Interaction Flow Modeling Language

Internet of Things and Internet of People: The Role of User Interaction in the IIoT vision

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Specification of IoT and IIoT so far focused mainly on machine-to-machine interactions

• Things talking to things

But ultimately human contribution must be in the loop!

• Reporting
• Data visualization
• Data analysis
• Data exploration
• Decision making
• Storytelling
The last mile to the user: Costly and inefficient process

Complexity of user interfaces (UIs)

Ineffective design tools

Manual specification of data and visualization

No support for human interpretation of data

The UI Design Problem – UIs for IIoT
Hence **the Interaction Flow Modeling Language (IFML)**
The UI Design solution: IFML

Platform independent description of UIs

Focused on user interactions

No definition of graphics and styles

Reference to external models
IFML Objectives

- User and System Events
- Binding to Business Logic
- Binding to Persistence Layer (data storage)
- Content of the UI
- Interaction Options and Navigation Paths
IFML by example
IFML by example

View Container

ParameterBinding

View Component

Event

«ParameterBindingGroup»
SelectedArtist → AnArtist
IFML by example
IFML by example

```
Album List

ParameterBindingGroup
SelectedAlbum → AnAlbum
```

Albums

Album Deletion
Multiple aspects modeling

UML Use Case

UML Sequence

UML Statechart

BPMN process

IFML
Integration with BPMN

The UI of each activity can be described by an IFML module. Some UML dynamic diagrams (e.g., activity, sequence, ...) execute the payment.

<table>
<thead>
<tr>
<th>ParameterBindingGroup</th>
<th>Name → Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>CreditCard</td>
<td>CC</td>
</tr>
</tbody>
</table>
Given that IFML is an EXECUTABLE model...

- Possibility of complete code generation of the Uis
- Extremely quick time-to-market
- Reliable and bug-free code
- Repeatable, reusable, and coherent resulting UI
Successful IFML projects in industry
Success Stories of IFML and WebRatio

GE Capital Fleet Services
Fleet Management System integrated with legacy systems and high standard security
1 million lines of code
500 user interaction flows
Used in 3 countries
By 150K-200K users

UniCredit Leasing
Online leasing quotations Creditworthiness evaluation system
Building construction check-up system
More than 11 million lines of code
220 roles
4,680 user interaction flows

acer Worldwide public portal
www.acer.com
Workflow system for managing content production, approval and visualization
60 Countries
22 Languages
more than 1 million visits per day

ikea
Q&A and internal trouble ticket system
System for organizing cash register intake at the end of the day
Euro 29.2 billion "Cash Mgmt System" Powered by WebRatio
Used in 42 Countries by 1,620 employees
A Web Intranet managing all the information about the core objects of the Fleet Services business: drivers and vehicles.

A set of dashboards, to allow fleet managers to monitor the costs and performance trends of their fleets.
Vehicle – Expense Overview

Vehicle Expense Overview
June 2014

Overview

<table>
<thead>
<tr>
<th></th>
<th>Rental</th>
<th>Maintenance</th>
<th>Fuel</th>
<th>Accident</th>
<th>Support</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Invoice Cost</td>
<td>$478.73</td>
<td>$0.00</td>
<td>$348.52</td>
<td>$0.00</td>
<td>$60.63</td>
<td>$887.88</td>
</tr>
<tr>
<td>Life Of Unit Invoice Cost</td>
<td>$13,207.81</td>
<td>$264.39</td>
<td>$15,356.44</td>
<td>$0.00</td>
<td>$2,655.33</td>
<td>$31,483.97</td>
</tr>
<tr>
<td>Average Monthly Invoice Cost</td>
<td>$489.18</td>
<td>$9.79</td>
<td>$568.76</td>
<td>$0.00</td>
<td>$98.35</td>
<td>$1,166.08</td>
</tr>
</tbody>
</table>

Fuel Overview

| Current Invoice Cost per Gallon/Liter | $1.18 |
| Current Invoice Quantity             | 295   |

Estimated Mileage Overview

| Last Odometer Reading | 96752.00 |
| Odometer Date         | 02/26/2014 |
Developed Applications: Performance dashboard
Developed Applications: Performance dashboard

