Geogame design

Part I: Location-based games

Christoph Schlieder
University of Bamberg
... contribute to a Geogame-Workshop

AGILE Workshop on Geogames and Geoplay

The workshop will be held as a pre-conference workshop of the 19th AGILE International Conference on Geographic Information Science 2016 in Helsinki.

Geogames are playful activities in which the analysis and the creation of geodata constitute a core element of the game mechanics. The technological approaches adopted by Geogames are as diverse as the possible usage scenarios. Geogames have been realized as console games, browser games or mobile location-based games and make use of GI technologies such as virtual environments or simulations. Application scenarios include environmental education, cultural tourism, and Geodesign.

Geogames currently attract considerable interest from researchers and GI professionals. This is reflected by recent developments on the GI market such as Google's announcement to deploy in 2016 - two years after the Ingress game - a second massively multiplayer Geogame. At the same time, Geogames raise a number of challenging geospatial research issues, e.g. the spatio-temporal balancing of the game flow or the creation of virtual game.

Gamify your own research! Position papers are welcome.

IMPORTANT DATES

April 25, 2016
Submission deadline for workshop short and positional papers

May 09, 2016
Author Notification

May 23, 2016
Camera-ready

May 30, 2016
Papers available on the workshop website

June 14, 2016
Geogame AGILE Workshop
Follow-up work

- Position paper
  - “describing an application scenario (max. 1500 words)“

- Workshop
  - Describing a gamification scenario
  - Research literature: Int. Conf. Entertainment Computing, …

Gamification scenario

- What problem do you want to solve?
- What game mechanics have been described in the literature to address the problem?
- How do the design alternatives compare?
- Which improved game mechanics do you suggest?
Adapt & describe a gamification approach

- Participants are invited to either submit
  - a short paper (max. 3000 words) about original ongoing research in Geogames
  - or a position paper (max. 1500 words) describing a game demo or an application scenario.

- Geogames@UJI
  - Geogame design course: gamification approach for a specific scenario
  - Geogame programming course: implementing a game demo
Timeline

- Geogames@UJI
  - Feb 23-24, 2016

- Draft position paper
  - Mar 25, 2016

- Feedback
  - Apr 8, 2016

- Workshop submission
  - Apr 25, 2016
Welcome to Geogames@UJI

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thomas.heinz@uni-bamberg.de

www.geogames-team.org
Geogame design: more than software
Geogame design: more than treasure hunts

www.geocaching.com      A multi-cache game
## Overview

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0930 - 1100</td>
<td>Location-based games</td>
</tr>
<tr>
<td>break</td>
<td></td>
</tr>
<tr>
<td>1130 – 1300</td>
<td>The Geogame design process</td>
</tr>
<tr>
<td>lunch</td>
<td></td>
</tr>
<tr>
<td>1400 – 1530</td>
<td>Game flow balancing &amp; game relocation</td>
</tr>
<tr>
<td>break</td>
<td></td>
</tr>
<tr>
<td>1600 - 1700</td>
<td>Documenting the design of a Geogame</td>
</tr>
</tbody>
</table>
Agenda

- Part I
  What are geogames?

- Part II
  Describing a spatial gamification scenario

- Part III
  Play-testing a geogame
Spatial gamification

www.foursquare.com

geograph.uk.org

www.ingress.com

Neocartographer
Many names

• adaptronic games • alternate reality games (ARG) • ambient games • appropriative games • augmented reality games • big games • brink games • context aware games • crossmedia games • geogames • hybrid games • immersive games • invasive games • location-based games • locative games • massive games • mixed reality games • mobile games • pervasive games • reality games • supergames • total games • transreality games • ubiquitous games • urban games •

“This new family of games has been called by many names” (Montola, Stenros, Waern; 2009; p. xix)
A geogame involving search: Citypoker

In a location based game, the spatial position of the player matters …
Gaming on mobile devices

- Typology
  - Schlieder, Kiefer, Matyas (2006), Kremer, Schlieder, Feulner, Ohl (2013)

- Mobile games
  - Player interacts with the game through the interface of a mobile device
  - native app or web app
  - client- or server-based game engine

- Location-based game
  - The spatial position of the player determines which game actions are available
  - Positioning technology: GPS, Wi-Fi, network
  - Self-reported: location check-in
  - Position perceived by other players: sports
Defining Geogames

$$\text{Geogames} = \text{MobileGames} \cap \text{LocationBasedGames}$$

All mobile location-based games are considered Geogames.
A more specific concept of geogame

Geogames_2 ⊆ MobileGames ∩ LocationBasedGames

mobile location-based games with additional features (Schlieder & al., 2006)
A different concept of geogame

The authors call their desktop simulation game a „geogame“.
This is not compatible with our definition of geogame.

