identifying of the at least one controller associated with the new device is based on information generated by training a machine learning algorithm on one or more previously generated graph representations of the commercial real estate building.

[006a] According to certain aspects of the present disclosure, a system for generating a contextually-aware digital twin of a commercial real estate building is provided. The system comprises one or more processors. The system comprises a memory storing computer-readable instructions that, when executed by the one or more processors, configure the one or more processors to generate information about relationships for devices based on training a machine learning algorithm, wherein the relationships are between physical entities of the commercial real estate building. The instructions configure the one or more processors to insert the information about the relationships into a device library. The instructions configure the one or more processors to receive device data about an asset comprising one or more devices residing in one or more physical spaces associated with the commercial real estate building. The instructions configure the one or more processors to store the device data about the one or more devices in the device library. The instructions configure the one or more processors to discover, based on a received identification of a discovered device connected to an associated network, whether the discovered device is stored in a graph representation of the commercial real estate building. The instructions configure the one or more processors to access the device data from the device library, wherein the device data includes the information about the relationships. When the device data from the device library is known about the discovered device, the instructions configure the one or more processors to identify device information about the discovered device from the accessed device data; predict at least one relationship associated with the discovered device; in response to the predicting, create one or more related entities and relationships associated with the discovered device; in response to the creating, automatically set up one or more nodes and relationships in the contextually-aware digital twin based on the created one or more related entities and relationships. When the discovered device is not stored in the graph representation, the instructions configure the one or more processors to modify the graph representation in a graph database to include the discovered point, the discovered controller, the discovered location, and the associated network.

[006b] According to certain aspects of the present disclosure, a non-transitory machine readable storage medium comprising machine-readable instructions for causing a processor to execute a method of generating a contextually-aware digital twin of a commercial real estate

building is provided. The method comprises generating information about relationships for devices based on training a machine learning algorithm, wherein the relationships are between physical entities of the commercial real estate building. The method comprises inserting the information about the relationships into a device library. The method comprises receiving, by a computing device, device data about an asset comprising one or more devices residing in one or more physical spaces associated with the commercial real estate building. The method comprises storing the device data about the one or more devices in the device library. The method comprises discovering, based on a received identification of a discovered device connected to an associated network, whether the discovered device is stored in a graph representation of the commercial real estate building. The method comprises accessing the device data from the device library, wherein the device data includes information about relationships. When the device data from the device library is known about the discovered device, the method comprises identifying, device information about the discovered device from the accessed device data; predicting, at least one relationship associated with the discovered device; in response to the predicting, creating one or more related entities and relationships associated with the discovered device; in response to the creating, automatically set up one or more nodes and relationships in the contextually-aware digital twin based on the created one or more related entities and relationships. When the discovered device is not stored in the graph representation, the method comprises modifying the graph representation in a graph database to include the discovered point, the discovered controller, the discovered location, and the associated network.

[006c] According to certain aspects of the present disclosure, a system for generating a contextually-aware digital twin of a commercial real estate building is provided. The system comprises one or more processors. The system comprises a memory storing computer-readable instructions that, when executed by the one or more processors, configure the one or more processors to train a machine learning algorithm on building data associated respectively with a plurality of commercial real estate buildings and on a plurality of digital twins respectively associated with the plurality of commercial real estate buildings. The instructions configure the one or more processors to generate information about relationships for devices based on the trained machine learning algorithm, wherein the relationships are between physical entities of the commercial real estate building. The instructions configure the one or more processors to insert the information about the relationships into a device library. The instructions configure the one or more processors to receive device data about an asset

[0007] comprising one or more devices residing in one or more physical spaces associated with the commercial real estate building. The instructions configure the one or more processors to store the device data about the one or more devices in the device library. The instructions configure the one or more processors to discover, based on a received identification of a discovered device connected to an associated network, whether the discovered device is stored in a graph representation of the commercial real estate building. The instructions configure the one or more processors to access the device data from the device library, wherein the device data includes the information about relationships. When the device data from the device library is known about the discovered device, the instructions configure the one or more processors to identify device information about the discovered device from the accessed device data. When the discovered device is not stored in the graph representation, the instructions cause the one or more processors to modify the graph representation to include the discovered device with the identified device information, wherein modification of the graph representation comprises: determining at least one relationship with one or more assets of the first commercial real estate building; validating, using one or more asset templates that are based on the trained machine learning algorithm, the at least one relationship with the one or more assets; and based on successfully validating the at least one relationship, modeling the at least one relationship in the graph representation of the first commercial real estate building. According to certain aspects of the present disclosure, a system for generating a contextually-aware digital twin of a commercial real estate building is provided. The system includes one or more processors. The system includes a memory storing computer-readable instructions that, when executed by the one or more processors, cause the one or more processors to receive information about an asset comprising one or more devices residing in one or more physical spaces associated with the commercial real estate building. The instructions cause the one or more processors to determine based on an identification of the one or more devices of the asset, one or more points corresponding to a sensor or an actuator of the one or more devices. The instructions cause the one or more processors to identify, based on the one or more points, at least one controller that serves the asset via the one or more points. The at least one controller is a physical or logical entity. The instructions cause the one or more processors to determine, one or more networks, and one or more locations

