

Apport des systèmes multi-agents à l'interaction tangible sur table interactive RFID

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Introduction

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- Global typology of **large interactive surfaces**:



Wall

(ex.: CityWall, Helsinki)

Floor (ex.: Catchyoo)



Large screen

(Ex.: *Minority Report* movie, 2002)



Shop window (or advertising panel)

(Ex.: Vitrine Chanel, Tokyo)

<http://www.youtube.com/watch?v=NdGcIW66q3s>



Tabletop (Ex.: TangiSense V1)

<http://www.gbm.co.jp/gbm-catchyoo/case/case01.html>

Introduction

Tangibility and interactive tabletops: basic concepts

- Since about 25 years: **Tangible User Interfaces** (TUI); more and more studies, prototypes and products

- ISHII and ULLMER (1997) : to manipulate **real objects** which are integrated into a **virtual environment**



Reactable

- « Tangible User Interfaces (TUIs) are those in which physical objects are used to represent and control **computational abstractions** » (BLACKWELL *et al.*, 2007)
- To **break the barrier** of the touch created by the mouse (MOGGRIDGE, 2006)
- Digital information: directly **palpable** (tangible) by the hands and **perceptible** by our senses (ISHII *et al.*, 2001)



⇒ **New types of applications using tangible interaction**
in our case: interactive applications using multi-agent technologies

Agenda

- Interactive tabletops
- *TangiSense*: hardware and software architecture
- *TangiSense*: modelling
- *TangiSense*: demonstrators (selection)
- Conclusion and research perspectives

Interactive tabletops

- New interaction platforms
- Collaborative and co-localized workspaces, allowing several users to interact (work, play...) simultaneously



DiamondTouch (1999)
(Dietz & Leigh, 2001)



ReacTable (2005) (Jordà et al., 2006)
(used by **Björk** during concerts)



Microsoft Surface 2.0/PixelSense
(2011, with Samsung)

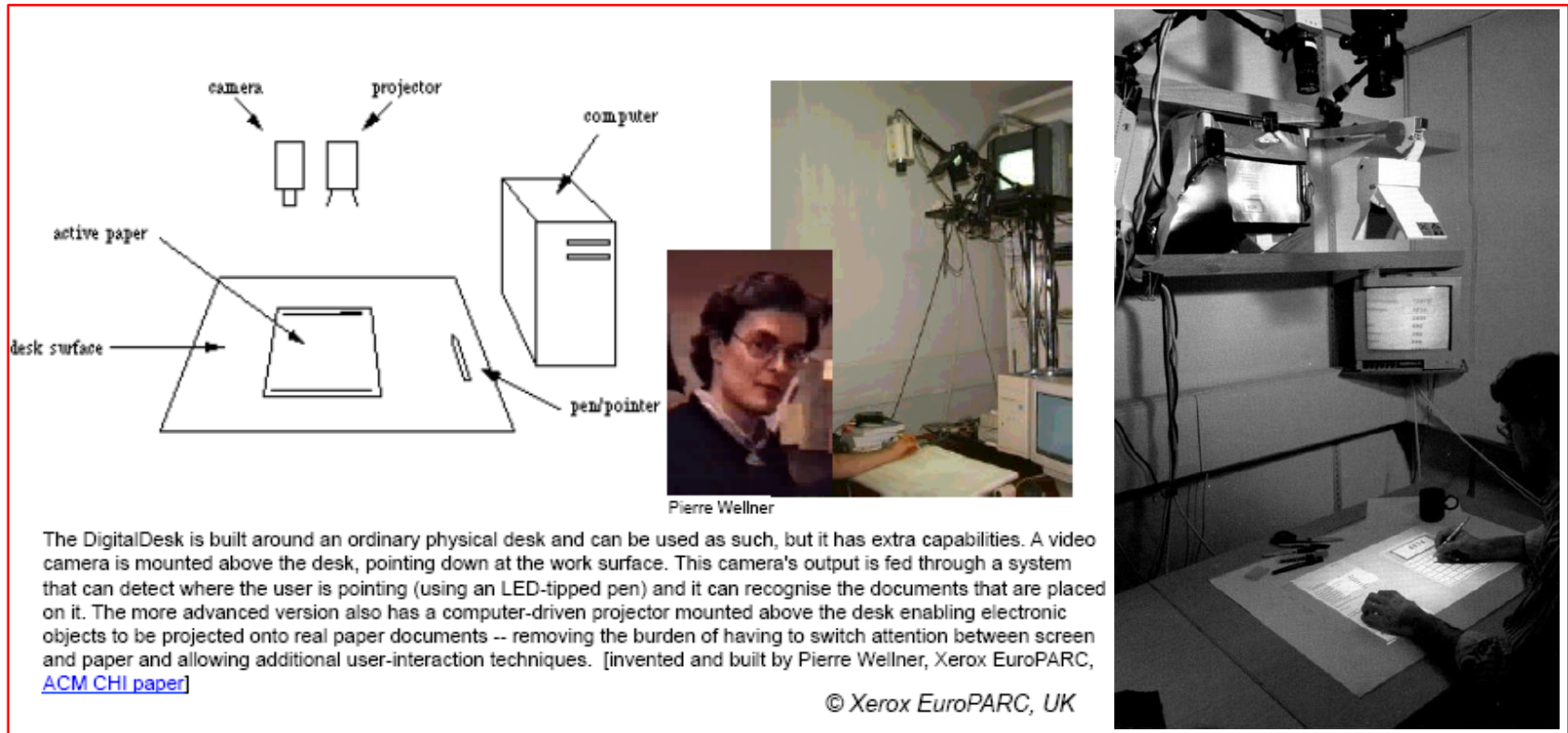


Silver Concept, Lille, 2014, applications for seniors
in specialized centers

Interactive tabletops

- **Growing interest** for these platforms:

➤ *First prototype:* **Digital Desk** (Pierre Wellner, 1991)



The DigitalDesk is built around an ordinary physical desk and can be used as such, but it has extra capabilities. A video camera is mounted above the desk, pointing down at the work surface. This camera's output is fed through a system that can detect where the user is pointing (using an LED-tipped pen) and it can recognise the documents that are placed on it. The more advanced version also has a computer-driven projector mounted above the desk enabling electronic objects to be projected onto real paper documents -- removing the burden of having to switch attention between screen and paper and allowing additional user-interaction techniques. [invented and built by Pierre Wellner, Xerox EuroPARC, [ACM CHI paper](#)]

© Xerox EuroPARC, UK

➤ Movies, TV series, many prototypes, several commercialized products, dedicated conferences and workshops, PhD Thesis, books...



