REAL-TIME POSITION ANALYSIS DURING SOCCER MATCHES

Oliver May – Lead GIS developer
DFC Software engineering
Company profile

- Belgium-based ICT company
- Independent
- Est 1994
- Located in Ghent
  \([51°4'26" / 3°40'49'\])
Company profile

- GIS & integration projects
  - Public sector 60%
  - Corporate market 30%
  - Innovation Studies 10%

- Open Source Minded
- Stable, cohesive team: 12 software architects
- www.dfc.be/gis/
Personal profile

- Java Developer
- Joined DFC Software engineering 3 years ago

Professional interests
- Open Source Software
- Software project development techniques
- People dynamics in project teams
Personal profile

Accomplishments

- Project coordination of several strategic GIS projects
- Implementation of AGILE/Scrum in the GIS team
- Member of the geomajas Project Steering Committee
The project: BIPS™

- **HJB Systems**
  - Belgian start up
  - Patented hardware for high accuracy GPS positioning
  - Ball Intelligent Positioning System™
  - GPS receivers built into heart-rate monitors

- **DFC → Build a Proof Of Concept application for Soccer Analysis**
What is the POC meant to do?
Functional requirements (1)

- Real-time visualisation of playing field, players and ball
- Recording and playing of the match data
- Aid the referees during a soccer match
  - Goal
  - Players Offside
  - Ball out
  - ...

Functional requirements (2)

- Training/Match analysis
  - Man marking
  - Ball possession
  - Strategy
  - Health monitoring and statistics
    - Heartbeat sensors
What are the goals of the customer?
Business requirements

- **Low cost**
  - In the price range of every team
  - No installation on site
    - No complex camera systems
    - No special RF triangulation
    - ...
  - Portable
    - Employable on external locations

- Software as a service
How did we (developers) want to build the POC?
Technology requirements

- Requirements?
  - Rendering API for rendering actors on playing field
  - Easy modelling of soccer game
  - Web based (SAAS)
  - Rapid Application Development
Technology of choice

- Choice: geomajas
  - Able to model and display domain logic
  - Web based
  - Known technology
  - Framework allows rapid development
    - Easy extendible
    - Server oriented
    - 100% Java
      - No time waste debugging JS
      - One project, one team, one language!
Design questions?

Problems we stumbled upon during analysis
Design questions?

- Modelling the playing field
- Aggregating the actor data
- Event system
Lots of soccer fields don't have standard measurements

Some examples:

(Source: Google maps)
Modelling the playing field

105 meter wide
68 meter height
Modelling the playing field
Modelling the playing field
Modelling the playing field

- Problems
  - Playing fields differ in size
    - Length: 90~120 meters (100~110 by FIFA)
    - Width: 45~90 meters (64~75 by FIFA)
  - Positions of zones may differ
    - Goal might not be in exact centre
  - GPS Coordinates differ for every location
Modelling playing field

- Cartesian plane with centre spot: x=y=0
- Polygons define field topology
How to cope with variances in different fields?

Initialisation

- Measure 4 corners
  - Transformation from GPS coordinates to Cartesian plane

- Define position of goal and zones, if needed
  - Transform topology to fit reality
Modelling playing field

Transformation
Translation
Event system

- How to capture data?
- How to handle events?
Event system

- **Input**
  - Actors with sensors via RF
    - 22 players
    - 1 ball
    - 3 referees

- **Output**
  - Frames with positions of actors
  - Events
Event system model
Server side Java process

- Hardware
- Input readers
- Recorder
- Frame
  - Single frame = arbitrary time period
- State processor
- Event processors
  - Online
  - Offside
  - Ball possession
- Persistence processor
- Memory buffer (real time)
- Postgis (recordings)

Contains:
- Players
- Ball
- Referees
Event system model
Client side Java process

- Controller
  - start/stop recorder

- Memory buffer (real time)

- Postgis (recordings)

- Geomajas server framework
  - Provides:
    - data access
    - security
    - rpc
    - topology data

- Geomajas client framework (GWT)

- Frame
  - Events

- Field topology
In action (goal)

- Example recording of a goal:

Input data modeled in desktop GIS:
In action (goal)

- Movie
In action (offside)

- Example recording of offside:

Input data modeled in desktop GIS:
In action (offside)

- Movie
## Match analysis

<table>
<thead>
<tr>
<th>Time</th>
<th>EventType</th>
<th>Duration</th>
<th>Description</th>
<th>PlayerName</th>
</tr>
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<tbody>
<tr>
<td>02:12:04</td>
<td>BALL</td>
<td>6017</td>
<td>Ball ownership: VT 1 (Albert)</td>
<td>VT 1 (Albert)</td>
</tr>
<tr>
<td>02:12:08</td>
<td>MANMARKING</td>
<td>7051</td>
<td>Man Marking: HT 2 (Jef) -&gt; VT 2 (Alfred)</td>
<td>HT 2 (Jef)</td>
</tr>
<tr>
<td>02:12:08</td>
<td>MANMARKING</td>
<td>7051</td>
<td>Man Marking: VT 2 (Alfred) -&gt; HT 2 (Jef)</td>
<td>VT 2 (Alfred)</td>
</tr>
<tr>
<td>02:12:12</td>
<td>DUEL</td>
<td>3018</td>
<td>Duel between: HT 2 (Jef), VT 2 (Alfred)</td>
<td></td>
</tr>
<tr>
<td>02:12:15</td>
<td>BALL</td>
<td>14023</td>
<td>Ball ownership: VT 2 (Alfred)</td>
<td>VT 2 (Alfred)</td>
</tr>
<tr>
<td>02:12:29</td>
<td>MANMARKING</td>
<td>2998</td>
<td>Man Marking: HT 2 (Jef) -&gt; VT 2 (Alfred)</td>
<td>HT 2 (Jef)</td>
</tr>
<tr>
<td>02:12:29</td>
<td>MANMARKING</td>
<td>2998</td>
<td>Man Marking: VT 2 (Alfred) -&gt; HT 2 (Jef)</td>
<td>VT 2 (Alfred)</td>
</tr>
<tr>
<td>02:12:31</td>
<td>BALL</td>
<td>4007</td>
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<td>VT 1 (Albert)</td>
</tr>
<tr>
<td>02:12:37</td>
<td>MANMARKING</td>
<td>3000</td>
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<td>HT 2 (Jef)</td>
</tr>
<tr>
<td>02:12:37</td>
<td>DUEL</td>
<td>2001</td>
<td>Duel between: HT 2 (Jef), VT 2 (Alfred)</td>
<td></td>
</tr>
<tr>
<td>02:12:37</td>
<td>MANMARKING</td>
<td>3000</td>
<td>Man Marking: VT 2 (Alfred) -&gt; HT 2 (Jef)</td>
<td>VT 2 (Alfred)</td>
</tr>
<tr>
<td>02:12:39</td>
<td>GOAL</td>
<td></td>
<td>The visitorteam scored.</td>
<td></td>
</tr>
</tbody>
</table>
Metrics of development cycle

- One week sprint
- Team of 4 developers
- 20 development days
  - Analysis and sprint planning
  - Test driven development
  - Simultaneously develop client and server thanks to single definition of DTO's
- Daily SCRUM meetings
- Delivered POC on time!
Questions?

Contact me:

- oliver.may@dfc.be
- During foss4g:
  - oliver4g@dfc.be
  - Between sessions at booth 12 (geosparc)

Thank you for your time!