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:

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

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 a graph representation of the commercial real estate building;

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

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; and

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. 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:

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

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 a graph representation of the commercial real estate building;

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

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; and

modifying the graph representation in a graph database to include the discovered point the discovered controller, the discovered location, and the associated network.

9. 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;

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 relationship;

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.

10. The system of claim 9, 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.

11. The system of claim 9, 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.

12. The system of claim 9, 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.

13. A method of asynchronous control of a plurality of Internet of Things (IoT) devices connected to a Building Automation Control (BAC) network of a commercial real estate building comprising:

defining at least one rule comprising a first criterion for evaluating data of a first IoT device, and a second criterion associated with a determination that the data of the first IoT device does not meet the first criterion;

receiving, by a first actor, a first real-time datum from the first IoT device, wherein the first actor corresponds to the first IoT device and mimics the first IoT device;

determining, by a computing device for the first actor, and based on an evaluation of the first real-time datum from the first IoT device with the first criterion, whether the first real-time datum from the first IoT device meets that first criterion;

identifying, by the computing device for the first actor, and based on a determination that the first real-time datum from the first IoT device does not meet the first criterion, a plurality of second IoT devices to be controlled;

requesting a plurality of other actors for information based on the second criterion wherein the plurality of other actors are associated with the plurality of second IoT devices;

receiving, by the first actor from the plurality of other actors, the requested information, wherein the requested information is indicative of a plurality of actions associated with the plurality of second IoT devices to be controlled;

selecting, by the computing device for the first actor, one of the plurality of actions associated with the one or more second IoT devices; and

instructing, by the computing device for the first actor, one of the plurality of second IoT devices to perform the selected action.

14. The method of claim 13, wherein said one action was indicated in the requested information from one of the plurality of other actors and wherein the selected action is performed via said one actor.

15. The method of claim 13, wherein the instructing of said one of the plurality of second IoT devices is based on determining whether a second plurality of data of the first IoT device meets the second criterion.

16. The method of claim 13, further comprising:

based on a determination that a second plurality of data of the first IoT device meets the second criterion, controlling said one of the plurality of second IoT devices to return to a normal operation.

17. The method of claim 13, wherein each of the plurality of IoT devices correspond to an associated actor in an actor model to mimic said each of the plurality of IoT devices, and the defining the at least one rule for evaluating the data of the first IoT device comprises defining a rule for the associated actor corresponding to the first IoT device.

18. The method of claim 13, wherein a determination that the first real-time datum from the first IoT device does not meet the first criterion comprises evaluating the first real-time datum from the first IoT device within a predetermined time window.

19. The method of claim 13, further comprising:

storing past device data collected over a predetermined time period for a third IoT device in a time series database; and

when recent device data about the third IoT device is not expected with respect to the past device data, querying cloud resources for big data related to the third IoT device.

20. A non-transitory machine readable storage medium comprising machine-readable instructions for causing a processor to execute a method of asynchronous control of a plurality of Internet of Things (IoT) devices connected to a Building Automation Control (BAC) network of a commercial real estate building comprising:

defining at least one rule comprising a first criterion for evaluating data of a first IoT device, and a second criterion associated with a determination that the data of the first IoT device does not meet the first criterion;

receiving, by a first actor, a first real-time datum from the first IoT device, wherein the first actor corresponds to the first IoT device and mimics the first IoT device;

determining, by a computing device for the first actor, and based on an evaluation of the first real-time datum from the first IoT device with the first criterion, whether the first real-time datum from the first IoT device meets the first criterion;

identifying, by the computing device for the first actor, and based on a determination that the first real-time datum from the first IoT device does not meet the first criterion, a plurality of second IoT devices to be controlled;

requesting a plurality of other actors for information based on the second criterion, wherein the plurality of other actors are associated with the plurality of second IoT devices;

receiving, by the first actor from the plurality of other actors, the requested information, wherein the requested information is indicative of a plurality of actions associated with the plurality of second IoT devices to be controlled;

selecting, by the computing device for the first actor, one of the plurality of actions associated with the plurality of second IoT devices; and

instructing, by the computing device for the first actor, one of the plurality of second IoT devices to perform the selected action.