The iDom®Framework: A Novel Tool to Achieve Energy Efficiency

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Abstract. Herein, we present an innovative and practical platform named iDom® Framework that enables non-specialist developers to create automated applications to monitor and control any physical device that relies on measurable physical units. A case study of our product Rulergy®, a solution for energy efficiency, that was built using the iDom® Framework is presented.

Keywords: Framework; Software; Hardware; Home Automation; Building Automation; Energy Efficiency; Sustainability; Energy Management System.

1   Introduction

There is a growing interest in innovative solutions for connecting the physical and the logical world. Most systems however fail in making such a connection. At DOMATICA, we set ourselves to create a platform that can be used by non-specialist developers and that facilitates bridging software and real world by enabling monitoring and controlled manipulation of physical devices. We aim to contribute to a better world by endowing these devices with intelligence, in an interconnected global network, interacting with humans in real time, facilitating their operations, business and cost control in a centralized platform. In this manner, we believe we can be part of the development of societies with a direct impact in keys areas including industry automation, process and energy efficiency or health management.

2   The iDom® Framework

DOMATICA has created the iDom® Framework,[1] an innovative technological solution that narrows the distance between the physical and the logical world. Skilled programmers often develop applications for software platforms using high level programming codes and databases. However, a significant barrier is found when trying to get out of the computing environment and to connect such applications with physical devices. The iDom® Framework is a practical platform that enables non-specialists

developers to create automated applications to monitor and control any physical device that rely on measurable physical units.

The physical world is complex. There exist an almost infinite number of sensors available to measure the same logic unit and that can also act as actuators. The iDom® Framework makes it simple for developers to quickly build applications that can access real world physical devices. Complex systems are in this way built at a glance, without the need of special knowledge of the physical devices themselves, electrical signals or even communication protocols. Additionally, sensors, actuators and hardware blocks may be manipulated without changing a single code line at the application level.

The iDom® Framework consists of the Collector, Gateway, Project and SDK and is depicted in the Figure 1.
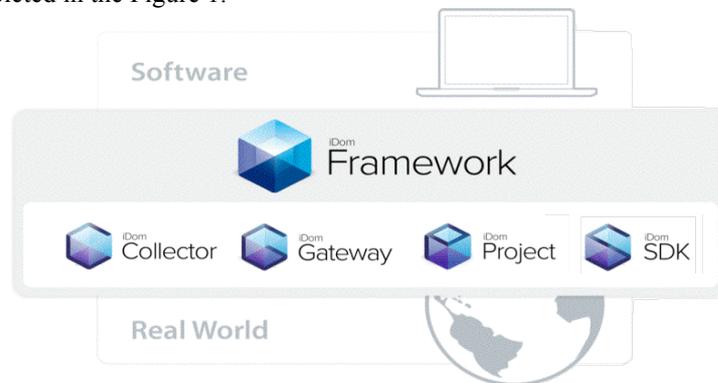

Figure 1 – Overview of the iDom® framework components.

The iDom® Collector as part of the iDom® Framework, works in a distributed intelligence architecture, where each module has its own program memory, object data memory (devices, timers, variables) as well as high processing power. When a module is added to a network, it adds power and resources to that network, instead of consuming resources from other modules. Peripheral devices receive and emit electric signals. The iDom® Collector handles these signals and supports almost all types of physical devices.

The iDom® Gateway is a communication concentrator, functioning as the bridge between the control devices and the SDK. Additionally, it also handles communications with several peripheral and sub-system protocols, bringing them to the iDom® Framework in a transparent way.

The iDom® Project provides drivers for many known devices. Nevertheless, new drivers can be easily created for new devices, at anytime, using driver builder. Once those drivers are applied, virtual devices are created and became available to the upper layer, for any custom application.

The iDom® SDK is the piece of the iDom® Framework that delivers the equalized objects to high level applications. iDom® SDK empowers applications to the physical world. iDom's SDK manages socket connections and communication frames, freeing the software engineer from this tasks. The iDom® SDK is available

for all major platforms including Windows, Linux, Apple iOS and Android with a multitude of applications, such as OS Applications, Web Applications, Web services, SQL Databases connection and others.

