Rapid Prototyping of Context-Aware Games

Kimmo Koskinen[1] kimmo.m.koskinen@iki.fi
Riku Suomela[2] riku.suomela@nokia.com

[1]Lappeenranta University of Technology, Finland

[2]Nokia Research Center, Finland

July 5th, 2006
2nd International Conference on Intelligent Environments

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Introduction

- Location aware applications are commonly used
  - Navigation (e.g. TomTom, Route66), searching for services (e.g. google maps), routes, restaurants
- Location easy to understand for game developers
  - Mapping real world to virtual world
  - Location as input data
- Other contexts still straight-forward in sense of data types
  - For example weather: wind speed and direction, humidity...
- But what entities and how should this information affect?
  - Nature of context data: e.g. speed of change slow in weather, although it is highly spatial

Research questions

- Given a context information supporting platform and a focus on context-aware applications: what kind of context aware application would be developed?
- Are other context information sources as usable as location information?
- Study the feasibility of the platform for application development

Overview of the study

- A 5 days long intensive course on context-aware game development was arranged
- Offered to master level students
- Hands-on intensive development
- Develop a context-aware game in groups of 2-3 people
- Lectures on game design, MUPE programming and context-awareness

Related work

- Location information in game applications such as
  - Pirates![1], ARQuake[2], The Journey[3]
  - *Fun, no accurate context recognition*
- Development platforms
  - Context toolkit: widgets to mediate context information
  - Phidgets: physical user interfaces
  - ARToolkit: Augmented Reality applications
  - MIDAS: Integration of external devices to Macromedia Director

[1] Björk, et al. 2001
[2] Thomas, et al. 2002
[3] `http://journey.mopius.com/`

Multi User Publishing Environment (MUPE)

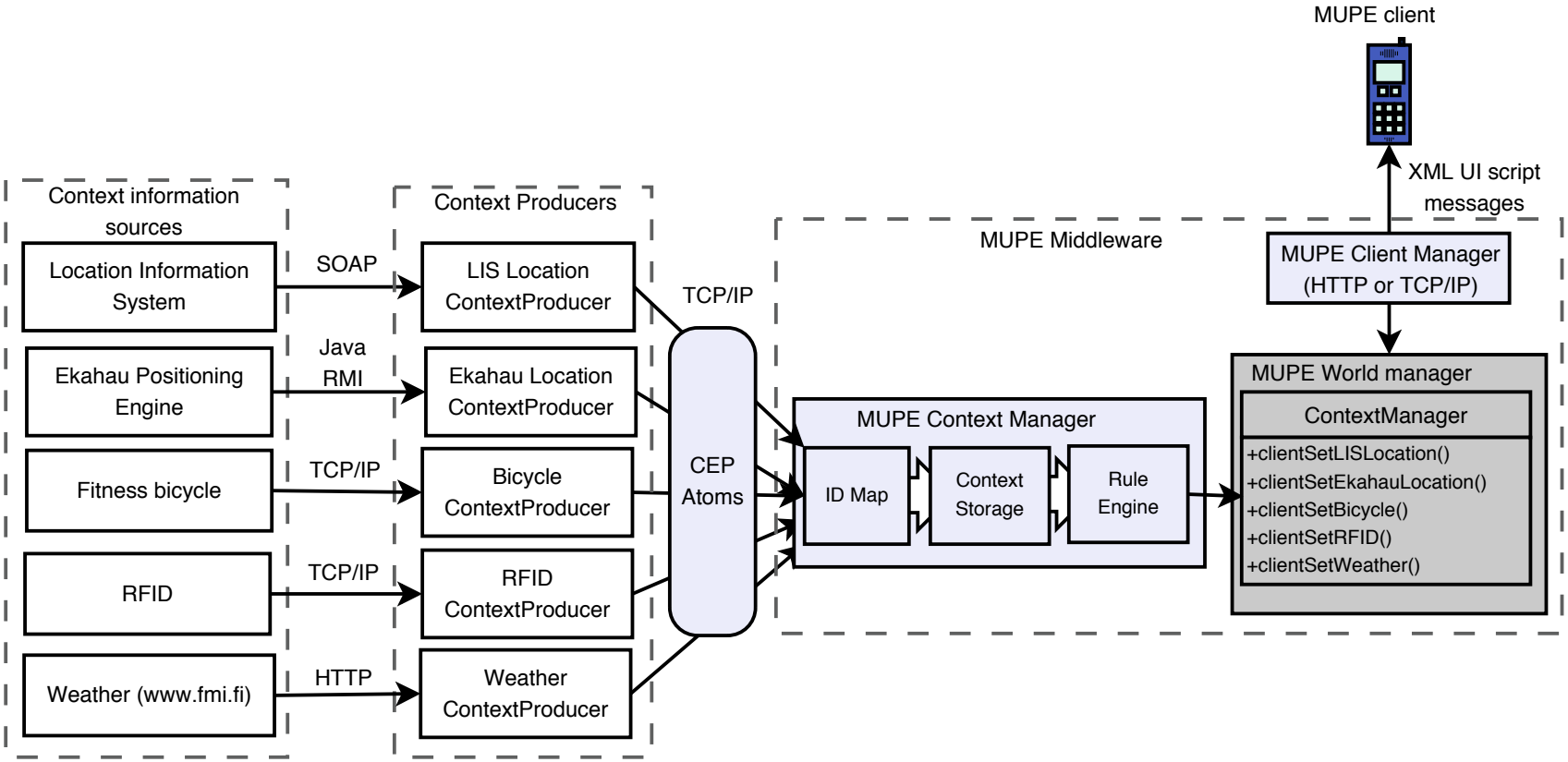
- A client-server platform with focus on applications on the mobile phones
- Client:
  - Java J2ME client
  - Scriptable user interface created with XML documents
  - XML protocol: modify UI and notify events to server

