Interaction Flow Modeling Language in the IIoT context

Marco Brambilla
marco.brambilla@polimi.it
@mariobrambilla
The UI Design Problem – UIs for IIoT

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
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™
IFML by example
IFML by example

View Container

ParameterBinding

View Component

Event

«ParameterBindingGroup»
SelectedArtist → AnArtist
IFML by example

[Diagram showing the structure of an IFML model for an album search application, including windows, forms, lists, and details views.]

- **ParameterBindingGroup**: Title → AlbumTitle, Year → AlbumYear
- **SelectedAlbum → AnAlbum**

- **Window** AlbumSearch
  - **Form** Album Search

- **Window** Albums
  - **List** Album List

- **Window** Album
  - **Details** Album Details
IFML by example

Albums

Album List

Album Deletion

«ParameterBindingGroup»
SelectedAlbum \rightarrow AnAlbum

Actions
Multiple aspects modeling

UML Use Case
- Handle Rental
- Handle Renter
- Handover Car

UML Sequence
- Sales Clerk
- New rental
- Change days
- Accept payment

UML Statechart
- Car Available
- Car Rent
- Car Damaged
- Car Under Cleaning
- Car Under Maintenance
- Car Sold

BPMN process
- Customer Rent
- Book car
- Reject
- Payment execution
- Rental Date
- Pick up car

IFML
- Sales Clerk
- Customer Rental
- Check customer
- Register customer
- Prepare car
Integration with BPMN

The UI of each activity can be described by an IFML module. Some UML dynamic diagrams (e.g., activity, sequence, ...)
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
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.
Developed Applications: Program and Materials

001454 GE Unit #: 0000001

<table>
<thead>
<tr>
<th>Vehicle</th>
<th>Assigned Person</th>
<th>Additional Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON ROAD Since 03/14/2012</td>
<td>AARON PARR EMPLOYEE ID E1184785</td>
<td></td>
</tr>
<tr>
<td>2012 FORDX ESCAPE 4X4 S</td>
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<table>
<thead>
<tr>
<th>Details</th>
<th>Activity</th>
<th>Billing</th>
<th>Program Materials</th>
<th>Remarketing</th>
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<tbody>
<tr>
<td>Auto Maintenance Mgmt.</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Driver Authorized: 75</td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td>Limit: Pin 0713</td>
<td></td>
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<table>
<thead>
<tr>
<th>Accident Services</th>
</tr>
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<tbody>
<tr>
<td>Instrument No: A135320871</td>
</tr>
<tr>
<td>Instrument Status: Active</td>
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<tr>
<td>Last Issued: 02/14/2012</td>
</tr>
<tr>
<td>Expiration: 02/28/2015</td>
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</table>

<table>
<thead>
<tr>
<th>Instrument History</th>
</tr>
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<tbody>
<tr>
<td>Mailing History</td>
</tr>
<tr>
<td>Action Reason: No Action</td>
</tr>
</tbody>
</table>

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</tr>
</thead>
<tbody>
<tr>
<td>Action Reason: No Action</td>
</tr>
</tbody>
</table>
Vehicle Billing Structure

Structure Details

- **LEVEL 2**: 612102
- **LEVEL 3**: 006450
- **LEVEL 4**: 006430
- **LEVEL 5**: 000000
- **LEVEL 6**

Contract Details

- **SUB CONTRACT**: SW13
- **CONTRACT TYPE**: OPERATING LEASE (L2)
- **FINANCE TYPE**: FIXED

Life Cycle Details

- **CLIENT PO NUMBER**: 
- **CAPITALIZED COST**: $23,338.00
- **BOOK VALUE**: $13,278.52
- **AMORT TERM**: 60

Service Programs

- ACCIDENT SERVICES
- AUTO MAINTENANCE MGMT.
- DRIVER CARE
- DRIVER HISTORY REVIEW
Vehicle – Expense Overview

Vehicle Billing Structure | Event Dates | Vehicle Expense Overview | Sales Adjustments

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>
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<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>
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<tr>
<td>Life Of Unit Invoice</td>
<td>$13,207.81</td>
<td>$264.39</td>
<td>$15,356.44</td>
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<td>$2,655.33</td>
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<tr>
<td>Average Monthly Invoice Cost</td>
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<td>$9.79</td>
<td>$568.76</td>
<td>$0.00</td>
<td>$98.35</td>
<td>$1,166.08</td>
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</tbody>
</table>

Fuel Overview

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

Estimated Mileage Overview

Current Odometer Reading | 96,752.00
Last Odometer Reading | 96,752.00
Odometer Date | 02/26/2014
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
SmarterWater: online portal