Developed with 85% time reduction
SmarterWater: online portal

Front-end

- Web portal and mobile app for customers
- Admin Dashboard for the water supplier

Back-end

- Cloud + Big Data infrastructure
- Smart meters and other home sensors
Online billing and payment

Dashboard for consumption control
- Real-time data from smart meters at home
- Comparison with optimal consumption

Teaching and resources on water

Gamification
- Leaderboard, objectives and badges, points
Performance of the program

Customer segmentation

Geospatial analytics

Alarms for spills and exceptional consumption

Management of materials and training

CRM
Management of breakdowns on country-wise electrical network

A web system for electrical supply network supporting

- Monitoring of the network
- Request, planning, and execution of maintenance
- Reporting and analytics

For ordinary maintenance, malfunctionings, accidents of 130,000 network nodes and 33,000 production units
Management of breakdowns on country-wise electrical network
UI specification with IFML
Integration with BPMN business process specification
Monitoring of IIoT devices on the network nodes
Scheduling, web service interactions
Analytics and visualization: Gantt, Timeline, Excel, PDF
Request and management process
UML model of concepts involved
### Lista Eventi

<table>
<thead>
<tr>
<th>Data</th>
<th>Data P.</th>
<th>Tipo</th>
<th>Denominazione</th>
<th>Cod. L i b</th>
<th>Sottotipo</th>
<th>Nota evento</th>
</tr>
</thead>
<tbody>
<tr>
<td>20/01/16</td>
<td>12:00</td>
<td>LIN</td>
<td>Lina 593 BRESCIA - CISNEROS</td>
<td>PT-SC</td>
<td>manutenzione del CAP</td>
<td>normale</td>
</tr>
<tr>
<td>19/01/16</td>
<td>16:00</td>
<td>TMC</td>
<td>MORILOT BRES S (359)</td>
<td>VI</td>
<td>tensione di rete</td>
<td>massimo</td>
</tr>
<tr>
<td>19/01/16</td>
<td>16:00</td>
<td>TMC</td>
<td>MORILOT BRES S (359)</td>
<td>VI</td>
<td>tensione di rete</td>
<td>normalissimo</td>
</tr>
<tr>
<td>18/01/16</td>
<td>12:00</td>
<td>LIN</td>
<td>Lina 593 COTOLLA - FOGGI</td>
<td>VI</td>
<td>tensione di rete</td>
<td>superiore</td>
</tr>
<tr>
<td>17/01/15</td>
<td>15:00</td>
<td>STT</td>
<td>MONDAITO - SUPERETE 1 149 KV (353)</td>
<td>VI</td>
<td>tensione di rete</td>
<td>massimo</td>
</tr>
<tr>
<td>20/01/15</td>
<td>12:22</td>
<td>STT</td>
<td>ANAGNI ZI AL VALENTINE 1 100 KV (353)</td>
<td>VI</td>
<td>tensione di rete</td>
<td>superiore</td>
</tr>
<tr>
<td>21/01/14</td>
<td>10:10</td>
<td>TMC</td>
<td>A DELLATO A TOR DI QUATO (402)</td>
<td>DI</td>
<td>dimostrazione di rete</td>
<td>normale</td>
</tr>
<tr>
<td>21/01/14</td>
<td>18:10</td>
<td>STT</td>
<td>VILLA VALLE - SNA RICCI 1 100 KV (402)</td>
<td>PT-SC</td>
<td>manutenzione del CAP</td>
<td>normale</td>
</tr>
<tr>
<td>22/01/14</td>
<td>06:20</td>
<td>STT</td>
<td>VILLA VALLE - SNA RICCI 1 100 KV (402)</td>
<td>DI</td>
<td>dimostrazione di rete</td>
<td>normale</td>
</tr>
<tr>
<td>27/01/14</td>
<td>10:28</td>
<td>STL</td>
<td>COLDRI SILLA VAL符 100 KV (907)</td>
<td>ARMA</td>
<td>Emergenza</td>
<td>Apertura per urgente ripristino SPS (vedi mail)</td>
</tr>
<tr>
<td>20/01/14</td>
<td>10:39</td>
<td>UPT</td>
<td>TORNIO VAL RIO - 3 UP TRENTO VAL 3</td>
<td>GM</td>
<td>Incidente</td>
<td>Incidente di rete</td>
</tr>
<tr>
<td>24/01/14</td>
<td>19:00</td>
<td>UPT</td>
<td>MINI MONITOR - UP NERL MONIT 1</td>
<td>OR</td>
<td>Incidente</td>
<td>Incidente di rete</td>
</tr>
<tr>
<td>28/01/14</td>
<td>15:30</td>
<td>STT</td>
<td>PADO E 2400041122 112 KV</td>
<td>ARMA</td>
<td>Incidente</td>
<td>Incidente di rete</td>
</tr>
<tr>
<td>24/01/14</td>
<td>15:40</td>
<td>STT</td>
<td>PADO E 2400041122 112 KV</td>
<td>ARMA</td>
<td>Incidente</td>
<td>Incidente di rete</td>
</tr>
<tr>
<td>22/01/14</td>
<td>00:01</td>
<td>STT</td>
<td>VILLA VALLE - VILLA VALLE</td>
<td>ARMA</td>
<td>Incidente</td>
<td>Incidente di rete</td>
</tr>
</tbody>
</table>