O. Ahlqvist, R. Benkar, B. Mikula, K. Vatev, R. Ramnath, A. Heckler, Z. Chen, P. Peixuan (2014), see also geogame.osu.edu
Discuss #1

Fill in the missing entries!

<table>
<thead>
<tr>
<th></th>
<th>Foursquare / Swarm</th>
<th>Geograph</th>
<th>Ingress</th>
<th>Neocartographer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile game?</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>App type?</td>
<td></td>
<td></td>
<td>native</td>
<td></td>
</tr>
<tr>
<td>Location-based?</td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Positioning?</td>
<td></td>
<td></td>
<td>GPS / Wi-Fi</td>
<td></td>
</tr>
<tr>
<td>Geogame?</td>
<td></td>
<td></td>
<td>✔</td>
<td></td>
</tr>
</tbody>
</table>
Location-based games: 150 years ago

**Letterboxing**
- In 1854, James Perrot, a tourist guide in Dartmoor devised a search game:
- He hid a bottle with his business card in the moor …

Dartmoor, Devon, UK

(CC BY-SA 4.0) Herby, Wikimedia commons
Mobile games: 15 years ago

- Geocaching
  - Selective availability of GPS was removed on May 2, 2000
  - The very next day, Dave Ulmer placed the first geocache near Portland, Oregon

Geogame technology
2004
Geogames are locomotion games

indoor / motion

outdoor / locomotion
## Cognitive Spaces of Games

**Montello (1995)**

<table>
<thead>
<tr>
<th>Space</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>environmental space</strong></td>
<td>&gt;&gt; human body visual exploration requires locomotion</td>
</tr>
<tr>
<td><strong>vista space</strong></td>
<td>&gt; human body visually accessible from a single vantage point</td>
</tr>
<tr>
<td><strong>figural space</strong></td>
<td>&lt; human body haptically accessible</td>
</tr>
</tbody>
</table>
## Cognitive Spaces of Games

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>environmental space</strong></td>
<td>location-based games</td>
</tr>
<tr>
<td>&gt;&gt; human body visual exploration requires locomotion</td>
<td>Locomotion system, spatial memory, mental maps, ...</td>
</tr>
<tr>
<td><strong>vista space</strong></td>
<td>motion controller games</td>
</tr>
<tr>
<td>&gt; human body visually accessible from a single vantage point</td>
<td>Motor system</td>
</tr>
<tr>
<td><strong>figural space</strong></td>
<td>classical console games</td>
</tr>
<tr>
<td>&lt; human body haptically accessible</td>
<td>Hand-eye coordination</td>
</tr>
</tbody>
</table>
Spatial cognition research

- Reference
  - Montello (2001) on spatial cognition research in geography

- Spatial knowledge
  - acquisition & development
  - structure & processes
  - navigation & orientation
  - spatial language
  - individual differences

Reference page 24

www.spatiallearning.org/
Example: navigation tasks for geogames

- **Route knowledge**
  - Response-learning
  - Encodes specific turns at specific places

- **Overview knowledge**
  - Place-learning
  - Encodes distances and directions to places
  - Builds a mental map which permits to find shortcuts

- **Reference**
  - How do (some) people form cognitive maps?
Discuss #2

Geogame tasks
- You want to activate mental mapping processes in the players of your geogame.
- Rank the following spatial tasks according to which you think is most effective.
- What other suitable spatial task can you think of?

