

A SYSTEM AND METHOD FOR GENERATING A DIGITAL TWIN OF A BUILDING FOR ITS SUPERVISION

[001] The invention relates to digitization of infrastructure. More specifically, a system and method for generating at least one digital twin of at least one physical real-world building and its floors, for supervision of the building by at least one user through their user device.

BACKGROUND OF THE INVENTION

[002] Conventionally, the supervision of buildings is done through the involvement of human personal at the building to monitor and manage the building. Such means of supervision is tedious and also difficult to keep track. To ease supervision of the building, certain modern buildings have been constructed with its digital twin modelled in tandem. However, even so, not all buildings that are built have a corresponding digital twin.

[003] For context, a digital twin refers to a digital replica of a physical real-world object that is presented digitally in a virtual environment. In particular, the digital twin may be in the form of a combination of three-dimensional (3D) models and/or two-dimensional (2D) models that mirrors information about the physical real-world object based on information sourced from the real world.

[004] There are disclosed technologies over the prior art relating to systems and methods for generating a digital twin of a physical real-world building. Among them include a published United States Patent Application US20200304375A1. It discloses a system and method for creating a digital twin of a physical environment, which involves using depth data from at least one depth-sensing device to generate a three-dimensional map of the environment. This map forms the basis for creating the digital twin. In its implementation, there is a computing system that executes instructions to perform tasks that include receiving depth data, generating the 3D map, creating the digital twin, obtaining device location information, associating devices with their digital twins, and linking coordinates to device identities.

[005] However, the teachings derived from the aforementioned prior art have a number of drawbacks. Among them is that it relies on setting up devices at the site of the physical real-world building for generating the digital twin. Furthermore, users of the prior art are required to install a dedicated application software within their own devices. Accordingly, it is desirable for a system and method for generating at least one digital twin of at least one physical real-world building and its floors based on its floor plans for supervision of the building by at least one user through their user device, which can overcome the aforementioned drawbacks.

SUMMARY OF INVENTION

[006] The main objective of the present invention is to provide a system and method for generating at least one digital twin of at least one physical real-world building and its floors for supervision of the building by at least one user through their user device, in a manner that is akin to software as a service (SaaS). Furthermore, the present invention enables a digital twin of a physical real-world building to be generated based on its floor plans, in which the digital twin, and the modules that generate and visualize said digital twin, may be embedded within the user device or at least an application software of the user device. Moreover, the present application further adds qualitative and/or quantitative data collected from the physical real-world building within the digital twin in a visualized manner, for the physical real-world building to be supervised by the user via its digital twin.

[007] The present invention intends to provide a system for generating at least one digital twin of at least one building for its supervision, comprising a plurality of devices that includes a first device and a second device, at least one data storage unit for storing floor plan data content, and at least one processing unit that is part of the first device, which is configured to operate a plurality of modules and/or their related data content, in which the modules and/or their related data content are being provided, and/or previously provided, by the second device to the first device. The processing unit generates digital twin data content that forms the digital twin of the building from the floor plan data files, for the digital twin to be further included with information collected from the building, for supervision of the building through its digital twin via the first device.

[008] Preferably, regarding the system, the plurality of modules and/or their related data content are embeddable within the first device or at least one application software operating on the first device, for the plurality of modules operated by the processing unit to generate the digital twin data content that forms the digital twin of the building that is embedded within the first device or the application software operating on the first device.

[009] Preferably, regarding the system, the modules include an editor module that is stored in the second device and provided to the first device, in which during operation, the editor module is configured to scale the floor plan data files based on at least one dimension.

[0010] Preferably, regarding the system, the editor module is further configured to generate one or more digital models based on the floor plan data files, as the first device detects signals that correspond to tracing and/or sketching actions performed by the user upon the first device over the floor plan data file that is displayed thereon, in which one or more points are marked within a space of a virtual environment displayed on the first device for the digital models to be generated and/or provided in the virtual environment based on the marked points.

[0011] Preferably, regarding the system, the editor module is further configured to enable the models to each have a required or specific level of detail (LOD) as they are generated and/or provided within the virtual environment.

[0012] Preferably, regarding the system, the devices are configured to store any one or both first variable asset data content, which includes data files that correspond to a first type of information related to the building, which is in the form of be qualitative data, and second variable asset data content includes data files that correspond to a second type of information related to the building, which is in the form of be quantitative data related to physical phenomena within the building.

[0013] Preferably, regarding the system, the modules further include an asset mapping module that is stored in the second device and provided to the first device, in which during operation, the asset mapping module is configured to retrieve any one or a combination of the digital twin data content and the first variable asset data content to allow the user to

assign one or more unique identifiers so that their data files are mapped accordingly for generating topological asset data content.

[0014] Preferably, regarding the system, the modules further include an extraction and computation module that is stored in the second device and provided to the first device, in which during operation, the extraction and computation module is configured to analyse information within any one or a combination of the topological asset data content, the first variable asset data content, and the second variable asset data content, to generate analysed data content therefrom.

[0015] Preferably, regarding the system, the modules further include a visualization module that is stored in the second device and provided to the first device, in which during operation, the visualization module is configured to construct the digital twin together with information collected from the building, from any one or a combination of the topological asset data content, the first variable asset data content, the second variable asset data content, and the analysed data content, in which the digital twin together with information collected from the building are displayed on the first device in a user-interactable manner.