**Notabene:**
- Data Inizio: [ ]
- Data Fine: [ ]
- Ora Inizio: [ ]
- Ora Fine: [ ]
A real case: eventometers

MEASURE AND IMPROVE THE INTERACTION AT YOUR EVENTS

Mobile App

Social Network Analytics

IoT Data

Attendance profiling

People Counting

ARCHIVIO
GIOVANNI SACCHI
Design Resistente
Via Granelli, 1 - Sesto Sui Giovanni (MI)
CON/CORSI / DESIGN (GENERALI)
Internet of Things and Sensors

- **Sensors to measure**
  (visitors flow and attendance enviromental data as temperature, pression and umidity)

- **Sensors to interact**
  (proximity to points of interest, users profiling age, ethnicity, gender)
Enable data sharing and decision making

Exhibit Hall

People in/Out and temperature correlation per hour

People in/Out and humidity correlation per hour
Enable data sharing and decision making
People Counting

Real time data from sensors
People counters + Cloud data storage

Mobile and Web App
Front-end + Back-end

Models in IFML
Passenger counter on buses
IIoT in agriculture needs user monitoring and interaction too

[www.internetofgreens.com]
A Web app modeled with IFML is connected to cloud, showing real-time parameters of sensors implanted in the fields and pots that detect the garden’s humidity, temperature, conductivity and pH.

These sensors are connected to circuits that automatically irrigate and provide the garden with nutrients when necessary. Special grow lamps as well as natural lighting illuminate everything.

Users can take decisions on how to act.
IoT is not just about “T”s!

- People matter and need to be in the loop

You need coherent and consistent methods for covering design of things and people perspectives

IFML can be the tool for this

For more info, look up

www.ifml.org
Additional examples and resources
IFML example – online payment

- **Shopping Cart**
  - «List» Product List
  - Checkout

- **Customer Information**
  - «Form» Customer Information
  - «ParameterBindingGroup» Name → Name

- **Payment Information**
  - «Form» Payment Information
  - «ParameterBindingGroup» Name → Name
  - CreditCard → CC

- **Confirmation**
  - «Details» Confirmation Message
  - «ParameterBindingGroup» Total → Amount
  - Execute the payment
IFML concrete syntax – modules
IFML concrete syntax – modules

- Shopping Cart
  - «List»
  - Product List
  - Checkout

- Payment Execution
  - «ParameterBindingGroup»
  - Total → Amount

- Confirmation
  - «Details»
  - Confirmation Message

IFML Modules - usage
Model-Driven Software Engineering

*MDE in Practice*

Marco Brambilla
Jordi Cabot
Manuel Wimmer

Interaction Flow Modeling Language
Model-driven UI Engineering of Web and Mobile Apps with IFML

Morgan Kaufmann, The OMG press, USA, Q4 2014

“Model Driven Software Engineering in Practice”.
Brambilla, Cabot, Wimmer.

Morgan&Claypool, USA, 2012