Green Machine: Mobile Decision Displays to Promote Eco-Action

Aaron Marcus, President; Jérémie Jean, Designer/Analyst
Assistant Designer/Analysts: Eileen Li, Hye-Min Kim
Aaron Marcus and Associates, Inc. (AM+A)
1196 Euclid Avenue, Suite 1F. Berkeley, California 94708-1640, USA
Tel: +1-510-601-0994, Fax: +1-510-527-1994
Email: Aaron.Marcus@AMandA.com, Web: www.AMandA.com
AM+A’s Vision and Mission for 28 Years

AM+A helps people make smarter decisions faster: anyone, any time, any place, any technology, any market, any subject matter.

AM+A shapes the way technology affects everyday life through user-centered development of effective and compelling user-interface, information-visualization and storyselling.
Books, Publications
# Clients, Projects

*12 of 30 Dow Jones Industrial Average™ Firms*

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Green Machine: Design Data Decision Displays to Promote Eco-Behavior

- How can information design/visualization present persuasive information to promote ecological, or sustainable, short-term eco-actions and long-term eco-behavior?

- How can mobile technology assist in presenting persuasive information and promote eco-behavior?
Work in Progress: Where we Are and How we Got there

QuickTime™ and a decompressor are needed to see this picture.
Energy, Pollution: We’ve Known the Issues for More than 30 Years

- **Visualizing Global (Energy) Interdependence**
  - East-West Center VGI Project, Honolulu, 1978
  - Used information visualization using tables, charts, maps, diagrams, without words
  - Multidisciplinary, multi-cultural research and development team

- **Published VGI articles, showed presentation worldwide**
  - Recent showing at Tama Art University, Tokyo, Japan, 2008
VGI Presentation Examples

QuickTime™ and a decompressor are needed to see this picture.

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VGI Publication Examples

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What Do We Need?

- Information design and information visualization good
- But not good enough!
- What we need:
  - Persuasive Information Design *and* Information Visualization
Where Should we Show this Persuasive Information?

- **Mobile devices**: Most important, effective
- 3 billion people worldwide use them
- Smarter, faster, cheaper, better, with built-in social networking and video
- Primary communication and interaction platform now and in future
Essential Challenge for Sustainable Development

- People know **data** but do **not change behavior**
  - Global warming: Frightening threat to Earth’s future
  - Examples: **Al Gore**’s “An Inconvenient Truth”, VGI project

- **Challenge**: How to help people reduce carbon footprint?
Household Energy Consumption: Some Background

- With feedback, people can achieve 10% energy-consumption reduction without lifestyle change.
- 10% reduction in US: Total energy provided by US wind and solar, 113.9 billion kwh/year!
- US home consumption: 18% of CO₂ emission
  - Other sources: daily transportation, waste/recycling, eating/shopping
- US President Obama will invest $4.5 billion in Smart Grid to extend its use in US households.
- Companies developing software using Smart Grid to help people monitor their energy consumption.
Current SmartGrid Software Good, But Not Good Enough

- Most SmartGrid software focuses on **data analysis**
  - Requires analysis of users’ needs to understand which means enable them to improve eco-behavior

- Most SmartGrid software focuses on **PC**
  - Mobile phone apps match better use context and fit with other activities
  - Mobile phone apps offers ease-of-access and convenient use
  - Mobile phone apps always available, always on, at people’s fingertips

- People’s future ubiquitous platform: **Mobile phones**
Green Machine: Persuasive Info Design and Info Visualization

- **Key challenge:** How can we persuade people to make behavior change?
  - Current SmartGrid software not designed for persuasive info and not designed for best platform

- **Solution:** *Green Machine* mobile phone app with user interface design that helps people reduce their household energy consumption
Green Machine
User-Interface Design Challenges

- **Usable, useful, and appealing**
- **Educate** users
- **Motivate** users to reduce household energy consumption
- **Persuade** users to change behavior
Green Machine UI Analysis: User Profiles or Personas

- Later: business use
- Now: home use, general context, wider use
- Key users: Mom, Dad, Daughter, Son
Green Machine UI Analysis: Use Scenario

- Mom/Dad wants to check energy consumption before running major appliance. She/he uses mobile phone to check current household energy consumption to learn recent history and check tips on lowering usage.