<table>
<thead>
<tr>
<th>rank</th>
<th>task</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Describe how to get from your position to place X.</td>
</tr>
<tr>
<td></td>
<td>Estimate the distance from your location to a non-visible landmark X.</td>
</tr>
<tr>
<td></td>
<td>List landmark buildings on a street you know.</td>
</tr>
<tr>
<td></td>
<td>?</td>
</tr>
</tbody>
</table>

Schlieder | Geogame Design | p. 26
Gamification

- **Context of use**
  - Serious games: some ludic elements, but no full game is created
  - HCI: playful interaction

- **Definition**
  - Deterding et al. (2011)
  - „The use of game design elements in non-game contexts“

Scheme from Deterding et al. (2011) adapted to fit spatial gameplay
Example: achievement systems

- **Badges**
  - Ranking on a nominal scale of achievement
  - Example: Foursquare trainspotter badge

- **High-score list**
  - Ranking on an ordinal scale of achievement
  - Example: Geograph leaderboards

<table>
<thead>
<tr>
<th>Position</th>
<th>Contributor</th>
<th>First Geograph Points</th>
<th>Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>Kenneth Allen</td>
<td>12230</td>
<td>7.74</td>
</tr>
<tr>
<td>2nd</td>
<td>Richard Webb</td>
<td>10157</td>
<td>2.66</td>
</tr>
<tr>
<td>3rd</td>
<td>Jonathan Billinger</td>
<td>5202</td>
<td>2.34</td>
</tr>
<tr>
<td>4th</td>
<td>Oliver Dixon</td>
<td>4361</td>
<td>2.01</td>
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<tr>
<td>5th</td>
<td>Derek Harper</td>
<td>3057</td>
<td>5.23</td>
</tr>
<tr>
<td>6th</td>
<td>Andrew Smith</td>
<td>3048</td>
<td>2.31</td>
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<tr>
<td>7th</td>
<td>Walter Baxter</td>
<td>2557</td>
<td>3.08</td>
</tr>
<tr>
<td>8th</td>
<td>Michael Patterson</td>
<td>2485</td>
<td>1.01</td>
</tr>
<tr>
<td>9th</td>
<td>Graham Horn</td>
<td>2467</td>
<td>3.28</td>
</tr>
<tr>
<td>10th</td>
<td>John Allan</td>
<td>2434</td>
<td>1.90</td>
</tr>
</tbody>
</table>

geograph.org.uk
points = squares visited first
depth = photos / squares
Serious games

- **Education**
  - Abt (1970)
  - “these games have an explicit and carefully thought-out educational purpose and are not intended to be played primarily for amusement”

- **and other purposes**
  - Zyda (2005)
  - “a mental contest, played with a computer in accordance with specific rules that uses entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives”
Geogames as serious games

- **Game-based learning**
  - Broad variety of learning processes: biodiversity, industrial geography, ...
  - Klopfer (2008), Schaal & al. (2012), ...

- **Place marketing**
  - Spatial gamification in tourism and LBSN
  - Celtek (2010), Hodson (2012), ...

- **VGI games**
  - Provide an additional motivation for geospatial information crowdsourcing
  - Matyas & al (2008), Garcia Martí & al. (2013), Antoniou & Schlieder (2014), ...
Applications: game-based learning (1)

- Serious games
  - De Gloria & al. (2012)
  - Backlund & Hendrix (2013)
  - Field trip, ...

- Feature
  - motivating because highly self-determined
  - Locomotion matters: as in a field trip, players spend time moving to places
Applications: game-based learning (2)

- **Motivation in learning**
  - Measured by the intrinsic motivation inventory (IMI)

- **Games as motivation**
  - intrinsic motivation results in more effective learning
  - Correlates with perceived competence and perceived choice

---

subscale of IMI
v4 = I am satisfied with my performance
v7 = I could control my activity
Discuss #3

Empirical findings

- Gamification design guides such as Zichermann & al. (2011) list success factors.
- How would you measure success?
- Make an educated guess about how the success factors relate to perceived competence and choice.