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- TangiSense: equipped with **RFID** technology

- Technology which enables the user to manipulate tangible objects
- **Tangible** objects equipped with RFID tags
- RFID Tags which offer the possibility to track objects, to store data into objects or to superimpose objects

- based on a **Multi-Agent System** (**JADE** platform)

- Each (virtual or tangible) object = one agent
- The table has an Artificial Intelligence

- Thanks to our **partners**:

- ANR TTT Project, 07-10, Partners: LIG, LAMIH, CEA, RFIDées 
- ANR IMAGITProject, 10-13, Partners: LAMIH, LIG, RFIDées, Supertec 
- CITC-EuraRFID
- PRES Lille Nord de France, CISIT 
- CCI Grand Hainaut, ARACT



*Tiles composing the first version of the tabletop
(source: RFIdées company)*

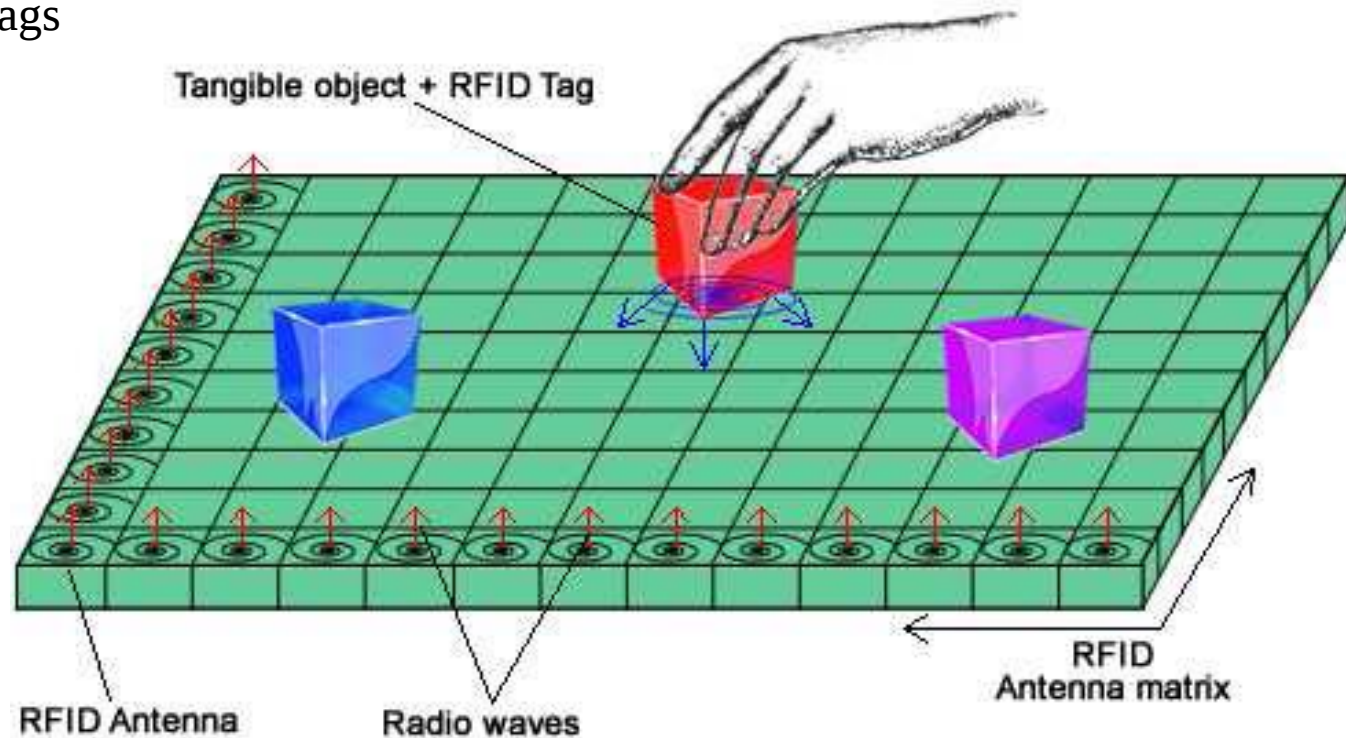


*TangiSense tabletop
(during an experiment)*

TangiSense: hardware and software architecture

- **RFID** (Radio Frequency Identification) as a capture technology:

- contactless technology, massive use in many industries, identification at a distance (in our case, max: 2 to 3 cm), without vision system
- Use of passive tags