- 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
<table>
<thead>
<tr>
<th>Data</th>
<th>Tipo</th>
<th>Denominazione</th>
<th>Cod. Bu</th>
<th>Sottotipo</th>
<th>FR</th>
<th>Nota eventi</th>
</tr>
</thead>
<tbody>
<tr>
<td>20/03/15 12:00</td>
<td>UN</td>
<td>LINEA 300 SEZZE FS - CASTENZI</td>
<td>PT-SC</td>
<td>Intervento per CAP</td>
<td>slotto</td>
<td></td>
</tr>
<tr>
<td>11/03/15 15:00</td>
<td>TRC</td>
<td>FORLI' FANO E.T. (550)</td>
<td>VL</td>
<td>Tensione/Corrente</td>
<td>mal I</td>
<td></td>
</tr>
<tr>
<td>11/03/15 18:00</td>
<td>TRC</td>
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<td>Tensione/Corrente</td>
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<tr>
<td>11/03/15 19:00</td>
<td>UN</td>
<td>LINEA 678 COTILIA - ROCCA SIN</td>
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<td>Tensione/Corrente</td>
<td>sporadico V</td>
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<tr>
<td>11/03/15 12:00</td>
<td>STL</td>
<td>MONTALTO - SUVERETO 1 400 KV (52)</td>
<td>VL</td>
<td>Mediana</td>
<td>mal</td>
<td>mediana</td>
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<tr>
<td>02/03/15 12:00</td>
<td>STL</td>
<td>ANACONZA - VALMONTONE 100 KV (531)</td>
<td>PT-SC</td>
<td>Intervento pre CAP</td>
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<td>14/03/14 10:30</td>
<td>TRC</td>
<td>AGLIO DEL PAPALINO (602)</td>
<td>DI</td>
<td>Disallamenti</td>
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<tr>
<td>25/03/14 20:20</td>
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<td>VILLAVALLE - SNIA-RITI 100 KV (601)</td>
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<td>Intervento per CAP</td>
<td>SCATTI</td>
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<tr>
<td>27/03/14 18:20</td>
<td>STL</td>
<td>COLLI ERETO - VACCHIA 150 KV (667)</td>
<td>AMAR</td>
<td>Emergenza</td>
<td>Emergenza di vigile del fuoco 3/5 (red 1)</td>
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<tr>
<td>21/04/14 10:38</td>
<td>U.P.</td>
<td>T nera - TORRE VAL DI</td>
<td>CA</td>
<td>Blocco 0/0 stato Gruppo</td>
<td>AVARIA GRUPPO</td>
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<tr>
<td>24/04/14 19:00</td>
<td>U.P.</td>
<td>NERA MONITORO - LE GRUPPO</td>
<td>GR</td>
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<tr>
<td>24/04/14 13:40</td>
<td>STT</td>
<td>FNO E.T. - ATM 180/122 112 KV</td>
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<tr>
<td>24/04/14 13:40</td>
<td>STT</td>
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<tr>
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<td>LINEA 300 VILLA NOVA - VILLAVALLE</td>
<td>ARMA</td>
<td>Tensioni</td>
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MEASURE AND IMPROVE THE INTERACTION AT YOUR EVENTS

Mobile App

Social Network Analytics

IoT Data

Attendance profiling

People Counting
Sensors to measure
(Visitors flow and attendance, environmental data as temperature, pressure, and humidity)

Sensors to interact
(Proximity to points of interest, user profiling, age, ethnicity, gender)
People Counting

Real time data from sensors
People counters + Cloud data storage

Models in IFML

Dashboard

Mobile and Web App
Front-end + Back-end
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.
How it works – schema (english)

- Fertilizer
- Electropump
- EC sensor
- Plants
- Ph sensor
- Irrigation
- Electropump
- Switch
- Light
- Light sensor
- Temperature sensor
- Humidity sensor
- Noise sensor

Data flow:
- Device
- Router
- Cloud
- Database
- Device
Thanks!

Marco Brambilla
marcobrambi
marco.brambilla@polimi.it
Some Ads

And the upcoming IFML book!

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
Additional examples
IFML example – online payment

Shopping Cart

- «List»
- Product List
- Checkout

Customer Information

- «Form»
- Customer Information

Payment Information

- «Form»
- Payment Information

Confirmation

- «Details»
- Confirmation Message

Parameter Binding Group:
- Name \(\rightarrow\) Name
- Credit Card \(\rightarrow\) CC

Execute the payment

Total \(\rightarrow\) Amount
IFML Modules - definition

Payment Execution

Customer Information

«Form»
Customer Information

«ParameterBindingGroup»
Name → Name

Payment Information

«Form»
Payment Information

«ParameterBindingGroup»
Name → Name
CreditCard → CC

Amount

Execute the payment

Confirmation
IFML Modules - usage