[0016] Preferably, regarding the system, the digital twin data content includes data files that define the digital twin of the building, in which it comprises any one or a combination of one or more data files related to information of a number of floors and of the building and their layout, one or more data files related to renderable wall models, their defined rooms, and their arrangement within one floor, which correspond to the building, one or more data files related to renderable fixture models and their arrangement within one floor, which correspond to the building, and one or more data files related to renderable furniture modules and their arrangement within one floor, which correspond to the building.

[0017] The present invention further intends to provide a method for generating at least one digital twin of at least one building for its supervision, comprising the steps of providing a plurality of devices that includes a first device and a second device, storing floor plan data content, by at least one data storage unit, and operating a plurality of modules and/or their related data content, by at least one processing unit, in which the modules and/or their related data content are being provided, and/or previously provided, by the second device to the first

device. The processing unit generates digital twin data content that forms the digital twin of the building from the floor plan data files, for the digital twin to be further included with information collected from the building, for supervision of the building through its digital twin via the first device.

[0018] Preferably, regarding the method, the plurality of modules and/or their related data content are embeddable within the first device or at least one application software operating on the first device, for the plurality of modules operated by the processing unit to generate the digital twin data content that forms the digital twin of the building that is embedded within the first device or the application software operating on the first device.

[0019] Preferably, regarding the method, it further comprises one or more steps that are further performed by an editor module that is stored in the second device and provided to the first device for its operation, which comprises scaling the floor plan data files based on at least one dimension, by an editor module.

[0020] Preferably, regarding the method, it further comprises one or more steps that are further performed by the editor module, which comprises detecting signals that correspond to tracing and/or sketching actions performed by the user upon the first device over the floor plan data file that is displayed thereon, marking one or more points are marked within a space of a virtual environment displayed on the first device, and generating and/or providing one or more digital models in the virtual environment based on the marked points.

[0021] Preferably, regarding the method, it further comprises one or more steps that are further performed by the editor module, which comprises enabling the models to each have a required or specific level of detail (LOD) as they are generated and/or provided within the virtual environment.

[0022] Preferably, regarding the method, the devices are configured to store first variable asset data content, which includes data files that correspond to a first type of information related to the building, which is in the form of be qualitative data, and second variable asset data content includes data files that correspond to a second type of information related to the

building, which is in the form of be quantitative data related to physical phenomena within the building.

[0023] Preferably, regarding the method, it further comprises one or more steps that are further performed by an asset mapping module that is stored in the second device and provided to the first device for its operation, which comprises retrieving any one or a combination of the digital twin data content and the first variable asset data content, allowing the user to assign one or more unique identifies so that their data files are mapped accordingly, and generating topological asset data content.

[0024] Preferably, regarding the method, it further comprises one or more steps that are further performed by an extraction and computation module that is stored in the second device and provided to the first device for its operation, which comprises analysing information within any one or a combination of the topological asset data content, the first variable asset data content, and the second variable asset data content, and generating analysed data content.

[0025] Preferably, regarding the method, it further comprise one or more steps that are further performed by a visualization module that is stored in the second device and provided to the first device for its operation, which comprises constructing the digital twin together with information collected from the building, from any one or a combination of the topological asset data content, the first variable asset data content, the second variable asset data content, and the analysed data content, and displaying the digital twin together with information collected from the building on the first device in a user-interactable manner.

[0026] Preferably, regarding the method, the digital twin data content includes data files that define the digital twin of the building, in which it comprises any one or a combination of one or more data files related to information of a number of floors and of the building and their layout, one or more data files related to renderable wall models, their defined rooms, and their arrangement within one floor, which correspond to the building, one or more data files related to renderable fixture models and their arrangement within one floor, which correspond to the building, and one or more data files related to renderable furniture modules and their arrangement within one floor, which correspond to the building.

[0027] One skilled in the art will readily appreciate that the invention is well adapted to carry out the objects and obtain the ends and advantages mentioned, as well as those inherent therein. The embodiments described herein are not intended as limitations on the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] To facilitate an understanding of the invention, there is illustrated in the accompanying drawings the preferred embodiments from an inspection of which when considered in connection with the following description, the invention, its construction and operation and many of its advantages would be readily understood and appreciated.

[0029] **FIG. 1** illustrates a block diagram of a system of the present application, according to one example embodiment.

[0030] **FIG. 2** illustrates a block diagram that shows the interactions between the modules that are involved within the present application, according to one example embodiment.

[0031] **FIG. 3** illustrates a flowchart of a method of the present application, according to one example embodiment.

DETAILED DESCRIPTION OF THE INVENTION

[0032] The present invention relates to a system and method for generating at least one digital twin of at least one building for supervision of the building by a user through their user device. In particular, the present application involves generation of at least one digital twin of at least one physical real-world building based on floor plans of the building, via a combination of modules that may be embeddable within the user device or at least one existing application software of the user device, for supervision of the building and/or its floors via its embedded digital twin by the user through their user device.

[0033] According to the concept of the invention, there is a plurality of devices that include a first device and a second device. The first device may be a user device in which the user interacts therewith. The second device is one that may be in communication with the first device for providing a plurality of modules thereto for these modules to operate on the first device to enable the first device to generate a digital twin of a corresponding physical real-world building. A third device may be optionally included, in which it is one that may be in communication with the first device for providing relevant information about the corresponding building for its inclusion within the digital twin for supervision of the corresponding building and/or its floors via the first device.