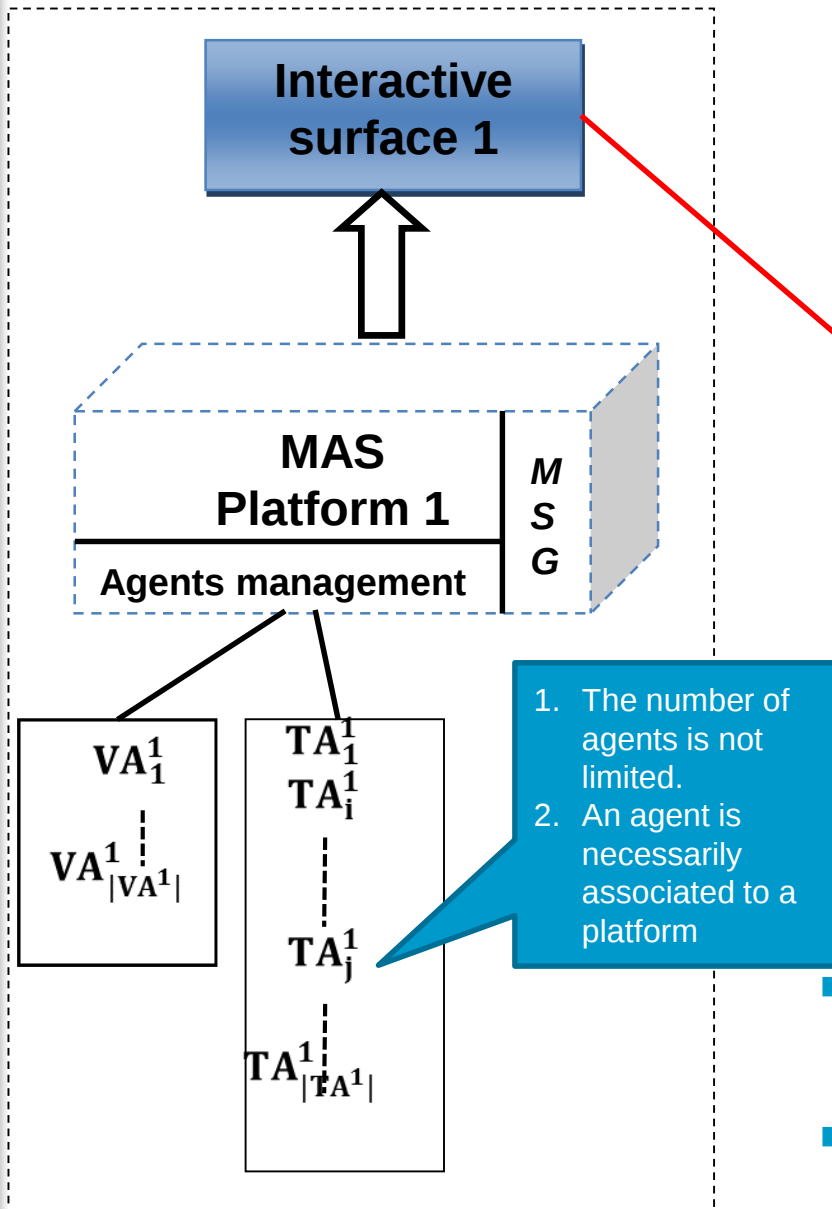


TangiSense: second generation (Integrated HD screen)



ANR IMAGIT Project, 2013

Architecture for one tabletop:



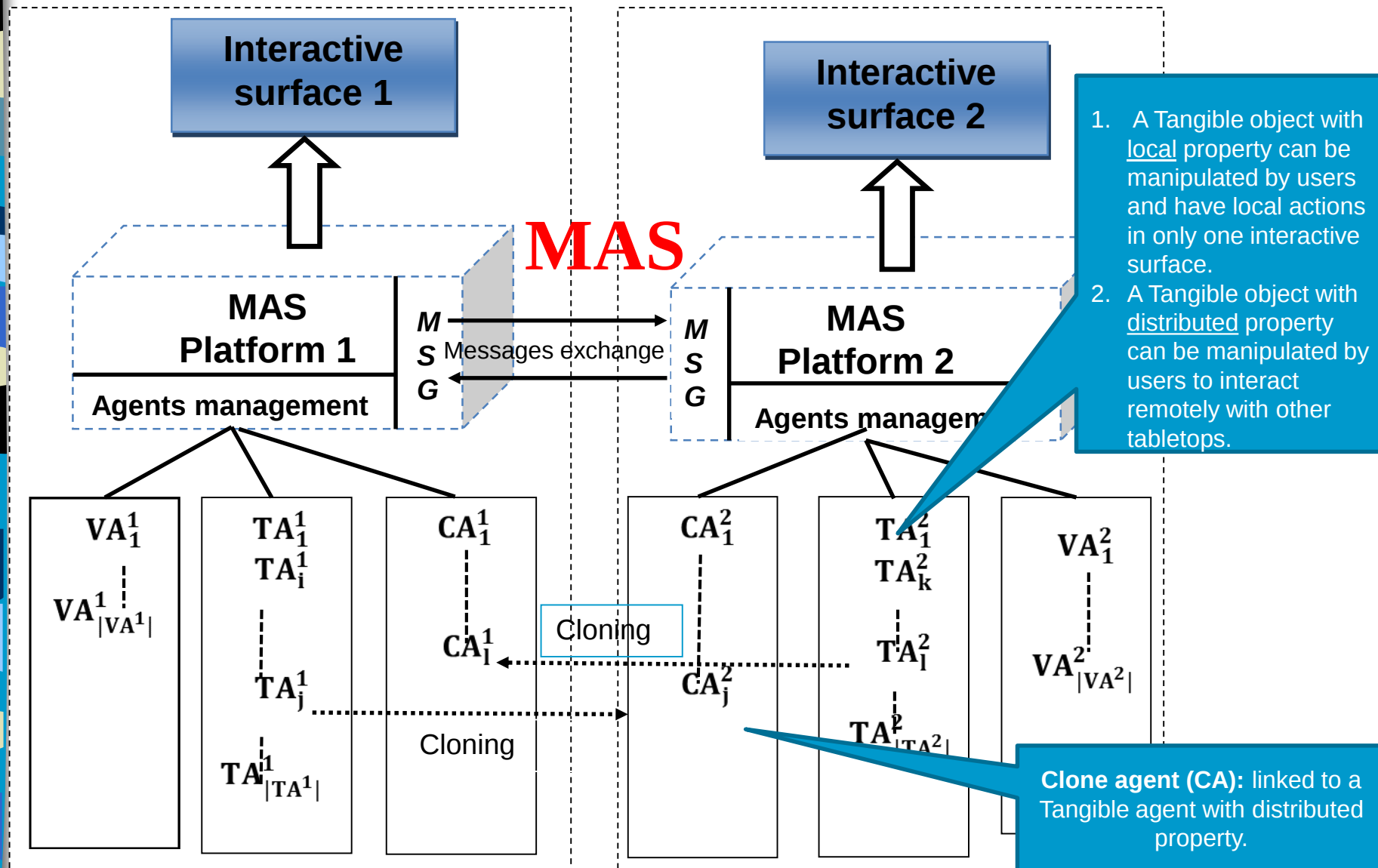
agents management: to create, to delete, to search, etc.

messages protocols (MSG): to exchange information between agents

■ **Virtual Agent (VA):** associated to virtual objects with a graphical representation on the interactive support

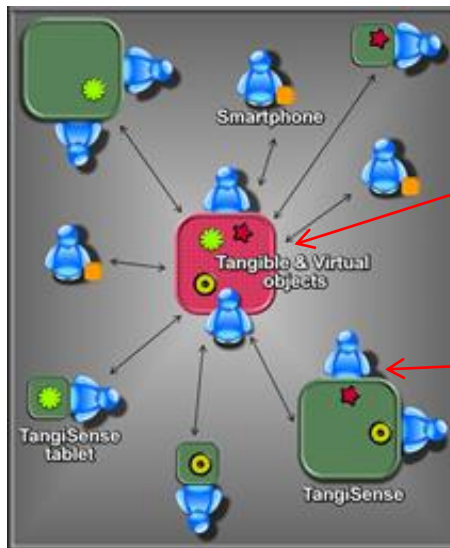
■ **Tangible Agent (TA):** connected to a Tangible object

Our proposition for $n (=2)$ surfaces :