- By lowering usage, she/he gains higher status in friends’ energy-saving group, earns some rewards points, and helps save the Earth.
Behavior Analysis: Behavior Changing Process

- 5 steps of users’ behavior-changing process through **Green Machine** application

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<td>Increase frequency of using application</td>
<td>Motivate reduced energy consumption</td>
<td>Teach how to reduce energy consumption</td>
<td>Persuade users to reduce energy consumption</td>
<td>Persuade users to change behavior</td>
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- Usability
- Usefulness
- Appeal
- Rewards

- Link between users needs and motivation
- Competition and challenge
- Goal setting
- Persuasion issues (Fogg, Cialdini)

- Tips in context
- Social interaction with advice
- Consumption feedbacks related to the goal setting

- Frequent consumption feedback
- Social interaction (display information, improvements)

- Long term use
Information Design Features that Improve Use Frequency

- **Rewards:** When users log data, they gain points for games/challenges, “greenies”, or other rewards.

- **User-centered design:** Gives application usable, useful and appealing user interface, which improves satisfaction and total user experience.

[US Magazine, May 2009]
Information Design Features that Improve Motivation, 1/6

- Sociobiological perspective motivation theory
  - People must understand: every action has influence on environmental change and Earth’s future
  - Maximize reproductive success and ensure future of descendants

- Earth in 2200: Visual impact on future
  - High energy consumption: Polluted Earth with famine, low water/food, war
  - Low energy consumption: Healthier Earth with sufficient food, water, greater chance for peace
Information Design Features that Improve Motivation, 2/6

- **Psychological definition of motivation**
  - Needs, wants, interests, desires propel people in certain directions

- **Maslow’s Needs** can be source of motivations in UI
  - **Safety/Security**: Show how much money saved
  - **Self-actualization**: Show how much CO\(_2\) released
  - **Belonging and being loved**: Show membership in eco-friendly community or to a team in Challenge (game) mode
  - **Esteem**: Show social comparison (with neighbors, friends) that display energy consumption or improvements
Information Design Features that Improve Motivation, 3/6

- **Competition and challenge** improves motivation
  - Competition enhances motivation and reduces energy consumption
  - App must provide challenges and competition that people want

- Challenge to reduce household energy consumption takes into account factors such as points, ranking
  - Personal: Challenging other individual households
  - Social: Challenge teams, cities, or regions
  - All feature social interaction
Information Design Features that Improve Motivation, 4/6

- **Goal setting** improves motivation
  - Helps people learn better, improves feedback relevancy
  - Encourages people, offering potential solution to long-term use

- People can set their own goals
  - How much money do I want to save?
  - How much CO₂ do I want to release into atmosphere?
  - Want to be same eco-friendly consumer as friend Pat?
  - Want to know if I could win challenge in training camp?
Information Design Features that Improve Motivation, 5/6

Fogg’s “Captology” technology techniques make persuasion more effective and improve motivation

- **Simulation**: Provide a “model” or “miniature”
- **Reduction**: Simplify details to make users notice selected items
- **Tunneling**: Predetermined event sequence facilitates key behaviors
- **Customization**: Provide personally relevant info to increase interest
- **Self-Monitoring**: Inform about progress to motivate behavior change
- **Suggestion**: Intervene at right time to motivate reacting in a certain way
- **Conditioning**: Use operant conditioning to reinforce target behaviors

Information Design Features that Improve Motivation, 6/6

- **Cialdini’s “Weapons of Influence”** persuasion techniques make persuasion more effective and improve motivation
  - **Reciprocity**: People tend to return favors
  - **Commitment and consistency**: People committed, orally or in writing, to idea or goal, more likely to honor commitment
  - **Social proof**: People do thing they see others doing
  - **Authority**: People tend to obey authority figures, even if asked to perform objectionable acts
  - **Liking**: People easily persuaded by others they like
  - **Scarcity**: Perceived scarcity generates demand

Information Design Features that Improve Learning, 1/2

- **Contextual tips**
  - Explain how to reduce energy consumption in relevant context
  - Show other users tips that had success: products, services tried
  - Must be based on feedback

- **Social advice**
  - Social interaction has important impact on behavior change
  - Enabling people to send/read advice advantageous to user

- **Social networking**
  - Blogs, Forums, Facebook, Twitter

- **Suggestion Box**
  - Enables users to propose new ideas
  - Feature new sustainability concepts, sketches
Information Design Features that Improve Learning, 2/2

- Feedback about consumption
  - Must be related to goal
  - Feedback must be relevant and more customized than only facts

- Visual feedback
  - Associated with goal setting for energy consumption
  - Contains positive or negative comments based on facts

- Goals vs. practice
  - Suggestions for change depend on difference between goal and current consumption level
  - High discrepancy example: Change lightbulbs
  - Low discrepancy example: Turn off sleep mode
Information Design Features that Reduce Consumption

- **Frequent feedback**
  - Promotes energy reduction
  - Special feedback for unusually low/high values

- **Daily Snapshots/Daily Diary**
  - Aided by relevant information
  - Examples: Energy consumption, difference from goals, money saved, Earth-image metaphor, social comparison, CO₂ release, etc.