[0034] The invention will now be described in greater detail, by way of example, with reference to the figures. For ease of reference, common reference numerals or series of numerals will be used throughout the figures when referring to the same or similar features common to the figures.

[0035] **FIG. 1** illustrates a block diagram of a system of the present application according to one example embodiment. As shown, the system may comprise a plurality of devices that include a first device **100**, a second device **220**, and a third device **230**. **FIG. 2** illustrates a simplified flow diagram that further shows the specific interactions between the aforementioned devices **100**, **220**, **230**, their modules, and their data content, for enabling generation of a digital twin of at least one physical real-world building for its supervision. It is to be noted that **FIG. 1** may be described with reference to **FIG. 2**.

[0036] With reference to **FIG. 1**, the first device **100** may be a device that is a user device, or a device that may be in the vicinity of the user for the user to interact therewith. The first device **100** may comprise one or more units including at least one processing unit **110**, at least one human-machine interface unit **120**, and at least one data storage unit **130**. Whilst not shown, the first device **100** may further include its own communication unit to be in communication with either one or both the second device **220** and the third device **230**.

[0037] With reference to **FIG. 1**, regarding the first device **100**, its processing unit **110** may be one that is configured to perform the scheduling and the execution of instructions that may relate to software modules operating thereon. In particular, the processing unit **110** may

have software modules related to a first application software **111** operating thereon. Embodiments of the processing unit **110** may be, but shall not be limited to, a conventional processor, an application-specific integrated circuit (ASIC), a field-programmable gate array (FPGA), a graphics processing unit (GPU), or a combination thereof. By way of example, the first application software **111** may be in the form of a web-browser installed on the first device **100**, a first-party or third-party application software that may be proprietary, non-proprietary, or open sourced, or the like.

[0038] With reference to **FIG. 1**, regarding the first device **100**, its human-machine interface (HMI) unit **120** may be one that is configured to enable at least one user to interact with the first device. In particular, the human-machine interface (HMI) unit **120** may be configured to either display graphical content, emit audio content, or a combination thereof. Furthermore, the human-machine interface (HMI) unit **120** may also be configured to allow the user to interact with the displayed graphical content. Embodiments of the HMI unit **120** may be, but shall not be limited to, a touchscreen display interface, a combination of peripherals that include a display monitor, a keyboard, a mouse, or the like.

[0039] With reference to **FIG. 1**, regarding the first device **100**, its data storage unit **130** may be configured to store digital content that may be related to the generation of at least one digital twin of at least one building. In particular, the data storage unit **130** may store floor plan data content **131**. Furthermore, the data storage unit **130** may store program files and/or computer-executable instructions related to the first application software **111**. The data storage unit **130** may have memory, for it to substantially act as any one or both a transient computer-readable storage medium and a non-transitory computer-readable storage medium. With that, embodiments of the data storage unit **130** may be one or a combination of digital storage mediums such as a flash memory unit, a read-only memory (ROM) unit, hard-disk drives, solid-state drives, hybrid drives, random access memory (RAM) unit, or the like.

[0040] With reference to **FIG. 1**, the second device **220** may be a device that may be located at a location that is away or remote from the first device **100**. The second device **220** may be configured to store digital content that may include an editor module **221** and its related data content, an asset mapping module **222** and its related data content, an extraction and computation module **223** and its related data content, a visualization module **224** and its

related data content, and digital twin data content **225**. Whilst not shown, the second device **220** may comprise its own processing unit, its own data storage unit for storing the aforementioned content, and its own communication unit for the second device **220** to be, or only be, in communication with the first device **100**. In certain embodiments, the second device **220** may be provided via cloud computing.

[0041] With reference to **FIG. 1**, the third device **230** may be a device that may be located at a location that is away or remote from any one or both the first device **100** and the second device **200**. The third device **230** may only be in communication with the first device **100**. Furthermore, the third device **230** may be configured to store digital content that may include any one of topological asset data content **231**, first variable asset data content **232**, and second variable asset data content **233**. Whilst not shown, the third device **230** may comprise its own processing unit, its own data storage unit for storing the aforementioned content, and its own communication unit for the second device **230** to be, or only be, in communication with the first device **100**. In certain embodiments, the third device **230** may be provided via cloud computing.

[0042] It is to be noted that the third device **230** is one that may be optionally included within the present invention. In alternative embodiments, either one or both the first device **100** and the second device **220** may be configured to perform the functions and/or operations described for the third device **230**.

[0043] The data content stored within the devices **100**, **220**, **230** shall now be described.

[0044] In particular, floor plan data content **131** stored in the data storage unit **130** of the first device **100** may relate to a plurality of floor plans that corresponds to at least one physical real-world building in which its digital twin is to be generated. The floor plan data content **131** may comprise a plurality of floor plan data files, which may each correspond to one floor of a physical real-world building to be digitized. In particular, these floor plans data files may include any one or a combination of [i] a plurality of walls that define one or more rooms or walkways within one floor of the building, [ii] a plurality of fixtures within one floor of the building such as doors, windows, staircases, or the like, [iii] a plurality furniture within one floor of the building such as tables, shelves, or the like.

[0045] Regarding the floor plan data content **131**, in certain embodiments, these floor plan data files may be raw floor plan data files that may be in the form of any known digital image formats, which may be, by way of example, Portable Network Graphics(.png) format, or the like. In alternative embodiments, the floor plan data content **131** may comprise computer-aided design (CAD) – based floor plan data files, which may be two-dimensional drawings of floor plans having digitally – configurable data, in which they may be in the form of any known digital drafting formats, which may be, by way of example, drawing interchange format (.dxf), or the like.