From TangiSense interactive tabletop to distributed surfaces

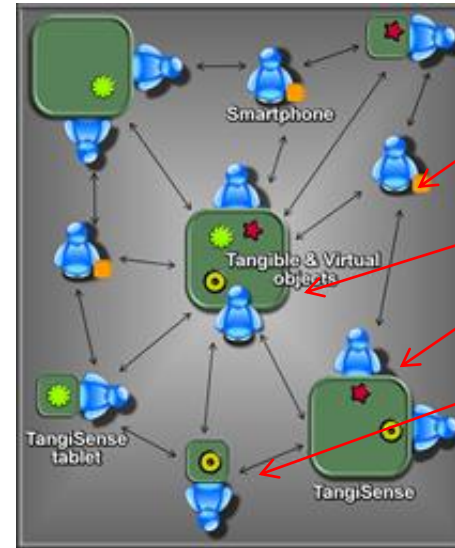
- **Centralized distribution of UI:** one « master » table and « slave » platforms



UI_1 is completed on master tabletop

UI_2 is a subset of master tabletop UI_1

- **Network of DUI:** autonomous platforms



UI_1

UI_2

UI

UI_3

$UI = f_1(UI_1) + f_2(UI_2) + f_3(UI_3)$

Functions to consider:
complete duplication, partial duplication, part extraction...

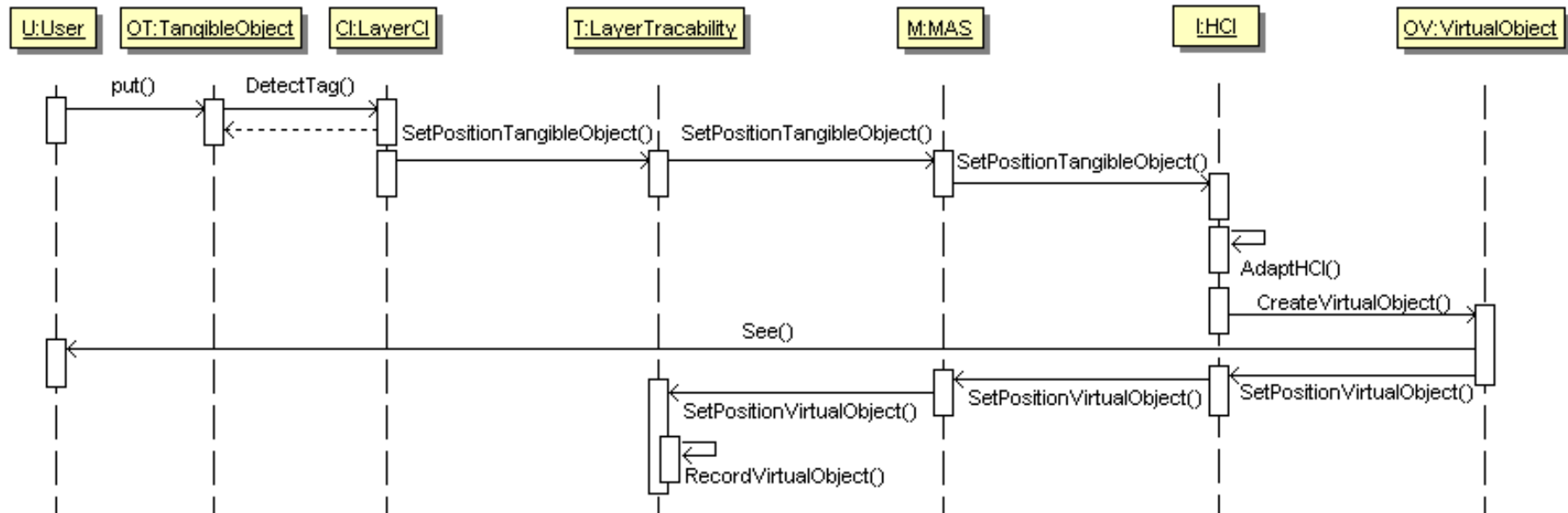
- A DUI can be a restriction, a global view, a local view
- Each user can be responsible of « his/her area »

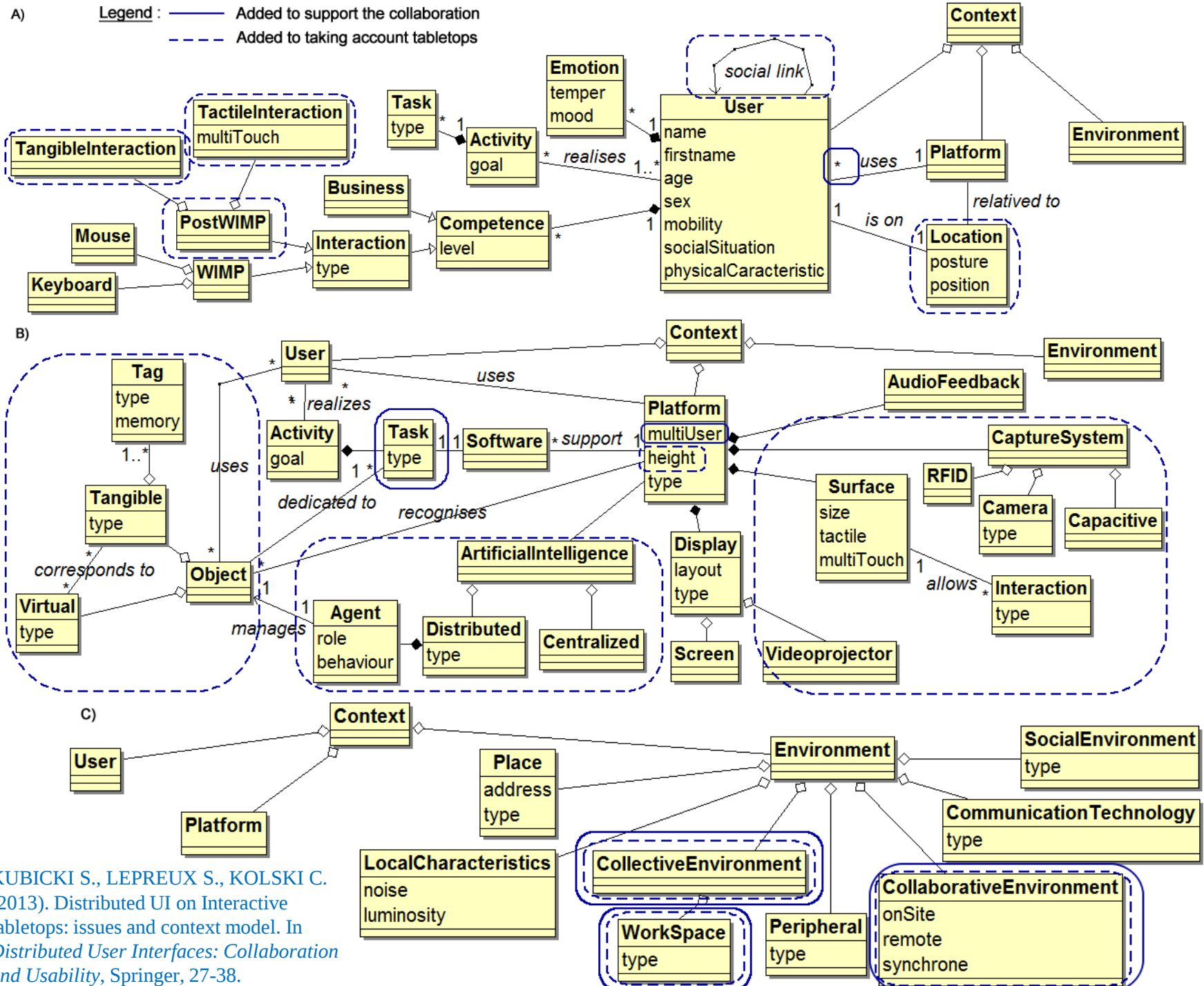
Lepreux S., Kubicki S., Kolski C., Caelen J. (2011). Distributed interactive surfaces using tangible and virtual objects. *Proceedings Workshop DUI'2011 "Distributed User Interfaces", at CHI'2011, Vancouver, Canada, pp. 65-68, may, ISBN 978-84-693-9829-6.*

