

# Rapid Prototyping of Context-Aware Games

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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!<sup>1</sup>, ARQuake<sup>2</sup>, The Journey<sup>3</sup>
  - ▶ *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

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<sup>1</sup>Björk, et al. 2001

<sup>2</sup>Thomas, et al. 2002

<sup>3</sup><http://journey.mopius.com/>

# Multi User Publishing Environment (MUPE)

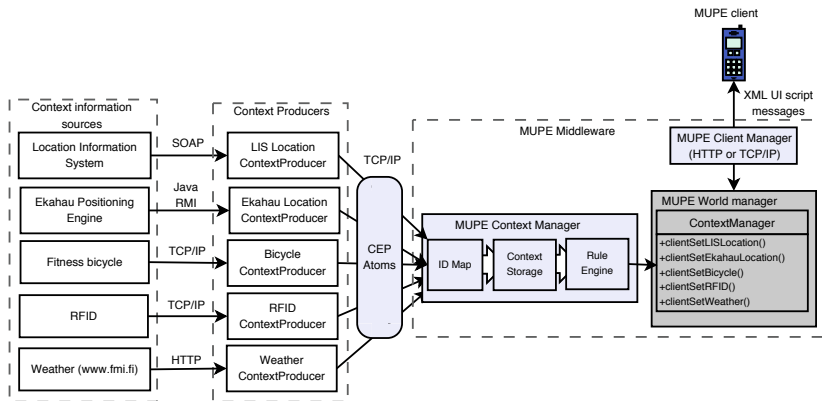
- ▶ A client-server platform with focus on applications on the mobile phones
- ▶ Client:
  - ▶ Java J2ME client
  - ▶ Scriptable user interface created with XML documents
  - ▶ XML protocol: modify UI and notify events to server

# 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<sup>4</sup>
- ▶ 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

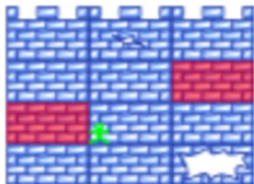
14 game applications developed by 38 students

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<sup>4</sup>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

<b>Context source</b>	<b>Usage (%)</b>
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 → focused design
  - ▶ One clear game input
  - ▶ Due to time limits
- ▶ Longer lasting game sessions were not considered
  - 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