- **Social interaction**
  - With information display, promotes energy reduction
  - Examples: Display user’s consumption, improvements, ecological product purchase
  - Examples: Display user’s energy consumption on Facebook or Twitter
  - Examples: View friends’ energy consumption/improvements and add comments
Initial Concept Sketch on i-Phone: Applications Screen

- **Consumption meter** (at top) shows current energy consumption as constant reminder

- **Application icon** (at bottom left) appears in list of all applications on home screen

QuickTime™ and a decompressor are needed to see this picture.
Initial Concept Sketch on i-Phone: User’s Energy Consumption

- **Multiple tracks:**
  multiple formats of info

- **Large text:**
  Shows recent net total

- **Small text:**
  Comparison

- **Thermometer chart:**
  recent net total re goal

- **Line chart:**
  Last 24-hours

- **Adjustable comparisons:**
  What? When?

QuickTime™ and a decompressor are needed to see this picture.
Initial Concept Sketch on i-Phone: Comparison, Competition

- **Send message**: User can send message to friend(s)
- **I beat you**: User can send friend short info of encouragement or triumph
Initial Concept Sketch on i-Phone: User’s Calendar (for all 3 sub-tabs)

- Custom date selection: filtered by Day, Week, Month and Year
- Green goal indicators: 3 small dots show how much you consumed and how well you met your goals
- Selected dates highlighted
- Selected dates summary
Initial Concept Sketch on i-Phone: Year 2200 Preview

- **Year 2200:**
  Shows extrapolated impact of user’s current consumption

- **News headlines:**
  Give impression of impact

- **Bar charts:**
  Show data of impact

QuickTime™ and a decompressor are needed to see this picture.
Initial Concept Sketch on i-Phone: Possible Friends Preview

- **Touch-sensitive chart:** when user circles chart, his/her friends’ name highlighted
- **User Highlights:** shows user or specific friend’s quick profile
- **Color circular chart:** Shows how green your friends are based on their behavior
Initial Concept Sketch on i-Phone: Tips, Viewing Sketches

- Tips mapping
- 2 axes: Price and energy reduction
- Social interaction visualization
- Zoom in/out
Evaluation: User Tests, Interviews, and Redesign

- **User-experience evaluation**
  - Usability, usefulness, and appeal

- **Cross-cultural evaluation**
  - AM+A Best-of-Breed culture model: Context, technology, time perception, uncertain avoidance, time perception
  - Recent research proves impact of culture on Web, mobile UIs

- **Results evaluation**
  - Motivation and actual reduced energy consumption
User-Test Analysis, 1/2

- 20 people, 18-65, men/women, students, adults
- Users positive re motivation, behavior change
User-Test Analysis, 2/2

- 35% Favor Earth 2200 screen, despite neg info
- Navigation path changes: faster route to Friends
- Some icons needed improvement: “+” confusing
Design Changes

Here is your 2000:
Earth Times Breaking news

Record heat waves in Europe for 2 months

Since the XX century the temperature of the earth has increased by 5°C.

The last oil reserve on earth has been depleted

- Animal species still alive: 53%
- Potable water access in the World: 35%
- Countries at war: 76%

Energy Use:

Total Energy Use: 10.35 kWh

Goal: +18%

Your Energy Use (Wh)

Past 24 hours
Green Machine: Conclusions

- Green Machine: proven motivation and persuasion
- Further R+D needed to complete full mental model and navigation
- Further R+D needed to complete interaction and appearance details
- Project ready to turn over to implementation sponsor in preparation for availability of Smart Grid
- Green Machine approach can be applied to other content, other platforms
Acknowledgements: AM+A Associates

- Brejcha, Jan
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- Li, Eileen
- Millican, Crissy
Green Machine: Project in Process

- **White Paper/presentation**
  - Summarizes and show results of user tests and explain impact on design of application and persuasion design

- **SmartGrid+mobile device demo**
  - Shows possible effective use of SmartGrid and mobile technology

- **Persuasive information + design/visualization**
  - Shows impact of well-designed mobile Smart-Grid apps to help reduce energy consumption

- **Resources**
  - AM+A bibliography of culture, culture dimensions, mobile technology
Bibliography

Green Machine: Event History

- User Experience (UX), 8.4, November 2009: Green Machine article
- World Usability Day, 13 Nov 09, Moscow, U-Lab: Webinar Lecture
- Information Design Journal, 2010: Green Machine article
- DD4D Proceedings, 2010: Green Machine article
- More to come…
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