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Modelling of the interactions (UML diagram sequence)





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- *TangiSense*: demonstrators (selection => **with distribution**)
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Demonstrator: Cooking ideas

Read also:

LEBRUN Y., LEPREUX S., HAUDEGOND S., KOLSKI C., MANDIAU R. (2014). Management of Distributed RFID Surfaces: A Cooking Assistant for Ambient Computing in Kitchen. The 5th International Conference on Ambient Systems, Networks and Technologies, ANT-2014 (June 2-5, 2014, Hasselt, Belgium), Procedia Computer Science, 32, Elsevier, pp. 21–28.

- A **Cooking Assistant** for Ambient Computing in Kitchen:

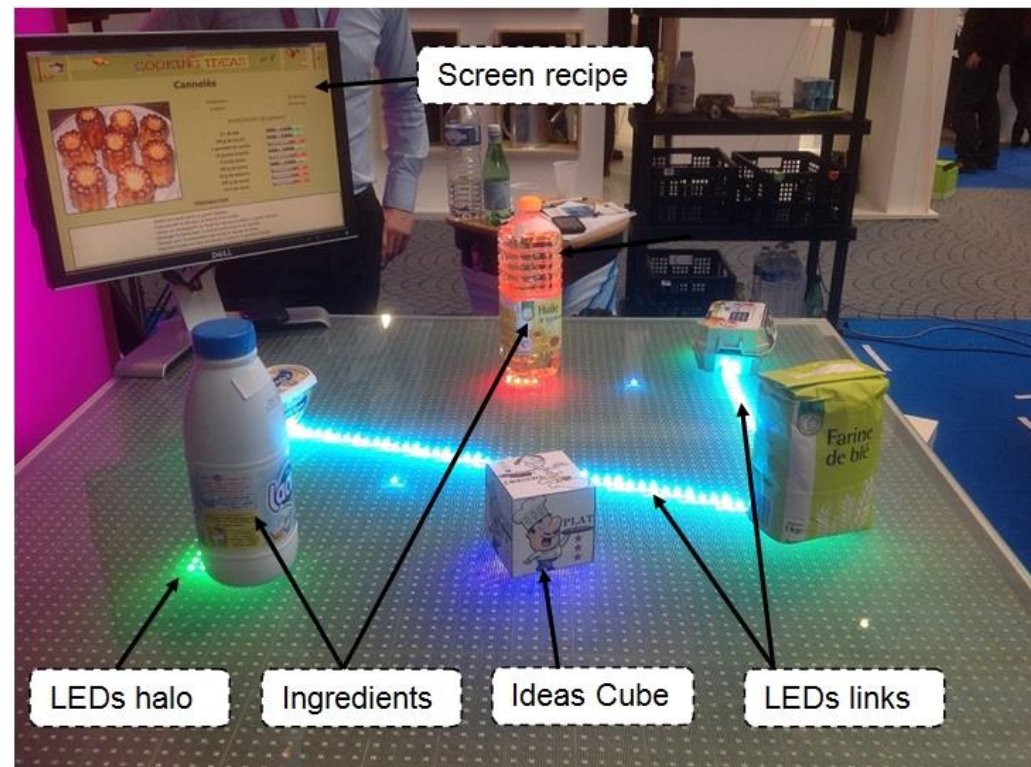
- Equipments: TangiSense tabletop, remote screen
- Use everyday ingredients: Ingredients equipped with RFID tags
- Learn the user's habits: User ID with a RFID card, Restricted ingredients, Special diets, etc.
- Suggest recipe ideas: dishes, desserts

Virtual objects/agents

- Feedback on the interactive table
 - LEDs halo
 - LEDs links
- Feedback on the screen
 - Useful information for making the recipe

Tangible objects/agents

- Ingredients
- Ideas cube : several faces
- User card



Cooking ideas on TangiSense

Demonstrator: Road traffic management

Read also:

KUBICKI S., LEBRUN Y., LEPREUX S., ADAM E., KOLSKI C., MANDIAU R. (2013). Simulation in Contexts Involving an Interactive Table and Tangible Objects. *Simulation Modelling Practice and Theory*, 31, pp. 116–131.

LEBRUN Y., ADAM E., MANDIAU R., KOLSKI C. (2015). A model for managing interactions between tangible and virtual agents on an RFID interactive tabletop: Case study in traffic simulation. *Journal of Computer and System Sciences*, 81, pp. 585–598.

