Geometric information provider platform

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Abstract

Renovation of existing buildings is known as an essential stage in reduction of the energy loss. Considerable part of renovation process depends on geometric reconstruction of building based on semantic parameters. Following many research projects which were focused on parameterizing the energy usage, various energy modelling methods were developed during the last decade. On the other hand, by developing accurate measuring tools such as laser scanners, the interests of having accurate 3D building models are rapidly growing. But the automation of 3D building generation from laser point cloud or detection of specific objects in that is still a challenge.

The goal is designing a platform through which required geometric information can be efficiently produced to support energy simulation software. Developing a reliable procedure which extracts required information from measured data and delivers them to a standard energy modelling system is the main purpose of the project.

Keywords

renovation; buildings; geometry; reconstruction; parameterisation; energy use; energy modelling; 3D models; laser point cloud

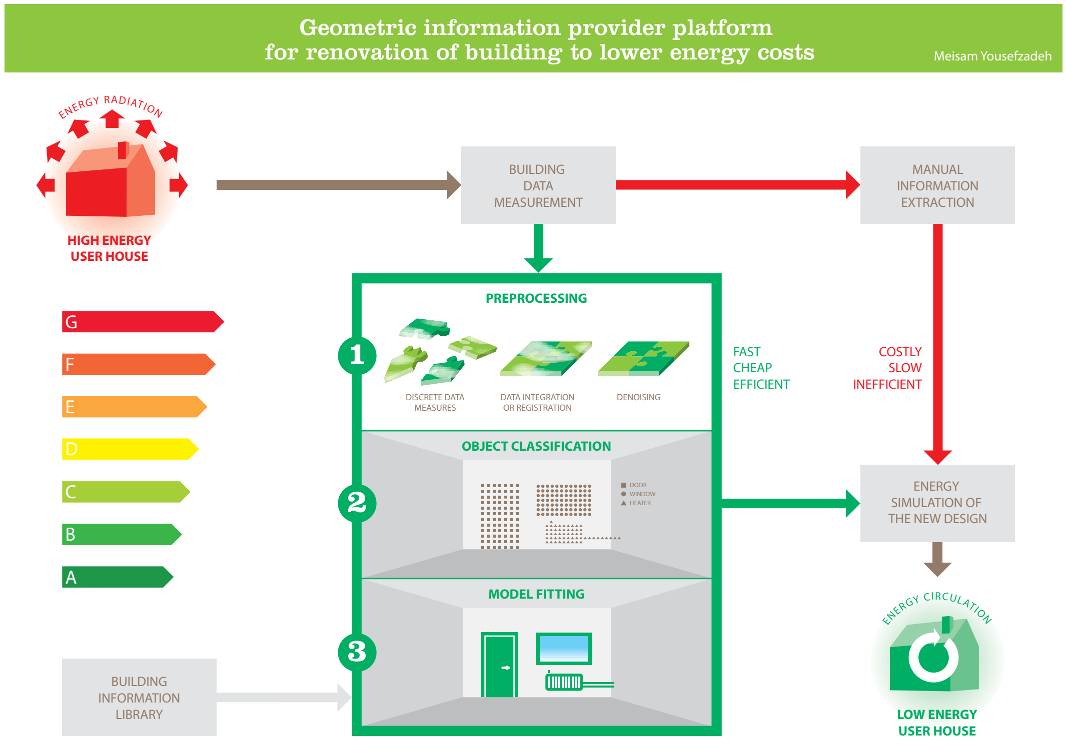

FIGURE 1 Graphical abstract

In current situation renovation procedure for energy efficiency is too slow and expensive and is not covering market demand. One of the bottlenecks is 3D as-built modelling which is an essential part of the energy simulation. However 3D modelling is a wide field in science with various methods and standards. Energy simulation software, such as Energy plus, requires general geometric information from indoor area of buildings. Area of the floors, position and orientation of walls, position and shape of the openings, position and volume of energy sources would be sufficient information for energy simulation which fits to LOD3. Therefore the problem is developing an efficient system which provides required geometric information.

To obtain a comprehensive picture of the project it is necessary to review current operational tasks. Followings are general operational steps of manual procedure:

Data collection: laser scanners are taken to the field. Based on a planned network scanning will take place, in order to cover the whole target area. As a result, several files (each of which takes few GB space) are stored for any project.

Data registration: Individual files have to be integrated to form a unique file for the interested area. This file includes all scanned points in unique ground coordinate system. For this aim Ground Control points are required to register collected 3D points to the ground coordinate system. Registration has to be within determined accuracy level. Any error in control points or lack of overlapping data directly affects registration accuracy.

Manual model fitting: 3D modelling of area proceeds through manual model fitting. Expert modellers draw or choose suitable models for building objects. This is the most time consuming task and depends on the skills of modeller and the facilities of the software.

Energy file format: Required geometric information has to be extracted and transformed to a file format which is suitable for Energy modelling. For instance, to produce IDF files for Energy plus, various geometric parameters have to be extracted from 3D model. Point vertexes for building objects as well as area and volume information are extracted from 3D models.

Full automation of this process is quite demanding. However automatic as-built generation for indoor area is in early development steps and still has loge way in research. In spite of many developed methods, not any general qualitative solution has verified yet.

A real-time modelling system is a dynamic system which obtains raw data from measurement tools, processes them through mathematical analysis and finally delivers achieved information to the user in standard formats. Thus an automatic system composed of the following sections:

Measurement: Point cloud measured by laser scanners, topological and thematic maps, metadata measured by local sensors and the history of energy consumption are assumed as input data.

End software: The results of data processing have to become ready for energy simulation and also to be visualised. Therefore the output of the modelling process will be a suitable input for Energy Plus and visualisation software.

Building Information Library: a simple library is necessary for facilitating building component selection. Automatic access to the most suitable model is the purpose of having such a library. Thus it is necessary to develop a model selection method which properly connects semantic labels to the appropriated models.

Modelling platform: Development of a reliable modelling process is the main purpose of this research. This section links the measured data to energy modelling and visualisation software. Due to the variety in architecture and complexity of data, having a comprehensive automatic process is not yet viable.

Support

VISICO, 3D Geo Solutions

Supervisors