

Smart Office

an IoT-based solution for energy efficient offices

Smart Office is a solution that optimizes the energy consumption in an office and flexibly adapts an overall office environment to customizable preferences. A set of sensors is applied for continuous monitoring of both the work environment and behaviour of employees, while the user experience is evaluated and used as a feedback for application adjustments.

The solution is built upon progressive and advanced technologies of Internet of Things (IoT), Semantic Business Rules and Processes, Smart Sensors, and namely the User eXperience (UX) Model enabling to capture the experience of office employees consuming the Smart Office services and evaluate it in knowledge, social, and business dimensions.



Smart Office is highly scalable in terms of both functionality and office size. It is specifically suitable for middle-size offices ranging from 5 to 20 employees in a single office room; however, it can be easily customized to smaller or larger offices and even adapted to a network of offices located in a floor or building.

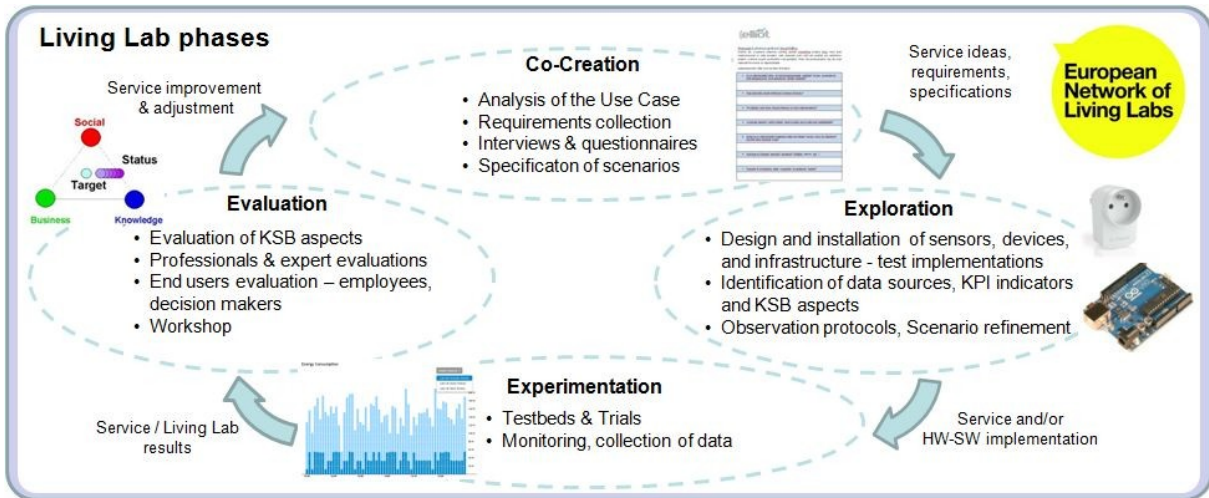
Besides the workplace occupancy and behaviour of employees, the Smart Office system monitors the indoor/outdoor temperature, humidity and light intensity. Standard set of provided devices includes sensors and actuators for controlling the energy consumed on each workplace during a regular work, as well as the energy consumption for heating and air conditioning. Thanks to standardised interfaces and open communication protocols adopted in the Smart Office solution, other types of sensors and devices can be included as well.