Road traffic management

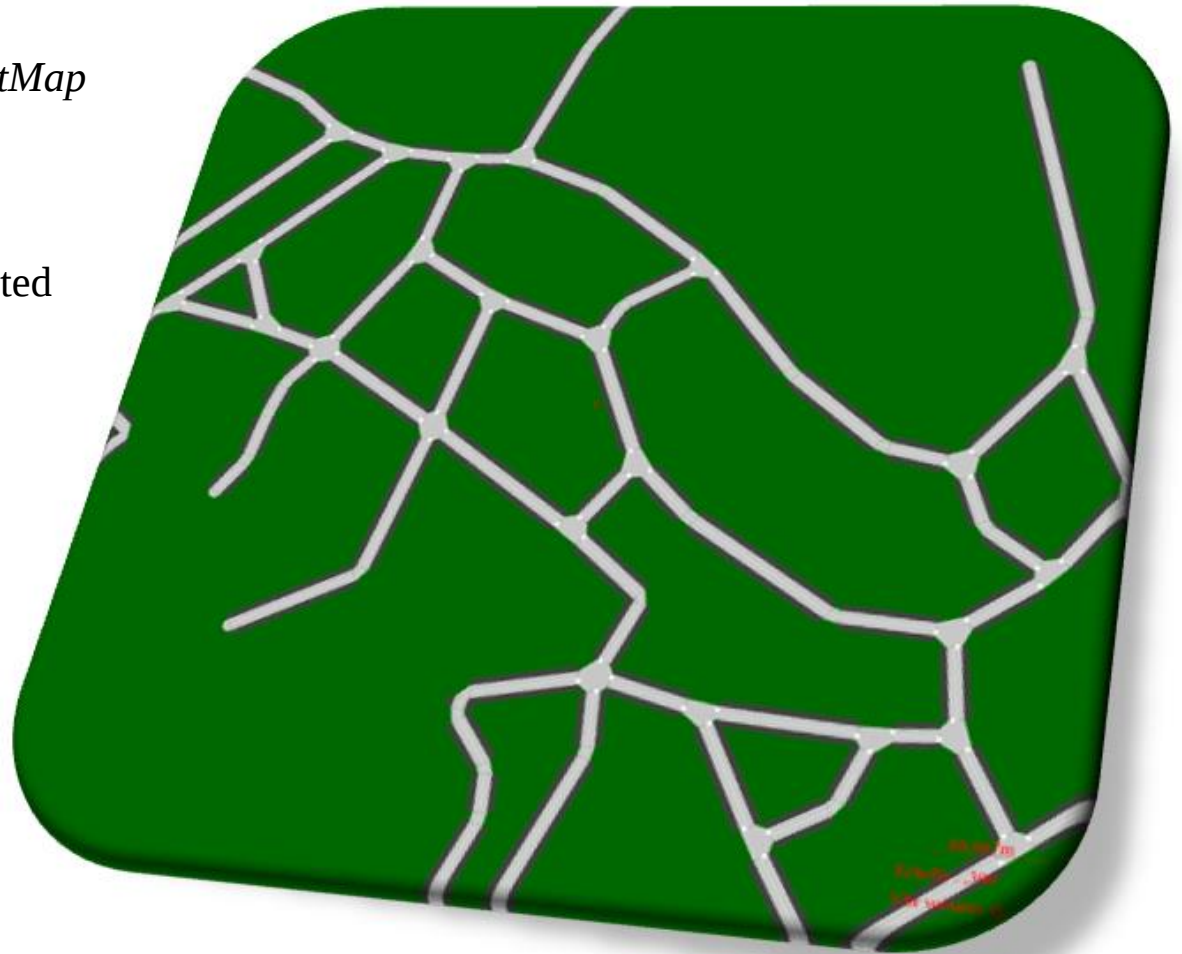
Basic concepts:

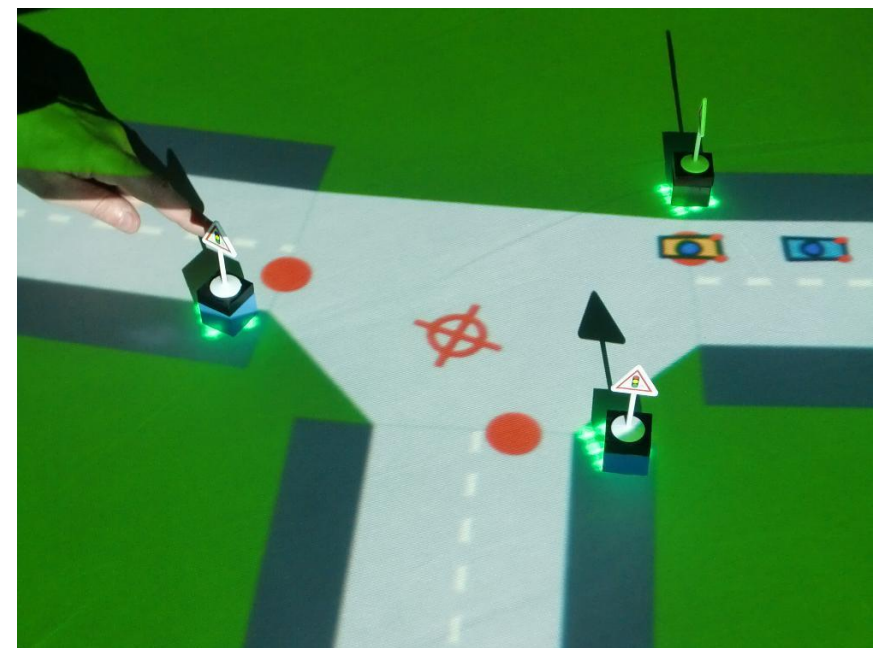
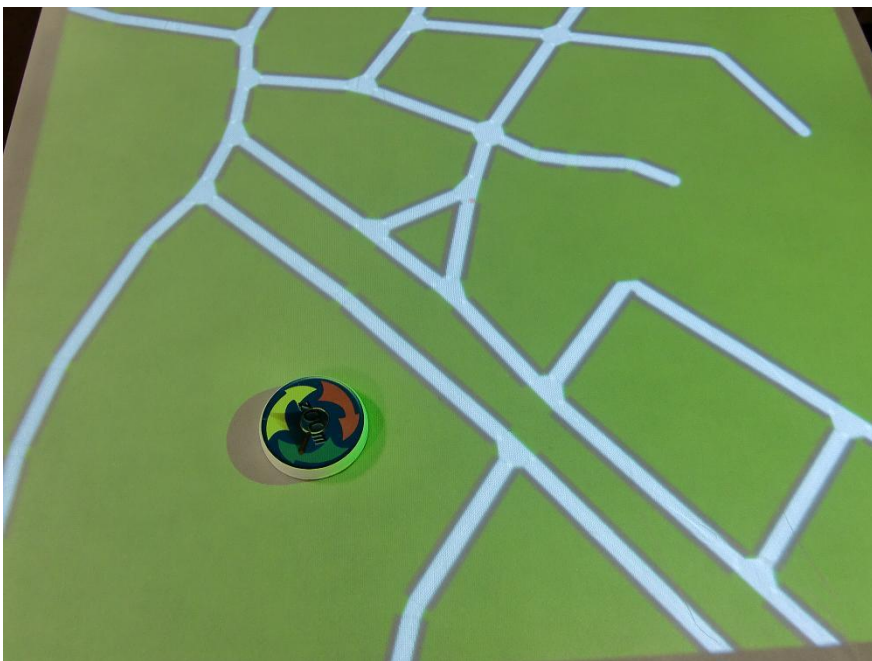
- **Road infrastructures:** allow to manage the road traffic
- **Users:** experts in security, architecture, transport, pollution...
- **Tangible objects / agents:**
 - Infrastructure objects (traffic lights, road-signs...)
 - Tampon (creation of new vehicles)
 - ...
- **Virtual objects / agents:**
 - Roads
 - Vehicles
 - ...