associated with the asset. The instructions cause the one or more processors to store each of the asset, the one or more points, the at least one controller, the one or more networks, and the one or more locations as separate nodes of a graph representation of the commercial real estate building.

[0008] In some implementations, the instructions cause the one or more processors to, determine, based on an identification of a device connected to a network, whether the device is stored in the graph representation of the commercial real estate building. In some implementations, the instructions cause the one or more processors to, based on a determination that the device is not stored in the graph database of the commercial real estate building, identify the device as a new device. In some implementations, the instructions cause the one or more processors to determine one or more points corresponding to a sensor or an actuator of the new device. In some implementations, the instructions cause the one or more processors to identify, based on the one or more points of the new device, at least one controller, at least one location, and at least one network that is associated with the new device. In some implementations, the instructions cause the one or more processors to store the one or more points, the at least one controller, the at least one location, and the at least one network associated with the new device in the graph representation of the commercial real-estate

CLAIMS

What is claimed is:

1. A system for generating a contextually-aware digital twin of a commercial real estate building comprising:

one or more processors; and

a memory storing computer-readable instructions that, when executed by the one or more processors, configure the one or more processors to:

generate information about relationships for devices based on training a machine learning algorithm, wherein the relationships are between physical entities of the commercial real estate building;

insert the information about the relationships into a device library;

receive device data about an asset comprising one or more devices residing in one or more physical spaces associated with the commercial real estate building;

store the device data about the one or more devices in the device library;

discover, based on a received identification of a discovered device connected to an associated network, whether the discovered device is stored in a graph representation of the commercial real estate building;

access the device data from the device library, wherein the device data includes the information about the relationships;

when the device data from the device library is known about the discovered device,

identify device information about the discovered device from the accessed device data;

predict at least one relationship associated with the discovered device;

in response to the predicting, create one or more related entities and relationships associated with the discovered device; and

in response to the creating, automatically set up one or more nodes and relationships in the contextually-aware digital twin based on the created one or more related entities and relationships; and

when the discovered device is not stored in the graph representation, modify the graph representation in a graph database to include the discovered point the discovered controller, the discovered location, and the associated network.

2. The system of claim 1, wherein the instructions further configure the one or more processors to:

determine, based on an identification of a device connected to a network, whether the device is stored in the graph representation of the commercial real estate building;

based on a determination that the device is not stored in a graph database of the commercial real estate building, identify the device as a new device;

determine, one or more points corresponding to a sensor or an actuator of the new device;

identify, based on the one or more points of the new device, at least one controller, at least one location, and at least one network that is associated with the new device; and

store the one or more points, the at least one controller, the at least one location, and the at least one network associated with the new device in the graph representation of the commercial real estate building.

3. The system of claim 1, wherein the identifying of the at least one controller associated with the new device is based on information generated by training a machine learning algorithm on one or more previously generated graph representations of the commercial real estate building.

4. The system of claim 1, wherein the instructions further configure the one or more processors to:

translate, from a first communication protocol to a translated communication protocol, discovered information about the discovered device;

communicate with a cloud platform via the translated communication protocol for further processing; and

determine from the translated discovered information whether the discovered device is stored in the graph representation of the commercial real estate building.

5. The system of claim 4, wherein the memory storing computer-readable instructions that, when executed by the one or more processors, configure the one or more processors to:

determine, based on an identification of a device connected to a network, whether the device is stored in the graph representation of the commercial real estate building;

based on a determination that the device is not stored in a graph database of the commercial real estate building, identify the device as a new device;

determine, one or more points corresponding to a sensor or an actuator of the new device;

identify, based on the one or more points of the new device, at least one controller, at least one location, and at least one network that is associated with the new device; and

store the one or more points, the at least one controller, the at least one location, and the at least one network associated with the new device in the graph representation of the commercial real estate building.

6. The system of claim 5, wherein the identifying of the at least one controller associated with the new device is based on information generated by training a machine learning algorithm on one or more previously generated graph representations of the commercial real estate building.

7. The system of claim 4, wherein the further processing is performed on the translated discovered data via the translated communication protocol to obtain a pattern for providing a recommendation on another building.