Multi User Publishing Environment (MUPE)

Server:

- Java server for application logic
- Stores and serves XML UI documents
- Middleware components for
  - Client connections
  - Context information reception
- Context information presented with *Context Exchange Protocol* (CEP)
- Scriptable context event system: filter and fire events from context data

Context Information Sources



Location information

- Location Information System (LIS)
  - Cell id/description based location information from a WLAN network
  - SOAP interface for queries and tracking events
- Ekahau Positioning Engine (EPE)
  - Map, room, x/y -based location information from a WLAN network
  - Signal fingerprinting: compare current signal measurements to calibrated signal fingerprint of an area
  - Java RMI based SDK for push -like location information reception
- RFID
  - Access 7 RFID readers and passive tags were used
  - Tag sightings were read with a dedicated application through a serial port

Weather and Physiological information

- Weather information service of the Finnish Meteorological institute was used
  - Wind speed and direction, temperature, humidity, cloudiness and air pressure measurements once per hour
  - Data in HTML page: parse it and serve to MUPE with CEP (job of the context producer component)
- Tunturi recumbent fitness bicycle provided...
  - Heart rate and speed of the bicycle
  - The data was read with dedicated program through a serial port
  - A context producer component provided the data to MUPE with CEP

Application Design and Implementation Process

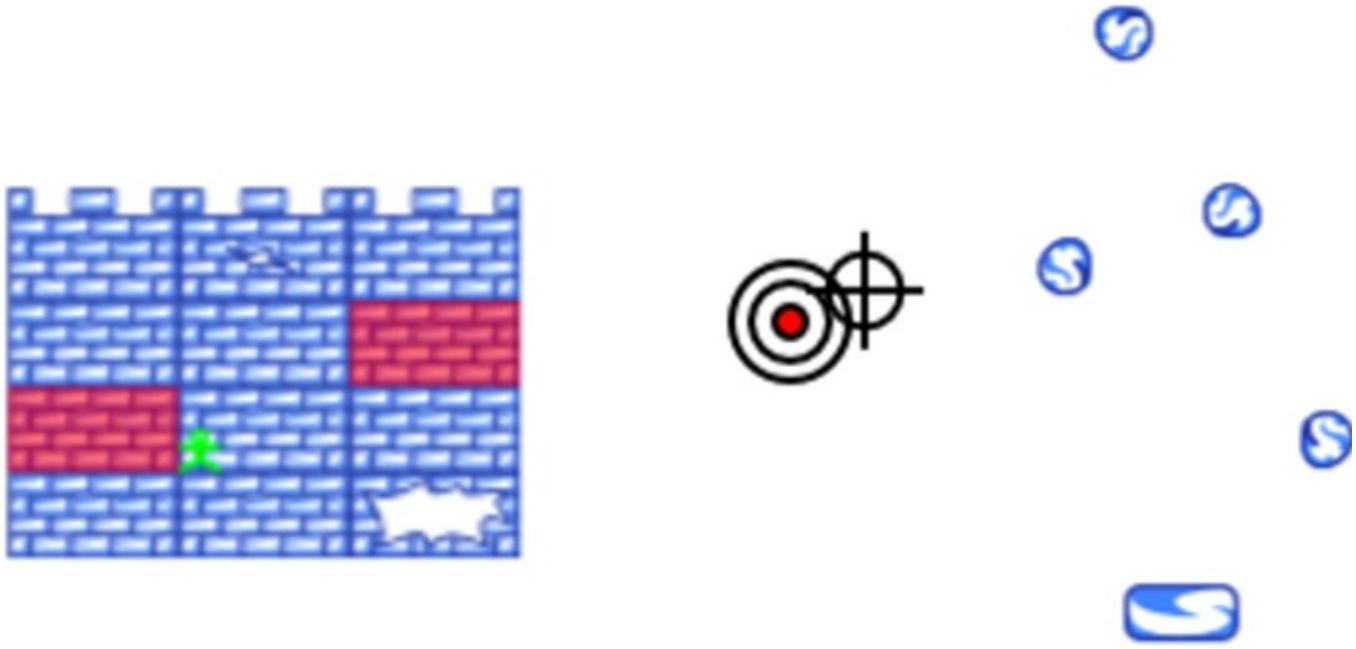
- Day 1: Game design patterns[4]
- Day 2: Tutorial to MUPE
- Day 3: Introduction to context-awareness setup
- Day 4: Current and past context awareness project lectures
- Day 5: Final application presentations

14 game applications developed by 38 students

[4] Bjork and Holopainen 2003

Examples of Applications Developed

Snow war



- Wall blocks mapped to locations on floors (leftmost)
- Two minigames: shooting and defending (center and right)