Targets addressed

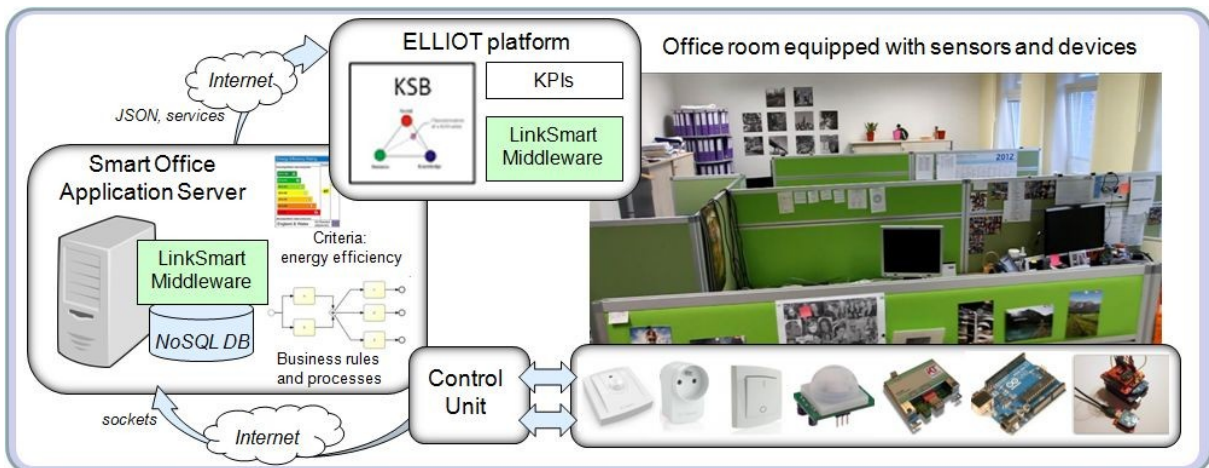
- Overall reduction of energy consumed by an office during regular working hours.
- Improvement of work environment in the office by adjusting settings of parameters (temperature, light intensity, etc.), to personal needs and preferences of people working in the office, which is expected to lead to an increase of comfort of these employees and thus also to higher productivity of work.
- Alignment of settings of the office work environment to the underlying business processes, which could be defined by milestones of running projects, pre-defined schedule of project tasks, plan of vacancies or business trips, etc.

Approach

The Smart Office system was developed and is typically installed as a **Living Lab**, which is an open experimental environment for user-driven creation, set up, and maintenance of applications. Living Lab phases of *Co-Creation*, *Exploration*, *Experimentation*, and *Evaluation* are applied for continual user experience monitoring and system adjustments. More information on the Living Lab approach can be found at www.openlivinglabs.eu.



The user experience monitoring and evaluation is accomplished in Smart Office by means of the **ELLIOT platform**, which receives the KPI indicators calculated by the Smart Office business logic upon the data provided by sensors and devices installed in the office room. The ELLIOT platform then processes and visualises the knowledge, social, and business aspects that enable adjusting of the whole system towards desired outcomes of energy consumption, comfort of employees, etc.



