequate solutions.

Proposed solution

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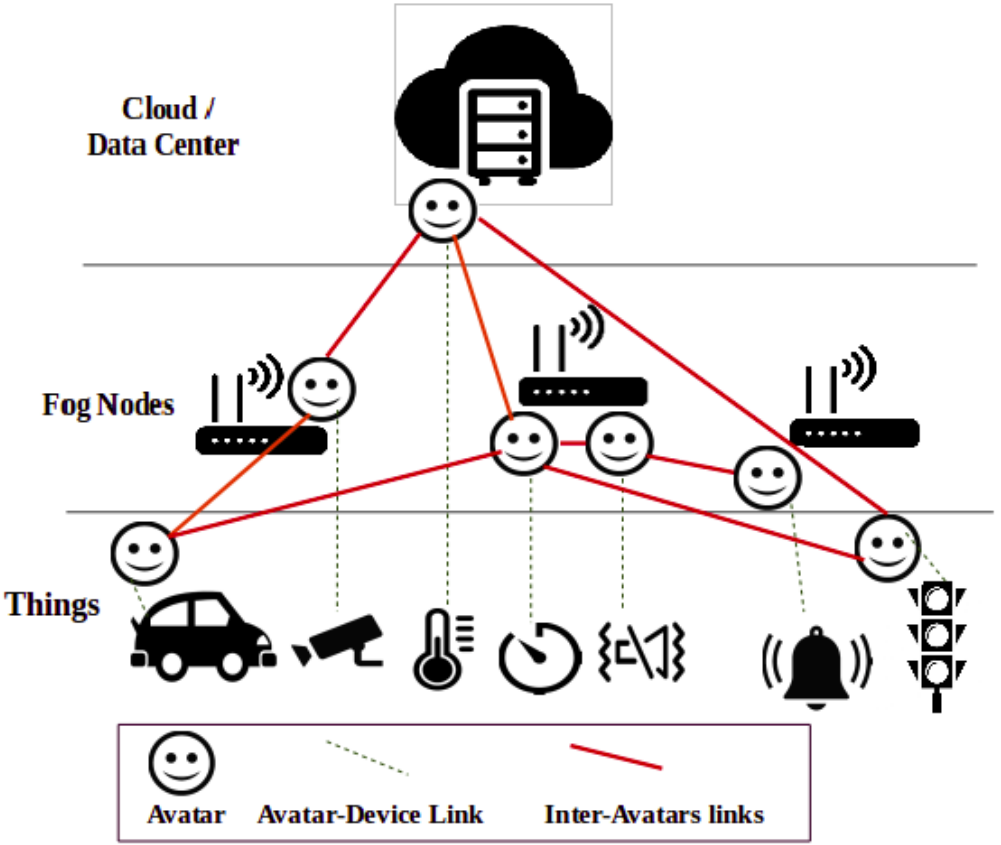
Avatars

Artifact of a physical or software entity on the Web.

Several features:
Autonomous reasoning, Device management, and Collaborative capabilities.



Global avatars based architecture

Avatars collaboration

Social network + Web of Things
= Social Web of Things

- Navigability
- Scalable
- Trustworthiness

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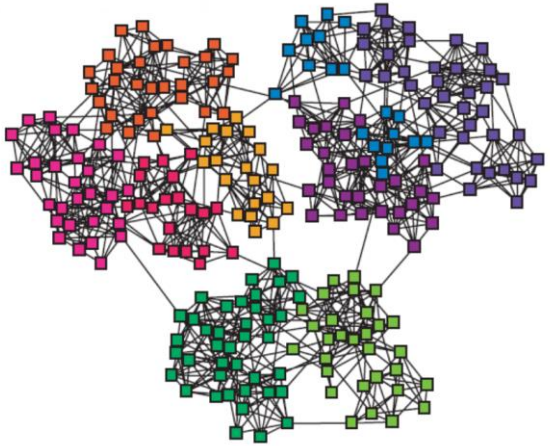
Clustering and repartition in groups

- Unsupervised learning
- Decrease the search space



System model and assumptions

- An avatars system is modeled as a graph G=<A, E, SD>

Where A is the set of avatars, E is the set of edges modeling social links between them and SD represents the social distance associated with a given edge.

- Each avatar provide one or more IoT services.
- Each avatar can accept or refuse the request of another one.