[0046] In particular, the digital twin data content **225** stored in the second device **220** may be one or more data files that are digital assets, which corresponds to a digitized building, i.e. a digital twin of a physical real-world building. These assets may be considered the digital assets that define an overall shape, form, and/or structure of the digitized building in a computer-readable language. In particular, the digital twin data content **225** may include information related to the physical real-world building. For defining the digital twin of the physical real-world building, the digital twin data content **225** may comprise any one or a combination of [i] one or more data files having information related to a number of floors and their layout, which correspond to the physical real-world building, [ii] one or more data files related to renderable wall models, their defined rooms, and their arrangement within one floor, which correspond to the physical real-world building, [iii] one or more data files related to renderable fixtures models and their arrangement within one floor, which correspond to the physical real-world building, and [iv] one or more data files related to renderable furniture modules and their arrangement within one floor, which correspond to the physical real-world building. It is to be noted that the models of the digital twin data content **225** may be any one or a combination of two-dimensional (2D) models or three-dimensional (3D) models.

[0047] In particular, the first variable asset data content **232** stored in the third device **230** may be one or more data files that are digital assets, which corresponds to a first type of information related to the physical real-world building, which may be sourced from the physical real-world building itself. In particular, this first type of information may be qualitative data, and may further be related to non-physical phenomena. By way of example,

the first variable asset data content **232** may include data files having information related to any one or a combination of [i] a scheduled occupancy or booking of at least one room, fixture, and/or furniture within one floor of the physical real-world building, [ii] tenancy and/or leasing information of at least one room within one floor of the physical real-world building, [iii] indication of defects of at least one room, fixture, and/or furniture within one floor of the physical real-world building, [iv] one or more coordinate locations of sensors located within one floor of the physical real-world building, or the like. It is to be noted that the third device **230** may be provided with the first variable asset data content **232** from an owner or an administrator of the physical real-world building, and the data for these assets may be modified through user-intervention. Furthermore, the first variable asset data content **232** may be stored in a manner such that its historical information is further recorded.

[0048] In particular, the second variable asset data content **233** stored in the third device **230** may be one or more data files that are digital assets, which corresponds to a second type of information related to the physical real-world building, which may be sourced from the physical real-world building itself. In particular, this second type of information may be quantitative data, and may further be related to physical phenomena. By way of example, the second variable asset data content **233** may include information related to any one or a combination of [i] a temperature of at least one room within one floor of the physical real-world building, [ii] a footfall of at least one room within one floor of the physical real-world building, [iii] a presence of at least one object at one or more furniture within one floor of the physical real-world building, or the like. It is to be noted that the third device **230** may be provided with the second variable asset data content **233** from sensing devices that may be installed within the physical real-world building, and the data for these assets may be automatically updated in real-time. Furthermore, the second variable asset data content **233** may be stored in a manner such that its historical information is further recorded.

[0049] In particular, the topological asset data content **231** stored in the third device **230** may be one or more data files that are digital assets, which are a combination of data content from the second device **220** and the third device **230**. More specifically, the topological asset data content **231** are data content resulting from the mapping of the first variable data content **232** onto the digital twin data content **225**, for the digital twin for the physical real-world building

to be further included with the first type of information related to the physical real-world building.

[0050] The modules **221 – 224** stored within the second device **220** shall now be described.

[0051] In particular, regarding the editor module **221**, the asset mapping module **222**, the extraction and computation module **223**, the visualization module **224**, and their corresponding data content, they may relate to at least one set of computer-executable instructions that may be in the form of computer-readable codes, which is to be read, executed and operated by at least one processing unit.

[0052] With reference to **FIG. 1** and **FIG. 2**, the editor module **221**, the asset mapping module **222**, the extraction and computation module **223**, the visualization module **224**, and their corresponding data content, may be provided from the second device **220** to the first device **100**, for them to be executed and operated by the processing unit **110** of the first device **100**. More specifically, the first application software **111** operated by the processing unit **110** of the first device **100** may send a request for the aforementioned modules **221 – 224** to the second device **220** by interacting with an application protocol interface (API) that may be set up on the second device **220**. With that, the aforementioned modules **221 – 224** and their related data content may be provided to the first device **100** for them to be embedded therein. More specifically, the aforementioned modules **221 – 224** may form, and/or be part of, a second application software **112** that may be embedded within the first application software **111** that is operated by the processing unit **110**. Preferably, any one or a combination of aforementioned modules **221 – 224** and/or their related data content may only be provided to the first device **100** and operate thereon only when a request is sent to the API of the second device **220**, and they may not be stored in the data storage unit **130** of the first device **100**.

[0053] With that, it is to be stated that at least one processing unit **110** of the first device **100** may be configured to operate any one or a combination of modules **221 – 224** and/or their related data content, as any one or a combination of the modules **221 – 224** and/or their related data content are being provided by the second device **220** to the first device **100**.

[0054] Alternatively, or furthermore, any one or a combination of the aforementioned modules **221 – 224** and/or their related data content may be previously provided or downloaded from the second device **220** and stored within the data storage unit **130** of the first device **100** in a permanent manner, or a semi-permanent in which they may be removed from the first device **100** after performing their designated functions.