Examples of Applications Developed

Pre-emptive strike

- Build a bomb from peaces found around the game area to blow the base of the opposing team
- Steal bomb peaces from opposite players by moving close to the player

Results of The Study: Platform

- Setup for using context information in the platform not optimal
- Possible solutions
  - Observer pattern: provide a context interface and registration mechanism
  - Template method: override default implementation with inheritance
- Difficulty in dividing logic between context scripts and application server

Results of The Study: Context Awareness

Context source	**Usage (%)**
LIS (cell location)	0
EPE (floor/room/x,y location)	78,6
Fitness bicycle (speed)	21,4
Fitness bicycle (heart-rate)	7,1
Weather	21,4
RFID	0

Table: Context usage distribution

- Location most used
  - Especially room location: ready, meaningful data for the applications
- Personal context information most wanted
  - e.g temperature of the phone was also requested
  - Weather + location: connection should have been provided to the developers

Results of The Study: Game Design

- Most of the developed games were fast paced, fairly physical in nature
  - Quickest to attack, collect, locate etc. wins
  - Game input needed fast player movement
- 4 applications used two context sources $\rightarrow$ focused design
  - One clear game input
  - Due to time limits
- Longer lasting game sessions were not considered

  $\rightarrow$ Game session length affects to the choice of contexts

Conclusions

- MUPE was used together with three context information sources to design and implement game applications in a rapid fashion
  - Location (cell, floor, room, x/y)
  - Environmental (weather)
  - Physiological (heart-rate, bicycle speed)
- Location information most used (technically superior, easy to understand)
- Usage of other environmental context data would still be more valuable
  - Longer game sessions, more variation in context data
  - Active participation should be minimized