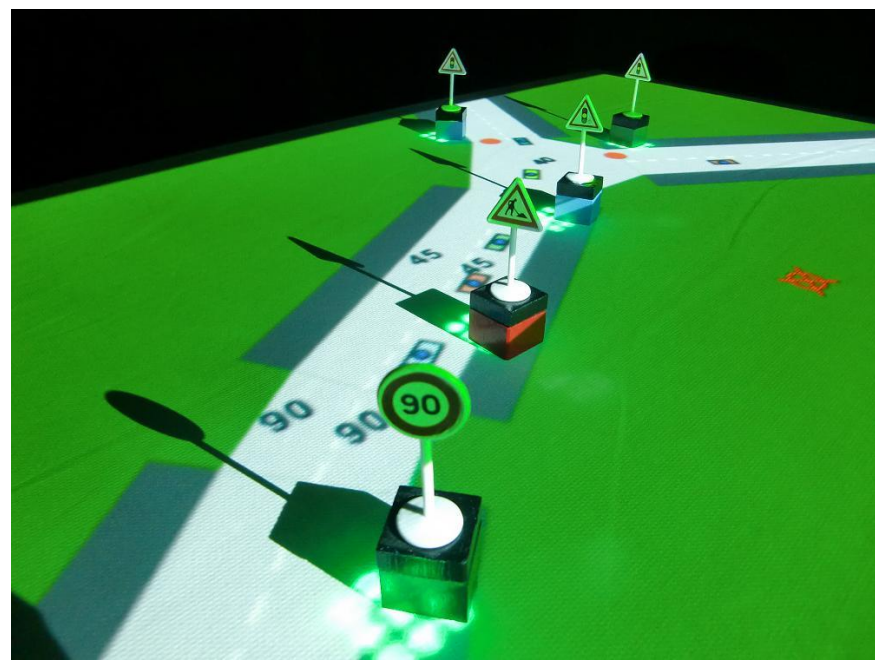
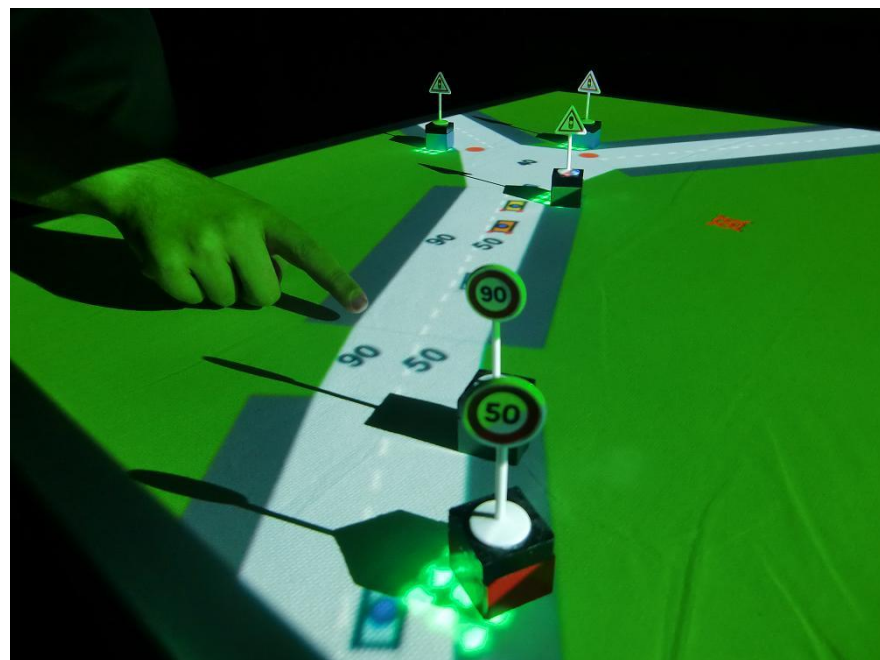
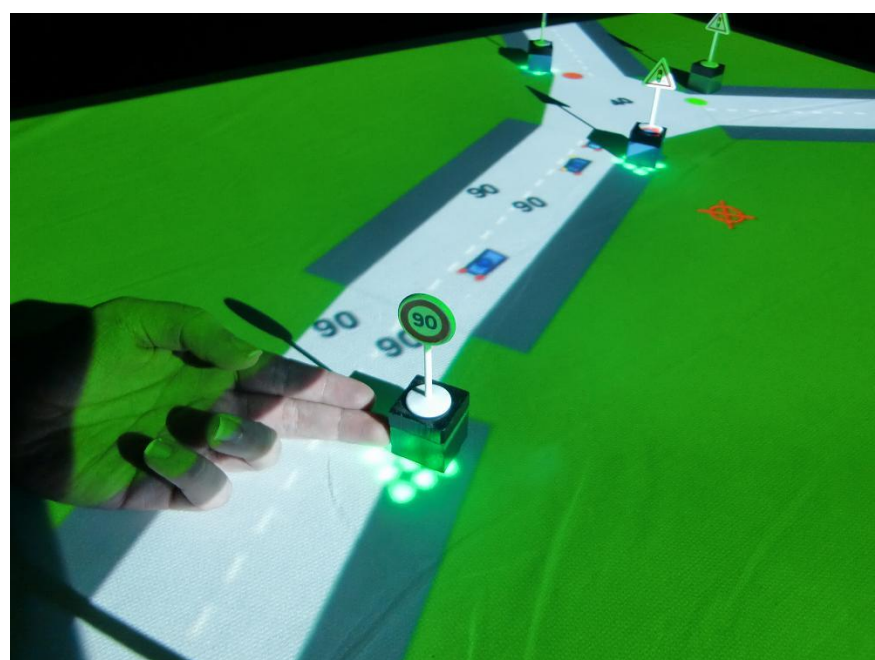
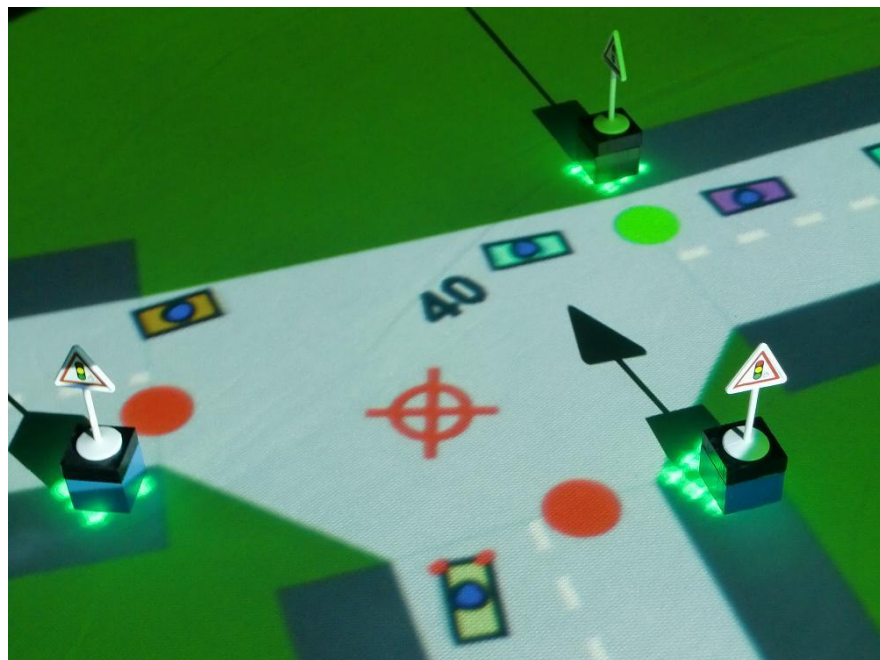
Application:



- **Geographical data:** *OpenStreetMap*
- Transform data into **XML**
- Generate an oriented and weighted **graph**







- Case study: Crisis management unit

❑ Several entities collaborate:

- Regional authorities
- Policemen
- Firemen – chief or agents
- Journalists

❑ Using several platforms distributed:

- *TangiSense* tabletop(s)
- Smartphone(s)
- Tablet(s)
- Etc.

❑ Centralized distribution:

- One *TangiSense* tabletop is « master »
- Other platforms: slave



Lepreux S., Kubicki S., Kolski C., Caelen J. (2011). Distributed interactive surfaces using tangible and virtual objects. Proceedings Workshop DUI'2011 "Distributed User Interfaces", at CHI'2011, Vancouver, Canada, pp. 65-68, may, ISBN 978-84-693-9829-6.



<http://www.autonews.fr/dossiers/votre-quotidien/140364-bouchons-belgique-paris-ralenti-etude>



<http://www.theroadtothehorizon.org/2008/03/news-dubai-biggest-in-road-accidents.html>



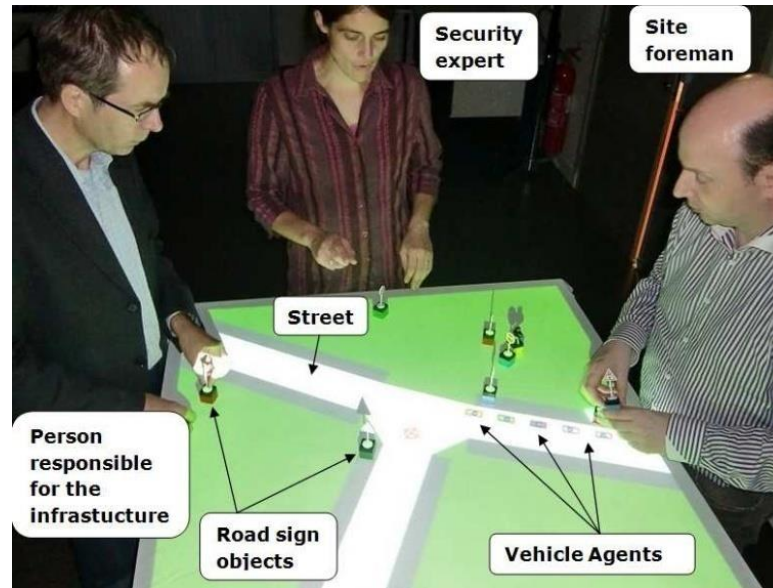
<http://www.abc.net.au/news/2013-01-19/flames-from-bushfire-jump-across-west-head-road/4472334>



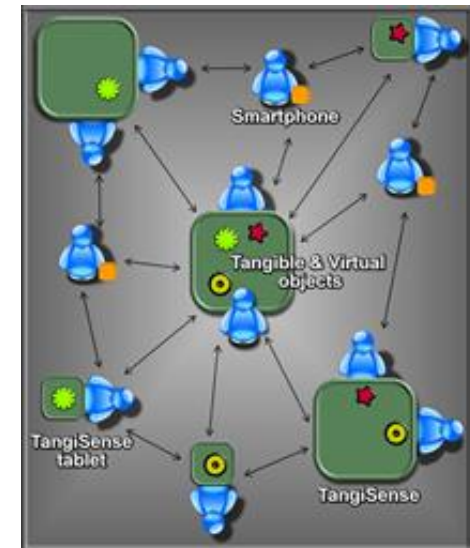
http://izismile.com/2009/03/12/roads_and_road_problems_in_russia_21_photos.html

Simulation: focus on road traffic management

- **Road traffic management** application: to be distributed on several tabletops



Kubicki S., Lebrun Y., Lepreux S., Adam E., Kolski C., Mandiau R. (2013). Simulation in Contexts Involving an Interactive Table and Tangible Objects. *Simulation Modelling Practice and Theory*, 31, pp. 116–131.



(Research in progress)

Road traffic management: first distributed version

Tabletop 1



Tabletop 2

- The **common work space** for the two user groups consists to collaborate on the same road map with the same initial traffic flows
- The representation of the workspace: changed using **tangible objects** of interaction

Road traffic management: first distributed version



Tabletop 1

Tabletop 2

- The user groups can collaborate on a **common problem** or on **different spatial areas**

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Conclusion and research perspectives

- Many researches and developements concerning **Tangible User Interfaces (TUI)**, **interactive tabletops**
- **Several capture technologies**
 - => Technology used in our researches: **RFID**
- **HCI + MAS => Tangible Interaction**
- Several **demonstrators**: finished or in progress, or envisaged
- Numerous possible **studies and experiments** (in general, or using *TangiSense* in particular)
- Current research ways studied: **distributed interactions**, **generic tangible objects (tangigets)**, **dynamic objects...**

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MERCI POUR VOTRE ATTENTION

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