<table>
<thead>
<tr>
<th>factor</th>
<th>gamification features</th>
</tr>
</thead>
<tbody>
<tr>
<td>status</td>
<td>let players publish and compare their progress</td>
</tr>
<tr>
<td>access</td>
<td>reward participation by unlocking new features</td>
</tr>
<tr>
<td>power</td>
<td>reward progress by making the player more powerful</td>
</tr>
<tr>
<td>stuff</td>
<td>reward achievement with badges, avatars, …</td>
</tr>
</tbody>
</table>

adapted from Zichermann & Cunningham (2011)
Applications: place marketing

- **Gamification objective**
  - Motivate players to go to places which they would probably not visit without the game

- **Tourist geogames**
  - Mostly place-specific geogames
  - Sintoris & al. (2014): Design workshops for creating a Pompeii game

www.ingress.com
XM can be collected at some places only
Applications: geoinformation crowdsourcing

- **Gamification objective**
  - Increase participation: demographically, temporally, …
  - Improve data quality: coverage, …

- **Noise mapping**
  - NoiseBattle: Garcia Martí & al. (2013)

Is there a shelter at the bus stop?
Do you feel safe at this place?
Yanenko, Schlieder (2012)
Agenda

- Part I
  What are geogames?

- Part II
  Describing a spatial gamification scenario

- Part III
  Play-testing a geogame
Games as a social medium

- Playing experience
  - Games connect their players socially

- First question
  - Do we need a game?
  - In what way, if at all, do we want to socially connect our students, visitors, customers, ...?

A geogame with a team communicating face-to-face
Geogames as a spatial medium

- Playing experience
  - Geogames also connect with the geographic environment

- Second question
  - Do we need a geogame?
  - What type of spatial experience do we want our students, visitors, customers, … to have?

A pre-digital location-based game
Gamification scenario

- **Principle**
  - Presents the design case for a serious geogame

- **Scenario elements (1)**
  - Who? Players: demographic, …
  - Where? Places: geography, …
  - When? Period: time of year or day, …

- **Scenario elements (2)**
  - What: Play activities exploration, evaluation, …
  - Why? Problem: Issue, the gamification approach is meant to resolve
Example: gamification scenario

<table>
<thead>
<tr>
<th>Players Who?</th>
<th>OSM feature update scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Contributors to OSM, especially less active ones</td>
</tr>
<tr>
<td>Places where?</td>
<td>Coverage of OSM, that is, everywhere</td>
</tr>
<tr>
<td>Period When?</td>
<td>Whenever someone chooses to contribute, that is, anytime</td>
</tr>
<tr>
<td>Play What?</td>
<td>Evaluation: updating OSM features</td>
</tr>
<tr>
<td>Problem Why?</td>
<td>Feature updates cluster around popular areas</td>
</tr>
</tbody>
</table>
Discuss #4

Gamification potential
- You plan an activity for first year students on their first day on campus.
- Could this be a location-based game? Justify your answer.

The first two questions
- In what way, if at all, do we want to socially connect the students?
- What type of spatial experience do we want the students to have?
Discuss #5

Gamification scenario

Specify a gamification scenario relating to the topic „first day on campus“

<table>
<thead>
<tr>
<th>First day on campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Players Who?</td>
</tr>
<tr>
<td>Places where?</td>
</tr>
<tr>
<td>Period When?</td>
</tr>
<tr>
<td>Play What?</td>
</tr>
<tr>
<td>Problem Why?</td>
</tr>
</tbody>
</table>
Geodesign: more than a conference series

- Spatial planning
  - design process models
    Steinitz (2012)
  - participatory technologies
    Batty (2013)

- Cognitive scale
  - environmental & geographic space

“Geodesign will not be limited to any particular **scale of application**, but my experiences lead me to suggest that we consider improving educations, research, and action in the middle range, from larger geographic areas to watersheds and regions”
Geodesign principles as games

- **Game mechanics**
  - Steinitz (2012), p. 67
  - Principles for the design of faunal preserves
  - Could be conceived as a spatial allocation game with better vs. worse as stakeholder / player 1 vs. stakeholder / player 2
Research issues

- **General**
  - Can Geogames also become a medium for the Geodesign process?