[0055] With reference to **FIG. 1** and **FIG. 2**, regarding the editor module **221** and/or its related data content, as it is executed and operated by at least one processing unit (e.g. the processing unit **110** of the first device **100**), it is configured to facilitate digitization of at least one building based on its floor plan data content **131** for generating the digital twin data content **225** that relates to the digital twin of the physical real-world building. More specifically, the editor module **221** may be further configured to provide and present a digital interface that includes at least one virtual environment, which is user-interactable, via the HMI unit **120** for the user to interact therewith. An example of the graphical content of the digital interface displayed on the HMI unit **120**, as the editor module **221** and/or its related data content is executed and operated by the processing unit **100**, is illustrated in **FIG. 2**.

[0056] In particular, the editor module **221** and/or its related data content may be further configured to [i] retrieve or receive the floor plan data content **131** of at least one building to be digitized from the data storage unit **130**, and [ii] facilitate and/or enable manipulation of the floor plan data files of the floor plan data content **131** by performing scaling upon the floor plan data files, alignment of the floor plan data files, stacking of the floor plan data files, or the like. These may be performed upon receiving a set of interactions by the user via the HMI unit **120**.

[0057] In particular, the editor module **221** and/or its related data content may be further configured to facilitate and/or enable generation of one or more two-dimensional (2D) and/or three-dimensional (3D) models related to the building to be digitized and/or its fixtures, based on its floor plan data files within floor plan data content **131**. This may be performed upon receiving a set of interactions by the user via the HMI unit **120**. More specifically, the editor module **221** is configured to [i] enable at least one floor plan data file of the floor plan data content **131** to be displayed to the user via the HMI unit **120**, [ii] detect signals from the HMI unit **120**, which correspond to tracing and/or sketching actions performed by the user

over the displayed floor plan data file, for marking one or more points within a space of the virtual environment, and [iii] generate or provide one or more models within the virtual space based on the points that were marked in the space of the virtual environment.

[0058] In particular, the editor module **221** and/or its related data content may be further configured to provide each model with a required or specific level of detail (LOD) as they are generated or provided within the virtual environment, as the user performs their tracing and/or sketching actions. In particular, the editor module **221** may adjust the level of detail (LOD) of the models in an adaptive manner for them to become more detailed or less detailed based on needs of the user. By way of example, the level of detail (LOD) of the models may include [i] floor models having footprints, [ii] wall models without door and/or window models, [iii] door or window models only, [iv] furniture models for furnishing or partially furnishing a room or a floor, or the like.

[0059] In particular, the editor module **221** and/or its related data content may be further configured to store the generated or provided models within the virtual space in the form of at least one data file as an asset that is, or part of, the digital twin data content **225**. With that, the editor module **221** may further facilitate provision of the digital twin data content **225** to the second device **220**. Alternatively, or furthermore, the editor module **221** and/or its related data content may facilitate provision of the digital twin data content **225** to the data storage unit **130** to be stored therein.

[0060] With reference to **FIG. 1** and **FIG. 2**, regarding the asset mapping module **222** and/or its related data content, as it is executed and operated by at least one processing unit (e.g. the processing unit **110**), it is configured to perform mapping of digital assets that are stored in any one or both the second device **220** and the third device **230**. It may further perform mapping of digital assets that may be stored in the first device **100**, if configured as so.

[0061] In particular, the asset mapping module **222** and/or its related data content may be further configured to enable the first device **100** to communicate with the second device **220** and the third device **230**, so that the first device **100** may receive any one or both the digital twin data content **225** from the second device **220**, and the first variable asset data content **232** from the third device **230**, for generating the topological asset data content **231**.

[0062] In particular, the asset mapping module **222** and/or its related data content may be further configured to facilitate and/or enable mapping of assets of the first variable asset data content **232** to those of the digital twin data content **225**, and/or vice versa. Furthermore, the asset mapping module **222** may be further configured to assign unique identifiers in the form of labels and/or numbers so that there is a relationship between at least one asset of the first variable asset data content **232** and at least one asset of the digital twin data content **225**. The mapping of assets may be automatically performed by the asset mapping module **222**, performed by the user under the assistance of the asset mapping module **222** for the user to provide the unique identifiers themselves, or a combination thereof.

[0063] In particular, the asset mapping module **222** may be further configured to store the mapped assets in the form of at least one data file as the topological asset data content **231**. With that, the asset mapping module **222** may further facilitate provision of the topological asset data content **231** to the third device **230**. Alternatively, or furthermore, the asset mapping module **222** may facilitate provision of the topological asset data content **231** to the data storage unit **130** to be stored therein.

[0064] With reference to **FIG. 1** and **FIG. 2**, regarding the extraction and computation module **223** and/or its related data content, as it is executed and operated by at least one processing unit (e.g. the processing unit **110**), it is configured to retrieve assets and perform cross-analysis thereupon to determine patterns within their data content.

[0065] In particular, the extraction and computation module **223** and/or its related data content may be further configured to receive the digital twin data content **225** that may be from the second device **220**. Alternatively, or furthermore, the extraction and computation module **223** may also be configured to retrieve any one or a combination of the topological asset data content **231**, the first variable asset data content **232**, and the second variable asset data content **233** from the third device **230**.

[0066] In particular, the extraction and computation module **223** and/or its related data content may be further configured to extract and correlate information within the topological asset data content **231**, the first variable asset data content **232**, and the second variable asset

data content **233** from the third device **230**. By way of example, the extraction and computation module **223** may correlate any one or a combination of the topological asset data content **231**, the first variable asset data content **232**, and the second variable asset data content **232** by matching their related identifiers.

