InSleepers
User experience as a method for reducing consumption in domestic buildings.

By Itai Cohen, 4118952.

Mentors:
Michela Turrin, M.Arch. - Design Informatics (TOI).
Florian Heinzelmann, Dipl.Ing. M.Arch. - Architectural Engineering (AE).
Dr. Ivo Wenzler, - TBM; Policy, Organisation, Law & Gaming Department.

Green Building Innovation track, Architectural Engineering + Technology Department. Faculty of Architecture, TU Delft.
Agenda
1. Introduction
Bob
33% of the world’s energy is consumed in the building sector.
Domestic energy consumption

33% of the energy consumed in a house is used by the comfort systems.
Research (Santin 2010) shows that similar houses vary in 12% due to user behavior.
Problem Definition:
“Current automation systems lack the ability to effectively stimulate users to reduce their resource demands.”
Research question:

“How can a user oriented home automation interface be designed to actively reduce resource consumption in a domestic building?”
Why do people try to be more ‘sustainable’?
Why do people try to be more ‘sustainable’?
Why do people try to be more ‘sustainable’?
Why do people try to be more ‘sustainable’?
Why do people try to be more ‘sustainable’?
Why do people try to be more ‘sustainable’?
Control as a game
game?
2. Literature study
2. Literature study
2.1 Automation systems
Machine Layer
Algorithm Core
User Interface
User Interface
2.2 Gamification
2.2 Gamification
WHO ARE THE NEW GAMERS?

The stereotype of the reclusive gamer is outdated. These days, games are everywhere, and gamers are social, tech-savvy, goal-oriented people with a real drive to improve themselves and the world around them.

THE NEW GAMERS ARE...

- Handheld Gaming Device: 48%
- Tablet: 36%
- Desktop: 62%
- Laptop: 76%
- Game Console: 80%
- Smartphone: 81%
- No Device: 12%

Preferred Gaming Platforms:

- Untethered
- Social

FUN AND GOAL-ORIENTED

Motivations for Gaming:

- To Do More Good for Society: 24%
- To Achieve Personal Goals: 47%
- To Socialize or Meet New People: 56%
- 95% For Enjoyment or Relaxation
- 84% use social media at least several times per week

*Smartphone ownership was a requirement to participate. This graphic is based on findings from The Future of Gaming study. Latitude's profile of The New Gamers is not intended to be representative of the current landscape; it is intended to showcase an emergent demographic and related opportunities in games and technology development.
WHERE WOULD YOU LIKE TO SEE MORE GAMES APPLIED?

- Learning & Education: 75%
- Social Connectivity: 56%
- Environmental Issues & Sustainability: 47%
- Economic Issues & Financial Planning: 52%
- Personal Wellness & Healthcare: 72%
- Government & Civic Engagement: 33%

HOW WOULD YOU LIKE TO INTERACT WITH GAMES IN THE FUTURE?

- I'd like it if objects could sense when I'm interacting with them, and register that online or convey that information to other objects: 56%
- I'd like a game that I could interact with just by thinking: 44%
- I'd like to see more location-aware games that register when I'm at a certain place, or near a certain person: 38%
- I'd like to see virtual environments or digital content overlaid onto the real world: 53%
- I'd like a game that automatically senses and reacts to my mood or bodily state: 43%
- I'd like if I could take action in games by gesturing or moving my body: 71%
5 most common mechanisms (Kim 2009):
• Collecting games
• Points
• Feedback
• Exchange
• Customization
Case study: Nike+
Total NikeFuel: 6,284

Total Kilometers: 31.41
Average Pace: 11'41"

Farthest Run: 4.23km
Longest Run: 44:33
Fastest 1K: 09:50
Fastest 1 Mile: 15:38

Total Runs: 21
Calories: 2094
Average Pace: 11'42"/km

Your last run:
10 weeks ago: 1.70km

You ran 0.53 km more and 1'12"/km slower than the average of your past 7 runs.
Manila Miles 25 Days Challenge

Most kilometers over 25 days

01 BullRunner 30.68 km
02 njrunnerFred 29.77 km
03 carlodl 21 km
04 King1 16.1 km
05 NJRunnergirl 16.09 km

Your Challenge ends on 07/31/07 at 11:59 PM.

Talk Trash

hehe, very kind of you peter...then you'll blaze past us!

hitme64
07/05/07

SEE ALL 5 MESSAGES
3. Design
3. Design
Game
LIVE

Savings

Challenges

Points

GAME

Trophies

€

REALITY

REALITY
• positively alter users’ resource consumption in fields of energy, water and waste
• Period: 3 months (Kim 2009)
• provide the users with new knowledge and knowhow to improve their skills
• positively alter users’ resource consumption in fields of energy, water and waste
• Period: 3 months (Kim 2009)
• provide the users with new knowledge and knowhow to improve their skills
• Player objective:
  – become the most sustainable player
    • Advance in level (points)
    • Collect trophies
    • Win matches and challenges
    • Convert to tangibles
3.3 Control environment
Tip!

It's 10:15 and the sun is up and shining.

You could gain up to 153 more points today by dimming down the lights.
Social feed
Phaedra Oikonomopoulou

Phaedra just beat Itai Cohen in the washing machine monthly challenge and won the Kantar fish for her island!

Pheadra’s virtual Island

Unlike · Comment · Share · Yesterday at 9:56am · 🐟

🐟 You, Wang Yajie, Konstantinos Mitafidis, An Hyejun and 26 others like this.