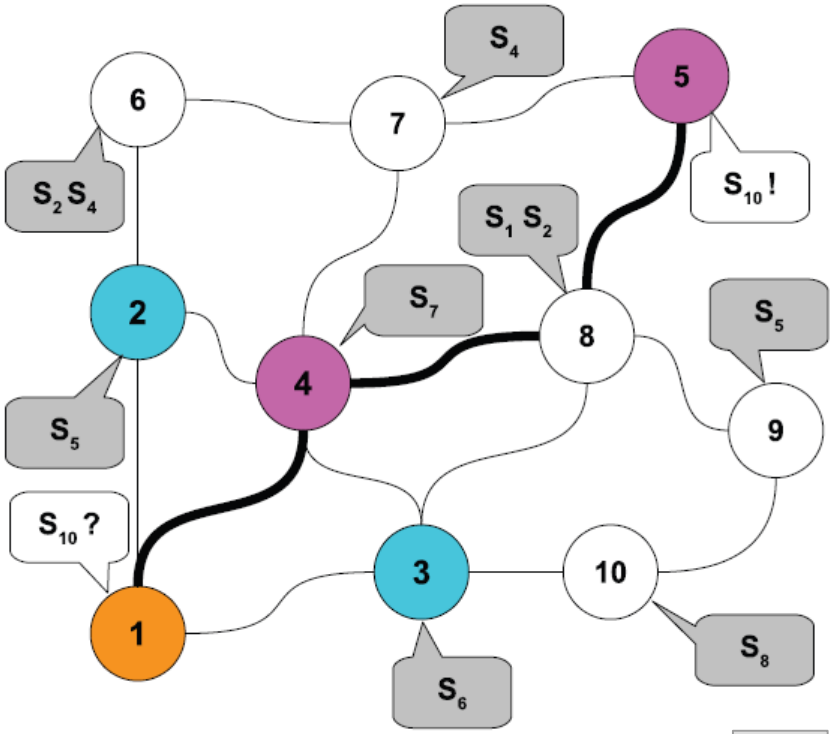


Fig. 1. Representation of the network nodes.

SWoT relationships

Four types of relationships have been defined for this paradigm [Atzori & al. 2011]

01 Co-work Object Relationship (C-WOR)

02 Co-Location Objects Relationship (C-LOR)

03 Parental Object Relationship (POR)

04 Ownership Object Relationship (OOR)

Fuzzy C-means Algorithm

Inputs: set of neighboring avatars A = {A1, A2, ..., Ak}, number of clusters C, data matrix X= $\begin{bmatrix} x11 \dots & x1f & \dots & x1k \\ \dots. & \dots & \dots. \dots & \dots \\ xi1 \dots & xif & \dots & xik \\ \dots. & \dots & \dots. \dots & \dots \\ xc1 \dots & xcf & \dots & xck \end{bmatrix}$

Output: a partition of C clusters of avatars.

Step 1: Build a membership matrix in a random way. $U= \begin{bmatrix} u11 \dots & u1f & \dots & u1k \\ \dots. & \dots & \dots. \dots & \dots \\ ui1 \dots. & uif & \dots & uik \\ \dots \dots. & \dots & \dots. & \dots \\ uc1 \dots & ucf & \dots & uck \end{bmatrix}$ $Such\ as:\ \sum_{j=1}^{c} uij = 1$

REPEAT

Step 2: Calculate the centroid of each cluster $$Cj = \frac{\sum_{i=1}^{k} [uij]^m\, xi}{\sum_{i=1}^{k} [uij]^m}$$

Step 3: Calculate the degree of membership of an avatar i to the cluster j. $$uij = \frac{1}{\sum_{k=1}^{C} \left(\frac{||xi-cj||}{||xi-ck||} \right)^{\frac{2}{m-1}}}$$

UNTIL Convergence (when the membership matrix U is no longer substantially modified.*)*

Step 6: Define final clusters

For each cluster: order the avatars according to their degree of membership and choose the first p avatars as cluster members.

Distributed discovery of IoT services

Social network building

Classification of Neighbors in C clusters

Designation of an elected avatar for each cluster.

