Ajuntament de Sant Feliu de Llobregat

THE SKYNET EXPERT SYSTEM

The city and its project

- **City:** Sant Feliu de Llobregat
- **Name of the Project:** Skynet
- **Project Area:** Environment.
- **Status of the project:** Network Up&Running with expected extensions

Purpose

Skynet is an **EXPERT SYSTEM** to automate the management of SmartCity infrastructures, in a quick and flexible way. It's a generic tool, reusable in different scenarios. It has the following features:

- **Integrable** with multiple sensory platforms: Sentilo, Fi-ware, other.

- **Portable** to embedded devices, Raspberry-pi, Android, etc, allowing Skynet to be used as an sensor controller. Skynet can connect sensors and actuators into sensory platforms.

- **Programmable in a functional language simple** and easy to learn, but powerful enough to implement complex algorithms of artificial intelligence, learning, etc.

- **Programmable remotely** via HTTP / REST interface.

- **Availability of Web tools, java and mobile** to program and test the expert system rules.

SKYNET – Components

A functional programming language

Specially designed for solving artificial intelligence problems.

Expert system rules are expressed in this language.
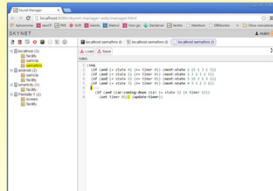
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An execution environment (server)

Light weight and portable, can run on cloud servers and embedded devices.

Expert systems run on it.

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An IDE (manager)

Web tool to manage the servers and programming the rules.
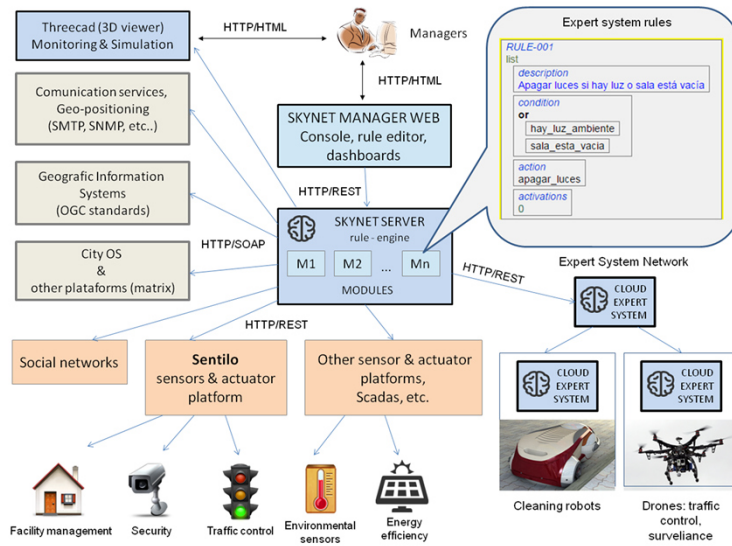

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A 3D viewer (threecad)

WebGL based viewer to monitor a smartcity infrastructure and to simulate the rules operation.
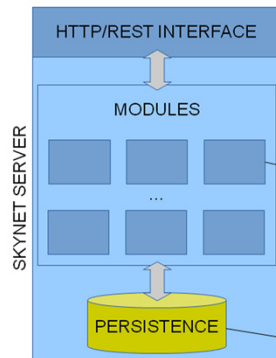
SKYNET - Interoperability

SKYNET server - Internal architecture (I)

A Skynet server is an artificial brain with this internal architecture:

HTTP/REST INTERFACE

MODULES

...