Write a comment...
Virtual reality
• Mirroring: to visualize cause and effect
  – Each player has a computer generated island
    • Energy consumption – vegetation
    • Water conservation – water and life
    • Waste management – ground fertility
  – Islands are grouped in one world, by social network
New player – Sandy ground, no flora and fauna.
Small plants – energy balance improves
Ground gets fertile – better waste management
Unique Trees – energy challenges met
Thick grass cover – great waste management
More Trees – energy balance is improved and level is higher
Wildlife – water balance is improved
3.4 Rules and gameplay
Points

79
• Variables to be normalized:
  – Different houses
  – Different occupation times
  – Different number of inhabitants
  – Etc....
Fair play
Fair play
Fair play
\[ S = \int_{t+10,800}^{t} f_{\text{benchmark;best}}(t) - f_{\text{sensor}}(t) \, dt \]

Where,

- **S** is the numeric score given to the player by the game engine.
- **t** is time in seconds.
- \( f_{\text{benchmark;best}} \) is the function describing the simulated consumption value of the best practice model, acquired by the survey and AI.
- \( f_{\text{sensor}} \) is the function generated by data collected and logged by the sensor array monitoring consumption.
Consumption

Sensor data

Benchmark

Score ref. area

1h  2h  3h  4h  5h
Fair play
Tasks

- Not time dependent
  - Shower
  - Laundry
  - Cooking

- Time dependent
  - Light
  - C. electronic
  - Water heating

Fair play
\[
S_{total} = \frac{\Sigma S_1}{10,800} + \frac{\Sigma S_2 \cdot \gamma}{t_{occupancy}}
\]

Where,

- \( S_{total} \) is the score given to the user every 3 hours.
- \( \Sigma S_1 \) is the sum of scores received for actions that are independent of time.
- \( \Sigma S_2 \) is the sum of scores received for actions that are dependent of time.
- \( \gamma \) is an optional correction coefficient meant to balance the impact \( S_2 \) has on \( S_{total} \).
- \( t_{occupancy} \) is the period of time in seconds in which the user is in a mode of active occupancy.
Fair play
Levels
$$f(n) = 1.15 \cdot (n-1)$$
• Challenges:
  – Limited by time and reduction
    • E.g:
      – Reduce 10% of time the TV is on in the next two weeks.
      – Make one less laundry this month
      – Reduce recycled waste to regular garbage ratio by 20% this month
  – Personal, competitive or ordered by 3rd party
## Trophies

<table>
<thead>
<tr>
<th>Level</th>
<th>Energy</th>
<th>Water</th>
<th>Waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easy</td>
<td>☀️☀️</td>
<td>☀️☀️</td>
<td>☀️☀️</td>
</tr>
<tr>
<td>med.</td>
<td>☀️☀️☀️</td>
<td>☀️☀️</td>
<td>☀️☀️</td>
</tr>
<tr>
<td>Hard</td>
<td>☀️☀️☀️</td>
<td>☀️☀️</td>
<td>☀️☀️</td>
</tr>
</tbody>
</table>
Tangibles
Tangibles
Tangibles
\[ \varepsilon_{\text{game}} = \left( \sum_{l=1}^{l} S_{\text{tot}} \right) \cdot \frac{\sum \left( \frac{1}{\alpha}, \frac{1}{\beta}, \frac{1}{\gamma} \ldots \frac{1}{\omega} \right)}{c_1} \cdot c_2 \]

Where,

- \( \varepsilon_{\text{game}} \) is the converted game currency.
- \( \sum S_{\text{tot}} \) is the sum of points gained in the current level in all three fields.
- \( \alpha \ldots \omega \) are coefficients representing Item’s commonness in the ecosystem. The higher the value the more common the item is.
- \( c_1, c_2 \) are constants used by the game to regulate the amount of currency converted into meaning full numbers.
Source: Csikszentmihalyi 1997

“Flow”
<table>
<thead>
<tr>
<th>No</th>
<th>Mode</th>
<th>Type</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tutorial</td>
<td>Single player</td>
<td>Calibration and education</td>
</tr>
<tr>
<td>2</td>
<td>Sandbox</td>
<td>Single player</td>
<td>Trial and error, pattern detection</td>
</tr>
<tr>
<td>3</td>
<td>Self challenge</td>
<td>Single player</td>
<td>Skill development</td>
</tr>
<tr>
<td>4</td>
<td>Social challenge</td>
<td>Single/single Competition</td>
<td>Social involvement and motivation</td>
</tr>
<tr>
<td>5</td>
<td>Team challenge</td>
<td>Group/group competition</td>
<td>Social involvement and motivation, peer pressure</td>
</tr>
<tr>
<td>6</td>
<td>Tournament</td>
<td>Single/single competition</td>
<td>Sustaining long play</td>
</tr>
</tbody>
</table>
Phase 0: setup
Phase 1: tutorial
This is the challenge screen!

5th place
Here you could start new challenges and follow your progress.
Phase 1: tutorial

Press the + to take a new Challenge!
Phase 2: sandbox
Tip!

It’s 10:15 and the sun is up and shining.

You could gain up to 153 more points today by dimming down the lights.

Phase 2: sandbox
Phase 3: self challenge
Phase 4: Social challenge
Phase 4: Social challenge

Phaedra Oikonomopoulou
Phaedra just beat Itai Cohen in the washing machine monthly challenge and won the Kantar fish for her island!

Pheadra’s virtual Island

Unless · Comment · Share · Yesterday at 9:56am · 🐟

You, Wang Yajie, Konstantinos Mitafidis, An Hyejun and 26 others like this.

Write a comment...
Phase 5: Team challenge
Phase 6: Tournament
View of the players island in real time
4. Prototype
4. Prototype
Prototype – Location based remote control
5. Conclusion
5. Conclusion
Research question:

“How can a user oriented home automation interface be designed to actively reduce resource consumption in a domestic building?”
A Layered reality game, interconnected to the home automation systems and controls is the key to decreases energy consumption
Patent (not yet) Pending
Thank you for your attention