For each abstract task composing the objective→send a request to the elected avatar of the cluster responsible on the requested functionality

Check if the elected avatar or the members of its cluster can perform the task

Propagation of the query in the social network of the elected so on

Use case

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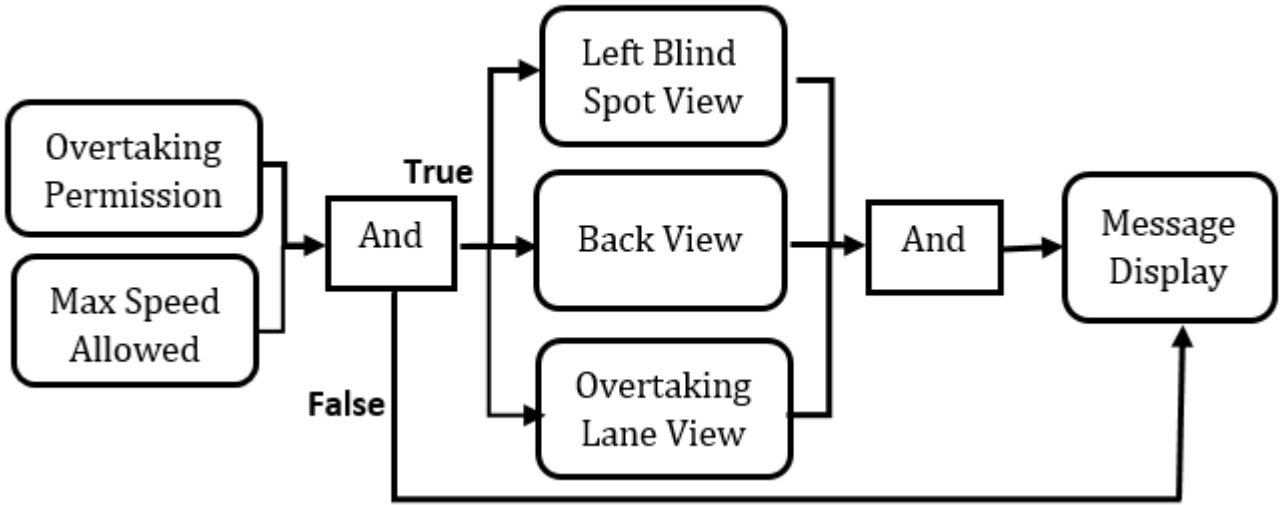
Overtaking scenario

- Overtaking is one of the most dangerous scenarios due to lack of visibility.

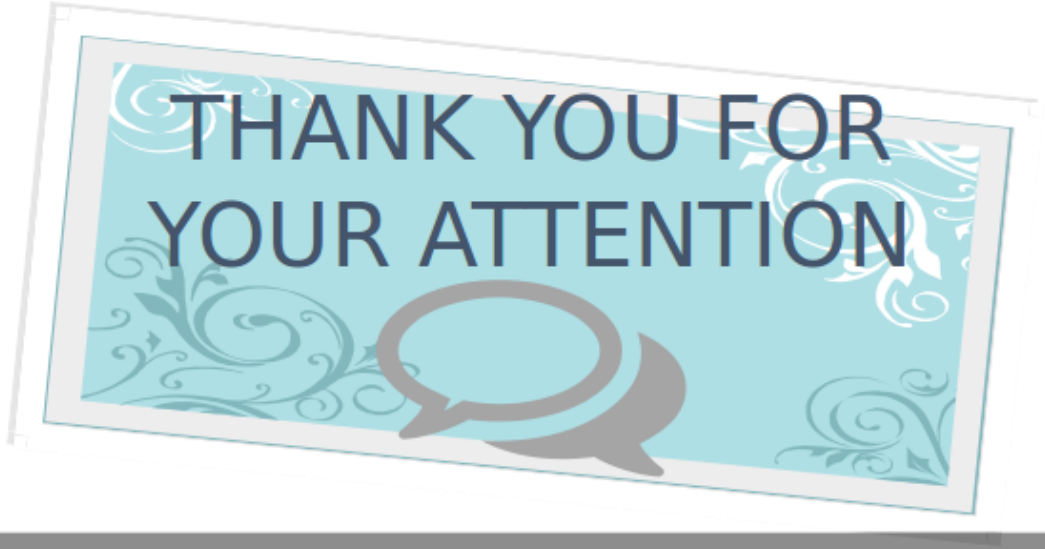
- Use social relationships with vehicles and devices around to ensure better visibility

Overtaking process modeling



Future works

Avatars based system management	• Control the execution of the initial composition and adapt it to the context
Overtaking use case	• Finalize the realization of the overtaking scenario.
Solution implementation	• Finalize the implementation of our solution and prove its performances
QoS	• Integrate QoS into our solution



QUESTIONS ?

Bibliography

[Atzori & al. 2011] L. Atzori, A. Iera and G. Morabito, “SIoT: Giving a Social Structure to the Internet of Things,” Communications Letters, vol. 15, no. 11, pp. 1193-1195, Nov. 2011.