PERSISTENCE

SKYNET SERVER

- HTTP/REST API for programing modules and interact with them.
- Supported methods:
  - GET: get data
  - PUT: put data
  - DELETE: delete data
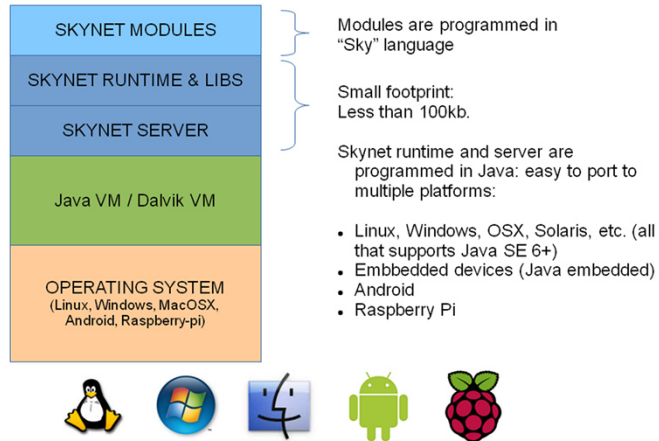 - POST: execute statement

- Modules are programmed in "sky", a functional language similiar to LISP.
- Each module implements an expert system with a set of facts and rules
- Modules do not share information but can work together
- Modules are multi-threaded, they can do multiple tasks simultaneously.

- The server can save and restore snapshots of all module data (facts and rules)

SKYNET server - Internal architecture (II)

Skynet server technology stack:

| SKYNET MODULES |
| SKYNET RUNTIME & LIBS |
| SKYNET SERVER |
| Java VM / Dalvik VM |
| OPERATING SYSTEM
(Linux, Windows, MacOSX,
Android, Raspberry-pi) |

Modules are programmed in
"Sky" language

Small footprint:
Less than 100kb.

Skynet runtime and server are
programmed in Java: easy to port to
multiple platforms:

- Linux, Windows, OSX, Solaris, etc. (all
  that supports Java SE 6+)
- Embbedded devices (Java embedded)
- Android
- Raspberry Pi

SKYNET – Project organization (Dependency diagram)

SKYNET MANAGERS (UI APPS)			SKYNET SERVERS (REST API)		
SKYNET MANAGER WEB (JAVASCRIPT)	SKYNET MANAGER SWING (JAVA)	SKYNET MANAGER ANDROID (JAVA)	SKYNET SERVER J2EE	SKYNET SERVER ANDROID	SKYNET SERVER RASP-PI
SKYNET CLIENT JAVASCRIPT	SKYNET CLIENT JAVA		SKYNET SERVER (JAVA)		
			SKYNET BASE LIBRARY (JAVA)		
	SKYNET BASE LANGUAGE RUNTIME (JAVA)				
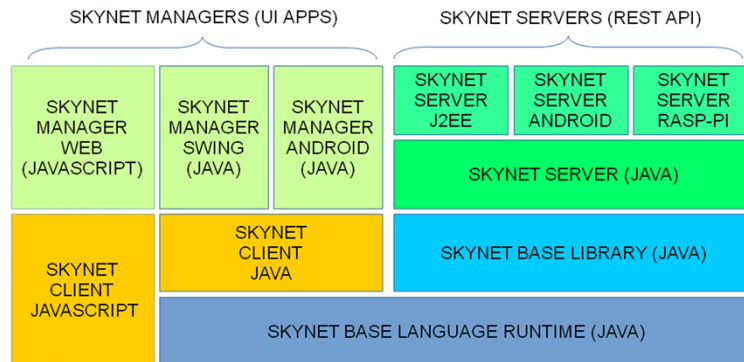
SKYNET language: features

- Very simple but powerful functional language
- Based on S-Expressions (homoiconicity: data and code are represented in the same way)
- Easy parsing and code generation (Wizards can create rules easily)
- Small footprint (can be ported to devices with low resources)
- Easy to extent with new built-in functions
- Support for user defined functions
- User defined functions can be recursive
- Multi-threaded
- Just 5 basic data types: strings, numbers, booleans, references (symbols), lists
- All these data types are persistent

SKYNET – Experience & valuations

Demonstrated the viability of the tool and its possibilities with several projects:

• Energy efficiency in SF Town Hall central building.
• Traffic control in Reus city center.
• Parking control in taxi ranks (Reus city).

Achivements:

• Reduction of development costs.
• More flexibility for changing the control logic.
• Better integration of smartcity solutions.

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www.santfeliu.cat