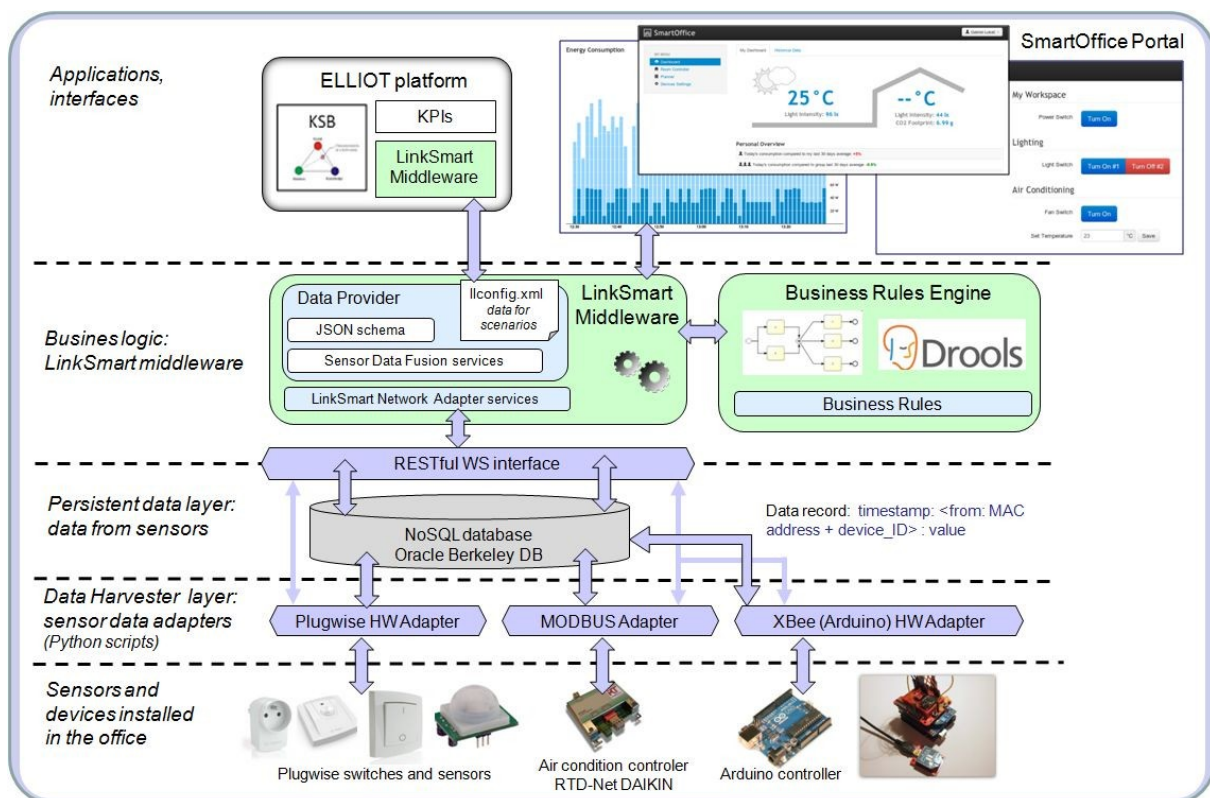
Acknowledgement

The Smart Office application was developed within the **ELLIOT (Experiential Living Lab for the Internet of Things)** project, co-funded by the European Commission in the 7th Framework Programme upon the contract. No. 287560. To obtain more information on the ELLIOT project and the ELLIOT platform please refer to www.elliOT-project.eu.

Technology

Underlying technology of Smart Office includes the **LinkSmart IoT middleware** that retrieves the data from sensors installed in the office, applies semantic reasoning and customizable business rules for sensor data fusion, calculates the performance indicators and stores the data records in a local database.

Sensors applied in the Smart Office system are built on Plugwise and Arduino frameworks. In its default configuration, Smart Office includes motion sensors, RFID card readers, switches and circles for electricity consumption monitoring, light intensity and temperature sensors, heating and air conditioning controllers. Sensor-generated data are wrapped by a RESTful Web Service interface and provided to the LinkSmart middleware for further processing. Thanks to this transparent and standardised interfacing, custom Smart Office applications can be easily extended on new types of sensors and devices.



Inner business logic is built on **Drools Business Rule Engine**, which is combined with OWL ontologies and respective reasoning mechanisms for KPI calculation. Resulting KPI values are converted to JSON data streams and are forwarded to a remote ELLIOT platform for further evaluation and visualisation of knowledge, social, and business parameters.

User interface is provided as a web application, so-called **Smart Office portal**, which serves as the main user interaction tool of the Smart Office system and enables online monitoring of all the data coming from sensors. Namely, it provides a personalised overview of actual energy consumption and environmental conditions in the office, historical records of energy consumed over a given period, specification of personal preferences on temperature and light intensity, planning of absences and adjusting long-term energy consumption, generating tips on energy savings, or competing on CO2 footprint reduction and energy savings between the office employees.

Services provided

Occupancy/presence sensing in an office environment

- ✓ Precise and accurate sensing of presence of persons on a given (working) place, which could be namely beneficial in emergency situations;
- ✓ Reports on monitored data of workplace occupancy (per person, per a working team).

Energy consumption monitoring

- ✓ Awareness of actual energy consumption in the office, as well as of history and trends in energy consumption, which may lead to energy savings;
- ✓ Availability of various customisable reports on energy consumption in the office.

Adaptation of the office environment to business processes

- ✓ Office environment adapted to the business processes, as well as to individual preferences or working schedules of employees, which may lead to energy savings.

Adaptation of the office environment to individual preferences of employees

- ✓ Office environment adapted to individual preferences of employees, which increases the work comfort and consequently may lead to a higher productivity of work;
- ✓ Awareness of employees on their energy consumption, as well as on energy consumption and work environment preferences of their colleagues;
- ✓ Recommendations on adjusting the office room temperature, light intensity, etc., generated by the service for particular employees, may lead to energy savings.

Game/competition on energy savings

- ✓ Awareness of actual/historical energy consumption and CO2 footprint in the office (per person, per a working team, and for the office as whole);
- ✓ The competition between employees may lead to energy savings;
- ✓ Availability of various customisable reports on energy consumption in the office.

The Smart Office portal

- ✓ Web interface that visualises actual/historical energy consumption and CO2 footprint in the office (per person, per a working team, and for the office as whole), provides customisable reports on energy consumption in the office;
- ✓ Recommendations on adjusting the office room temperature, light intensity, etc., generated by the service for particular employees, may lead to energy savings.

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ELLIOT project

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