[0067] In particular, the extraction and computation module **223** and/or its related data content may be further configured to analyse information within the topological asset data content **231**, the first variable asset data content **232**, and the second variable asset data content **233**. More specifically, the extraction and computation module **223** is configured to perform cross-analysis upon the information to determine one or more patterns within the data of the topological asset data content **231**, the first variable asset data content **232**, and the second variable asset data content **233**, to generate analysed data content.

[0068] In particular, the extraction and computation module **223** may be further configured to provide analysed data content to the visualization module **224** that may be operating on the first device **100**. Alternatively, or furthermore, the extraction and computation module **223** may facilitate provision of the analysed data content to the data storage unit **130** to be stored therein.

[0069] With reference to **FIG. 1** and **FIG. 2**, regarding the visualization module **224** and/or its related data content, as it is executed and operated by at least one processing unit (e.g. the processing unit **110**), it is configured aggregate any one or a combination of the topological asset data content **231**, the first variable asset data content **232**, and the second variable asset data content **233**, and the analysed data content, for them to be displayed on the HMI unit **120** to enable the user to perceive the physical real-world building and its current data content through its digital twin. An example of the graphical content of the digital interface displayed on the HMI unit **120**, as the visualization module **221** and/or its related data content is executed and operated by the processing unit **100**, is illustrated in **FIG. 2**. It is to be noted that combination of 2D models and/or 3D models may be rendered at the same time for display of the digital twin.

[0070] In particular, the visualization module **224** and/or its related data content may correlate assets of any one or a combination of the topological asset data content **231**, the

first variable asset data content **232**, and the second variable asset data content **233**. By way of example, the visualization module **224** may match their related identifiers so that the assets are correctly mapped to a virtual space or location within the digital twin of the physical real-world building for it to be presented to the user through the HMI unit **120**.

[0071] With this, the user may be able to supervise the physical real-world building based on its digital twin and its related data content via the first device **100**, or more specifically, through modules **221 – 224** that are embedded within at least one application software (e.g. application software **111**) operating on the first device **100** for these modules **221 – 224** to contribute to the generation and visualization of the digital twin. It is to be stated that the digital twin may be considered as an embedded digital twin as it may be embedded and displayed within any one application software operating first device **100** (e.g. application software **111**).

[0072] It is to be noted that for the rest of the description, the described hardware and software components described for the system of the present application may or may not be directly implicated. However, it is to be understood by a skilled person that the descriptions of the hardware and software components described above provide support for the rest of the description, and may also further complement the rest of the description.

[0073] **FIG. 3** is a flowchart that illustrates that steps involved within the method of the present application, according to one example embodiment. It is noted that the steps described in the sequence diagram, the flowchart, and within this detailed description, are to be interpreted as non-limiting, and minor modifications to the steps (e.g. repetitions, additions, omissions, or swaps) are permissible by a skilled person without substantial deviation from as described.

[0074] As shown in **FIG. 3**, the steps may begin with step **301**, which involves operating an application software by at least one processing unit **110** of the first device **100**. In particular, the application software may be the first application software **111**, which may have requested any one or a combination of the editor module **221**, the asset mapping module **222**, the extraction and computation module **223**, and the visualization module **224**, and/or their related data content from the second device **220** via an API set up on the second device **220**.

The aforementioned modules **221 – 224** and/or their data content may then be part of a second application software **112** embedded within the first application software **111**. However, it is to be noted that the modules **221 – 224** and their related content may be part of any one of the application softwares **111, 112** in which the modules **221 – 224** are each executed and operated by the processing unit **110**.

[0075] Following step **301** is step **302**. Step **302** involves providing floor plan data content **131** having one or more floor plan data files, which relate to at least one corresponding physical real-world building, to the editor module **221** executed and operated by the processing unit **110**. In particular, the floor plan data files of the floor plan data content **131** are raw floor plan data files in the form of an image format. This step may be performed automatically by the application software **111, 112** or upon receiving interactions from the user through the HMI unit **120**.

[0076] Following step **302** is step **303**. Step **303** involves selecting one floor plan data file from the floor plan data content **131** through the editor module **221**. This step may be performed automatically by the application software **111, 112** or upon receiving interactions from the user through a displayed interface on the HMI unit **120**.

[0077] Following step **303** is step **304**. Step **304** involves scaling the floor plan data file based on at least one dimension, through the editor module **221**. This step may be performed automatically by the application software **111, 112** or upon receiving interactions from the user through the displayed interface on the HMI unit **120**. In particular, for the case of the raw floor plan data file in image format, its measurement information (e.g. its size and/or its number of pixels) may be manipulated to fit the screen of the HMI unit **120** for it to be displayed thereon. With that, a scaled floor plan data file may be generated.

[0078] Following step **304** is step **305**. Step **305** involves digitizing the scaled floor plan data file through the editor module **221**. This step may be performed automatically by the application software **111, 112** or upon receiving interactions from the user through the displayed interface on the HMI unit **120**. By way of example, the editor module **221** may detect signals from the HMI unit **120**, which correspond to tracing and/or sketching actions performed by the user over the displayed floor plan data file, for marking one or more points

within a space of the virtual environment, and with that, the editor module **221** may generate or provide one or more models within the virtual space based on the points that were marked in the space of the virtual environment. Through the editor module **221**, the user may generate or provide any one or a combination of wall models, fixture models, and furniture models within the space of the virtual environment to form one digitized floor of the corresponding physical real-world building based on its floor plan data file. With that, a digitized floor plan data file is generated. The models may have a required or specific level of detail (LOD) as they are generated and/or provided within the virtual environment based on tracing and/or sketching actions performed by the user.