8. The system of claim 1, wherein the instructions, when executed by the one or more processors, further configure the one or more processors to:

determine, based on an identification of the one or more devices of the asset, one or more points corresponding to a sensor or an actuator of the one or more devices;

identify, based on the one or more points, at least one controller that serves the asset via the one or more points, wherein the at least one controller comprises a physical or logical entity;

determine one or more networks, and one or more locations associated with the asset;

store each of the asset, the one or more points, the at least one controller, the one or more networks, and the one or more locations as separate nodes of the graph representation of the commercial real estate building; and

when the discovered device is not stored in the graph representation, identify a discovered point, a discovered controller, and a discovered location associated with the discovered device.

9. A non-transitory machine readable storage medium comprising machine-readable instructions for causing a processor to execute a method of generating a contextually-aware digital twin of a commercial real estate building comprising:

generating information about relationships for devices based on training a machine learning algorithm, wherein the relationships are between physical entities of the commercial real estate building;

inserting the information about the relationships into a device library;

receiving, by a computing device, device data about an asset comprising one or more devices residing in one or more physical spaces associated with the commercial real estate building;

storing the device data about the one or more devices in the device library;

discovering, based on a received identification of a discovered device connected to an associated network, whether the discovered device is stored in a graph representation of the commercial real estate building;accessing the device data from the device library, wherein the device data includes the information about the relationships;

when the device data from the device library is known about the discovered device,

identifying, device information about the discovered device from the accessed device data;

predicting, at least one relationship associated with the discovered device;

in response to the predicting, creating one or more related entities and relationships associated with the discovered device; and

in response to the creating, automatically set up one or more nodes and relationships in the contextually-aware digital twin based on the created one or more related entities and relationships; and

when the discovered device is not stored in the graph representation, modifying the graph representation in a graph database to include the discovered point the discovered controller, the discovered location, and the associated network.

10. The non-transitory machine readable storage medium of claim 9, wherein the method executed further comprises:

determining, by the computing device, and based on an identification of the one or more devices of the asset, one or more points corresponding to a sensor or an actuator of the one or more devices;

identifying, by the computing device, and based on the one or more points, at least one controller that serves the asset via the one or more points, wherein the at least one controller comprises a physical or logical entity;

determining, by the computing device, one or more networks, and one or more locations associated with the asset;

storing, by the computing device, each of the asset, the one or more points, the at least one controller, the one or more networks, and the one or more locations as separate nodes of the graph representation of the commercial real estate building; and

when the discovered device is not stored in the graph representation, identifying a discovered point, a discovered controller, and a discovered location associated with the discovered device.

11. A system for generating a contextually-aware digital twin of a commercial real estate building comprising:

one or more processors; and

a memory storing computer-readable instructions that, when executed by the one or more processors, configure the one or more processors to:

train a machine learning algorithm on building data associated respectively with a plurality of commercial real estate buildings and on a plurality of digital twins respectively associated with the plurality of commercial real estate buildings;

generate information about relationships for devices based on the trained machine learning algorithm, wherein the relationships are between physical entities of the commercial real estate building;

insert the information about the relationships into a device library;

receive device data about an asset comprising one or more devices residing in one or more physical spaces associated with the commercial real estate building;

store the device data about the one or more devices in the device library;

discover, based on a received identification of a discovered device connected to an associated network, whether the discovered device is stored in a graph representation of the commercial real estate building;

access the device data from the device library, wherein the device data includes the information about the relationships;

when the device data from the device library is known about the discovered device, identify device information about the discovered device from the accessed device data; and

when the discovered device is not stored in the graph representation, modify the graph representation to include the discovered device with the identified device information, wherein modification of the graph representation comprises:

determining at least one relationship with one or more assets of the first commercial real estate building;

validating, using one or more asset templates that are based on the trained machine learning algorithm, the at least one relationship with the one or more assets; and

based on successfully validating the at least one relationship, modeling the at least one relationship in the graph representation of the first commercial real estate building.

12. The system of claim 11, wherein the memory storing computer-readable instructions that, when executed by the one or more processors, configure the one or more processors to:

predict a relationship between the discovered device and another entity of the graph representation of the commercial real estate building; and

determine at least one controller associated with at least one or more points of the discovered device.

13. The system of claim 11, wherein the memory storing computer-readable instructions that, when executed by the one or more processors, configure the one or more processors to:

train the machine learning algorithm with the received device data on the contextually-aware digital twin.

14. The system of claim 11, wherein the memory storing computer-readable instructions that, when executed by the one or more processors, configure the one or more processors to:

determine one or more points based on the device information.