3   A case study: Rulergy® - Solution for Energy Efficiency

Global energy consumption is growing at high pace.[2] The energy consumption of homes and buildings accounts for a great part of this energy and is expected to grow by 45% between until 2025. This creates a challenge for sustainable energy consumption and for the creation of tools that help reducing energy consumption of homes and buildings. Home and Building Automation Systems (BAS) provides a possible solution as an energy efficiency indicator, which shows consumption patterns and consumer behaviours, and allows consumers to take consumption choices in order to achieve energy efficiency. At DOMATICA, we used our iDom® Framework to create Rulergy®, a powerful and cost-effective tool to achieve energy efficiency and sustainability. This case study is now presented.

The Rulergy is an innovative Energy Management System for energy efficiency that was built using the iDom® Framework. It is a Plug&Play solution with data access in iDom® Live web platform that enables to monitor energy consumption in real-time, to know in detail energy usage, to control circuits and devices in real-time, to establish rules for automated control of devices, to create custom made performance alerts and reports. This is all accessible at anytime anywhere.

The Rulergy® system can be used in the context of many sectors including corporate, industrial and residential allowing immediate and significant energy savings. The main features of Rulergy® are the following:

- Energy consumption measurement
- Evaluation and control rules
- Monitoring the fulfilment of objectives
- Control devices and circuits
- Energy Quality
- Create consumption historical registers and reports
- System Condition and event notifications
- Easy to install (Plug & Play)
- Total mobility

3.1   Rulergy® based in iDom® Framework

The Rulergy solution is based in the iDom® Framework. Rulergy has its online access in iDom® Live platform that was built using the iDom® SDK, it structures the virtual devices into units and/or actions delivering this information to a higher level. Receive triggers from sensors such as buttons, energy meters and motion detectors, among others.

3.2 Rulergy® installation process

The Rulergy is a Plug&Play solution. The installation is performed at the electrical board level. For each circuit to be measured, a clamp must be added while each circuit to be controlled, a relay must be added. The Rulergy gateway connects data from circuit devices and also from Power Quality module. This data is deployed into the Rulergy web platform in real-time.

3.3 Constant Monitoring

On the web interface it is possible to access the different devices that are integrated into the system. The system display circuits and each individual device is organized by type, zone and/or group and is directly managed by the user. With the web interface, it is possible to have real-time information about the instant and the accumulated energy consumption of the selected device. Rulergy enables real-time reading and monitoring of energy usage, cost analysis, power quality, trends and the carbon footprint of the buildings. Rulergy monitors and logs values including voltage (single or 3 phases), current, watts, effective power, reactive power, apparent power, harmonics and power factor. Monitoring and controlling these elements is the cornerstone for sustainable energy consumption.

3.4 Devices Control

Each device has a dedicated control panel where it possible to monitor consumption readings while also controlling its state condition. Device control happens in two circumstances, by direct instruction (On /Off) from the user or by system automation.

3.5 Reports

Rulergy enables to monitor and to reduce consumptions and energy costs in the multifunctional reports. The used is able to choose the information at any given time, hourly, daily, weakly, monthly, yearly or on a specific date and to create activity reports for each device individually or by combination of various circuits and criteria and to export capability of the data analytics. These creates layers of monitoring and controlling that enables easy reduction of energy waste and therefore costs.

3.6 Rules

With the Rulergy one can establish the Rules and the system will monitor itself. It will be able to make the energy systems react to specific events, or even schedule the events:
- Time-based: Set a date and periodicity and automate the control of the devices.
- Event-based: Establish rules for the evaluation of events that translate into actions of notification or instructions for your devices.

4   Conclusions

There is a great demand for systems that enable the easy and systematic monitoring and control of physical devices. The iDom® Framework virtualises the physical world in a practical and unique manner. This framework can virtually be used with any physical devices in areas such as industry automation, process and energy efficiency or health management. We demonstrated the power of this framework by creating a tool for energy efficiency, Rulergy®, to face the world´s challenge of an immediate and sustainable reduction in energy consumption of homes and buildings.

5   References

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