[0079] Following step **305** is step **306**. Step **306** involves providing the digitized floor plan data file to the second device **220** for it to be store, or be part of, digital twin data content **211** of the corresponding physical real-world building. This step may be performed upon receiving interactions from the user through a displayed interface on the HMI unit **120**.

[0080] Following step **306** is step **307**, which is a decision step that involves determining whether or not all floor plan data files have been digitized. This step may be performed automatically by the application software **111**, **112** or by the user. Should this be the case, step **307** proceeds to step **309**. Else, step **307** proceeds to step **308**.

[0081] In step **308**, as it was determined that not all floor plans data files have been digitized, the step of selecting one different floor plan data file, which is yet to be selected, is performed. This step may be performed automatically by the application software **111**, **112** or upon receiving interactions from the user through a displayed interface on the HMI unit **120**. With that, step **308** may return to step **304** and continue therefrom.

[0082] In step **309**, as it was determined that all floor plan data files have been digitized, the step of aggregating any one or a combination of the digital twin data content **225** from the second device **210**, and the first variable building asset data content **232** from the third device **230**, is performed. This step may be performed automatically by the application software **111**, **112** or upon receiving interactions from the user through a displayed interface on the HMI unit **120**.

[0083] Following step 309 is step 310. Step 310 involves mapping one or more assets of the first variable asset data content 222 to any one or more assets of digital twin data content 225, by the asset mapping module 222. More specifically, within this step, unique identifiers may be assigned to each asset of the first variable asset data content 222 and the digital twin data content 225 so that they may each have a relationship with each other. This step may be performed through receiving interactions from the user through a displayed interface on the HMI unit 120.

[0084] Following step 310 is step 311. Step 311 involves generating the topological asset data content 221, by the asset mapping module 222, and providing the topological asset data content 221 to the third device 230.

[0085] Following step 311 is step 312. Step 312 involves aggregating any one or a combination of the topological asset data content 231, the first variable asset data content 232, and the second variable asset data content 233 from the third device 230. This step may be performed automatically by the application software 111, 112 or upon receiving interactions from the user through the HMI unit 120.

[0086] Following step 312 is step 313. Step 313 involves performing analysis upon the aggregated data, by the extraction and computation module 223. This step may be performed automatically by the application software 111, 112 or upon receiving interactions from the user through the HMI unit 120. With that, analysed data content may be generated.

[0087] Following step 313 is step 314. Step 314 involves compiling any one or a combination of the topological asset data content 231, the first variable asset data content 232, the second variable asset data content 233, and the analysed data content, by the visualization module 224, for the visualization module 224 to construct a virtual representation of the corresponding physical real-world building and/or its floors, i.e. its digital twin. This digital twin may be displayed on the HMI unit 120 in a manner that is user-interactable. This step may be performed automatically by the application software 111, 112 or upon receiving interactions from the user through the HMI unit 120. With that, the user may be able to supervise the physical real-world building and/or its floors through its digital twin that is presented on their first device 100.

[0088] With this, the details pertaining to a system and method for generating a digital twin of a building for its supervision have been described.

[0089] It is to be noted that the present application provides enhanced security and privacy measures due to the management of data that is exchanged between the devices. Notably, the second device **220** and the third device **230** may not exchange mapped data content, qualitative data of the physical real-world building, and quantitative data of the physical real-world building, and with that, sensitive data remains secured as it is not exchanged between second device **220** the third device **230**. Furthermore, since the modules **221 – 224** may be embedded within at least one application software (such as a third party software) of the user device (i.e. the first device **100**), and since the first device **100** and the third device **230** may be both managed by the the user, the user has full control over the dissemination and the usage of data related to the physical real-world building and its digital twin, as the aforementioned data does not leave the first device **100**.

[0090] The present disclosure includes as contained in the appended claims, as well as that of the foregoing description. Although this invention has been described in its preferred form with a degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination and arrangements of parts may be resorted to without departing from the scope of the invention.

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CLAIMS

1. A system for generating at least one digital twin of at least one building for its supervision, comprising
 - a plurality of devices that includes a first device and a second device;
 - at least one data storage unit for storing floor plan data content; and
 - at least one processing unit that is part of the first device, which is configured to operate a plurality of modules and/or their related data content, in which any one or a combination of the modules and/or their related data content are being provided, and/or previously provided, by the second device to the first device;wherein the processing unit generates digital twin data content that forms the digital twin of the building from the floor plan data files, for the digital twin to be further included with information collected from the building, for supervision of the building through its digital twin via the first device.
2. The system according to claim 1, wherein the plurality of modules and/or their related data content are embeddable within the first device or at least one application software operating on the first device, for the plurality of modules operated by the processing unit to generate the digital twin data content that forms the digital twin of the building that is embedded within the first device or the application software operating on the first device.
3. The system according to claim 1 or 2, wherein the modules include an editor module that is stored in the second device and provided to the first device, in which during operation, the editor module is configured to scale the floor plan data files based on at least one dimension.
4. The system according to claim 3, wherein the editor module is further configured to generate one or more digital models based on the floor plan data files, as the first device detects signals that correspond to tracing and/or sketching actions performed by the user upon the first device over the floor plan data file that is displayed thereon, in which one or more points are marked within a space of a virtual environment displayed on the first device for the digital models to be generated and/or provided within the virtual environment based on the marked points.