- **More specific**
  - What phases of the Geodesign process can Geogames contribute to?
  - What technological assistance facilitates using Geogames?
  - What game mechanics are most effective?
## Geogames and Geodesign

<table>
<thead>
<tr>
<th>Geogames</th>
<th>Steinitz et al. 2003</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exploration games</strong></td>
<td></td>
</tr>
<tr>
<td>Learning to use / to read a</td>
<td>How should the state of the landscape be</td>
</tr>
<tr>
<td>spatial design</td>
<td>described ...?</td>
</tr>
<tr>
<td>How do I move from A to B?</td>
<td>representation</td>
</tr>
<tr>
<td>What is the best place for</td>
<td></td>
</tr>
<tr>
<td>activity X?</td>
<td></td>
</tr>
<tr>
<td>How does the landscape</td>
<td>Is the current landscape working well?</td>
</tr>
<tr>
<td>operate?</td>
<td>evaluation</td>
</tr>
<tr>
<td>Evaluation games</td>
<td></td>
</tr>
<tr>
<td>Learning to evaluate a</td>
<td>How might the landscape be altered ...?</td>
</tr>
<tr>
<td>design</td>
<td>change</td>
</tr>
<tr>
<td>How do I feel about place A?</td>
<td></td>
</tr>
<tr>
<td>What would I need there?</td>
<td></td>
</tr>
</tbody>
</table>
Geodesign exploration games

Learning to read a changing urban design

Kremer, Schlieder, Feulner & Ohl (2013)
Proc. VS-GAMES, IEEE Press
Exploration patterns

Signal vs. noise
- What is not random about an observed movement pattern?

Focussedness
- measures a form of detour sinousity
- comparison to the shortest path
Artists as precursors

■ Literature
  – Baudelaire: spatial exploration as artistic stance
  – Guy Debord (1956), Théorie de la dérive

■ References
  – Karen O´Rourke (2013)
  – Walking and Mapping: Artists as Cartographers

Le Flâneur, Paul Gavarni, 1842
Random exploration

- Drifting
  - 2004, architecture festival, Orléans, France
  - A psychogeographic walk organized by Wilfried Hou Je Bek
  - Spatial exploration based on an algorithm
  - only non-digital hardware (paper and pencil)
Exploration algorithm

- Spatial exploration
  - an infinite loop repeating three turn directions

- Observation task
  - participants were asked to invent names for places they encountered
  - „It´s for playing“, „cestnuts on concrete“, …
Discuss #6

Spatial analysis
- What trajectory does the algorithm produce on a square grid?

- first right
- first left
- third right
- repeat
Loop pattern
Algorithmic analysis

Instruction sequence

- Count the number of left turns $L$ and right turns $R$ (ignore everything else)
- If $L = R$ and the incoming direction is the same as the outgoing direction, then the overall movement is translational
- Otherwise a loop pattern results with the special case of a direct way back
Real-world movement pattern

- **Spatial analysis**
  - The street layout in Orléans-la-Source is not grid-based
  - Most movement patterns are neither loops nor translations

- **Rules are incomplete**
  - there might be no $n$-th street to the left/right: dead-ends, T-crossing

Exploration pattern in Orléans-la-Source
Agenda

- Part I
  What are geogames?

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Discuss #8

Exploration game
- How do you organize in your team to come up with a distance guess?
- Can you identify an exploration pattern?
- Is there a landmark selection pattern?
- Which are disruptive events for this version of Guesstimate?
Playtesting Guesstimate

Pizza Pepedroni

- Incredible: the best pizza in town is delivered on campus by super fast drones!
- Just indicate your location by specifying your distance to four landmarks. The drone determines where to fly to and, once landed, shows its location on the map.
Playtesting Guesstimate

Pizza Pepedroni

- If your distance guesses are inaccurate, you may have to walk a few steps to collect your pizza.
- Try to guess the distances as accurately as possible to obtain a maximum number of pizzas during the next 10 minutes.
Playtesting Guesstimate

"Geogames are locomotion games"

game starts here

smart.uji.es
You should now be able to …

- Explain what geogames are
  - assess whether spatial gamification may help solving a problem
  - relate geogames to mobile and location-based games
  - give examples for serious games in education, tourism and VGI
- Create a gamification scenario
  - relate different types of geogames to the geodesign process
  - define the components of a gamification scenario
- Systematically play-test a game
  - explain why designers care about intrinsic player motivation
  - relate different cognitive spaces to different types of gameplay
  - analyze the mechanics of a spatial exploration game
Must read: Classics