5. The system according to claim 4, wherein the editor module is further configured to enable the models to each have a required or specific level of detail (LOD) as they are generated and/or provided within the virtual environment.
6. The system according to any one of the preceding claims, wherein the devices are configured to store any one or both
 - first variable asset data content, which includes data files that correspond to a first type of information related to the building, which is in the form of be qualitative data; and
 - second variable asset data content includes data files that correspond to a second type of information related to the building, which is in the form of be quantitative data related to physical phenomena within the building.
7. The system according to claim 6, wherein the modules further include an asset mapping module that is stored in the second device and provided to the first device, in which during operation, the asset mapping module is configured to retrieve any one or a combination of the digital twin data content and the first variable asset data content to allow the user to assign one or more unique identifies so that their data files are mapped accordingly for generating topological asset data content.
8. The system according to claim 7, wherein the modules further include an extraction and computation module that is stored in the second device and provided to the first device, in which during operation, the extraction and computation module is configured to analyse information within any one or a combination of the topological asset data content, the first variable asset data content, and the second variable asset data content, to generate analysed data content therefrom.
9. The system according to claim 8, wherein the modules further include a visualization module that is stored in the second device and provided to the first device, in which during operation, the visualization module is configured to construct the digital twin together with information collected from the building, from any one or a combination of the topological asset data content, the first variable asset data content, the second variable asset data content,

and the analysed data content, in which the digital twin together with information collected from the building are displayed on the first device in a user-interactable manner.

10. The system according to any one of the preceding claims, wherein the digital twin data content includes data files that define the digital twin of the building, in which it comprises any one or a combination of

- one or more data files related to information of a number of floors and of the building and their layout;

- one or more data files related to renderable wall models, their defined rooms, and their arrangement within one floor, which correspond to the building;

- one or more data files related to renderable fixture models and their arrangement within one floor, which correspond to the building; and

- one or more data files related to renderable furniture modules and their arrangement within one floor, which correspond to the building.

11. A method for generating at least one digital twin of at least one building for its supervision, comprising the steps of

- providing a plurality of devices that includes a first device and a second device;

- storing floor plan data content, by at least one data storage unit; and

- operating a plurality of modules and/or their related data content, by at least one processing unit, in which any one or a combination of the modules and/or their related data content are being provided, and/or previously provided, by the second device to the first device;

- wherein the processing unit generates digital twin data content that forms the digital twin of the building from the floor plan data files, for the digital twin to be further included with information collected from the building, for supervision of the building through its digital twin via the first device.

12. The method according to claim 11, wherein the plurality of modules and/or their related data content are embeddable within the first device or at least one application software operating on the first device, for the plurality of modules operated by the processing unit to generate the digital twin data content that forms the digital twin of the building that is embedded within the first device or the application software operating on the first device.

13. The method according to claim 11 or 12, further comprising one or more steps that are further performed by an editor module that is stored in the second device and provided to the first device for its operation, which comprises

scaling the floor plan data files based on at least one dimension, by an editor module

14. The system according to claim 13, further comprising one or more steps that are further performed by the editor module, which comprises

detecting signals that correspond to tracing and/or sketching actions performed by the user upon the first device over the floor plan data file that is displayed thereon;

marking one or more points are marked within a space of a virtual environment displayed on the first device; and

generating and/or providing one or more digital models in the virtual environment based on the marked points.

15. The method according to claim 14, further comprising one or more steps that are further performed by the editor module, which comprises enabling the models to each have a required or specific level of detail (LOD) as they are generated and/or provided within the virtual environment.

16. The method according to any one of the claims 11 – 15, wherein the devices are configured to store any one or both

first variable asset data content, which includes data files that correspond to a first type of information related to the building, which is in the form of be qualitative data; and

second variable asset data content includes data files that correspond to a second type of information related to the building, which is in the form of be quantitative data related to physical phenomena within the building.

17. The method according to claim 16, further comprising one or more steps that are further performed by an asset mapping module that is stored in the second device and provided to the first device for its operation, which comprises

retrieving any one or a combination of the digital twin data content and the first variable asset data content;

allowing the user to assign one or more unique identifies so that their data files are mapped accordingly; and
 generating topological asset data content.

18. The method according to claim 17, further comprising one or more steps that are further performed by an extraction and computation module that is stored in the second device and provided to the first device for its operation, which comprises

analysing information within any one or a combination of the topological asset data content, the first variable asset data content, and the second variable asset data content; and
 generating analysed data content.

19. The method according to claim 18, further comprising one or more steps that are further performed by a visualization module that is stored in the second device and provided to the first device for its operation, which comprises

constructing the digital twin together with information collected from the building, from any one or a combination of the topological asset data content, the first variable asset data content, the second variable asset data content, and the analysed data content; and

displaying the digital twin together with information collected from the building on the first device in a user-interactable manner.

20. The method according to any one of claims 11 – 19, wherein the digital twin data content includes data files that define the digital twin of the building, in which it comprises any one or a combination of

one or more data files related to information of a number of floors and of the building and their layout;

one or more data files related to renderable wall models, their defined rooms, and their arrangement within one floor, which correspond to the building;

one or more data files related to renderable fixture models and their arrangement within one floor, which correspond to the building; and

one or more data files related to renderable furniture modules and their arrangement within one floor, which correspond to the building.