

International Application No.: PCT/US2014/015976
Article 34 Amendment

REPLACEMENT SHEET

CLAIMS

What is claimed is:

1. A method of controlling data center operations comprising:

receiving, by a data center infrastructure control system ("DCICS"), a first expression in a non-compiled form specifying an aggregation and analysis of data center operations data associated with data center assets;

determining, by the DCICS and based upon the first expression, a first operation and data collection points associated with the data center assets;

generating, by the DCICS, machine code instructions from the non-compiled form of the first expression, wherein the machine code instructions include instructions to obtain first point data and perform the first operation based upon the first point data, wherein the first point data is obtained from the data collection points;

executing, by the DCICS, the machine code instructions to produce a first result of the first operation;

determining, by the DCICS and based upon the first result, a first control instruction, wherein executing the first control instruction causes a change in an operational state of at least one of a data center asset and a data center.

2. The method of claim 1, wherein the control operation comprises at least one of moving data from a first data storage device to a second data storage device, moving a software application from a first computing device to a second computing device, terminating a software application, initiating a software application, initiating a virus protection strategy, creating a user permission, revoking a user permission, shutting down a computing device, adjusting an operating temperature, initiating a fire suppression system, turning on an air handler, shutting down an air handler, adjusting a fan speed, adjusting a valve, locking a door, and unlocking a door, locking an access panel, and unlocking an access panel.

3. The method of claim 2, wherein at least one of a) the second computing device is in a separate physical location from the first computing device, b) at least one of the first computing

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device and the second computing device are virtual machines, c) the moving to a second computing device comprises creating a virtual computing device.

4. The method of claim 2, further comprising sending the first control instruction to a controller, wherein the controller executes the first control instruction.

5. The method of claim 4, further comprising, in response to the executing the first control instruction, verifying the change in the operational state.

6. The method of claim 5, wherein the verifying is based upon one of determining a control operation result and analyzing second point data.

7. The method of claim 6, wherein the control operation result is based upon the executing the first control instruction and wherein the second point data is obtained from the data collection points.

8. The method of claim 6, further comprising, obtaining the control operation result from at least one of the controller and a database.

9. The method of claim 6, further comprising, determining, based upon at least one of the control operation result, the second point data and the change in the operational state, a second operation.

10. The method of claim 6, further comprising, determining, based upon at least one of the control operation result, the second point data and the change in the operational state, a second expression.

11. The method of claim 1, further comprising retrieving the first point data from a database, wherein the database receives data from the data collection points.

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12. Cancelled.

13. The method of claim 1, wherein the receiving the first expression comprises at least one of retrieving the first expression from a database, receiving the first expression from an application, receiving the first expression via an application programming interface, and receiving the first expression from a controller.

14. The method of claim 1, wherein the first operation comprises at least one of sum, max, min, mean, and count.

15. The method of claim 1, wherein at least a subset of the data collection points comprises sensors.

16. The method of claim 15, wherein the sensors comprise at least one of a temperature sensor, a humidity sensor, a fire detector, a smoke detector, a high sensitivity smoke detector, a moisture detector, a spot leak detector, a pressure sensor, an intrusion detector, a valve position indicator, a power monitor, a fan speed and a fan direction.

17. The method of claim 1, wherein at least a subset of the data collection points comprises at least one of information technology (IT) equipment, an IT equipment interface, a virtualization system, and external system data.

18. The method of claim 1, further comprising:
determining that point data from at least one of the data collection points has changed; and
executing, based upon the point data, the machine code instructions to produce a second result of the first operation.

19. The method of claim 18, further comprising determining, by the DCICS and based upon the second result, a second control instruction, wherein executing the second control

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instruction causes a change in the operational state of one of the data center asset or the data center.

20. A data center infrastructure control system, comprising:
a memory in communication with a processor;
the processor when executing a computer program for data center control performs operations comprising:
receiving, by the processor, a first expression in a non-compiled form specifying an aggregation and analysis of data center operations data associated with data center assets;
determining, by the processor and based upon the first expression, a first operation and data collection points associated with the data center assets;
generating, by the processor, machine code instructions from the non-compiled form of the first expression, wherein the machine code instructions include instructions to obtain first point data and perform the first operation based upon the first point data, wherein the first point data is obtained from the data collection points;
executing, by the processor, the machine code instructions to produce a first result of the first operation;
determining, by the processor and based upon the first result, a first control instruction, wherein executing the first control instruction causes a change in an operational state of at least one of a data center asset or a data center.

CLAIMS

1. A method of controlling data center operations comprising:

receiving, by a data center infrastructure control system (“DCICS”), a first expression in a non-compiled form specifying an aggregation and analysis of data center operations data associated with data center assets;

determining, by the DCICS and based upon the first expression, a first operation and data collection points associated with the data center assets;

generating, by the DCICS, machine code instructions from the non-compiled form of the first expression, wherein the machine code instructions include instructions to obtain first point data and perform the first operation based upon the first point data, wherein the first point data is obtained from the data collection points;

executing, by the DCICS, the machine code instructions to produce a first result of the first operation, wherein the executing includes

determining at least one data center optimization dimension, wherein the determining includes selecting the at least one data center optimization dimension from at least a redundancy optimization dimension or a latency optimization dimension;

forecasting predictive data based on at least the first data point;

identifying a plurality of optimization actions based on at least the first data point and the predictive data;

determining, for each optimization action, a respective optimization score based upon the selected optimization dimension;

selecting, without operator interaction and based upon the selected optimization dimension, the predictive data, the input data, and the optimization scores, an optimization action as the first result;

determining, by the DCICS and based upon the first result, a first control instruction, wherein executing the first control instruction causes a change in an operational state of at least one of a data center asset and a data center.

2. The method of claim 1, wherein the control instruction comprises at least one of moving data from a first data storage device to a second data storage device, moving a software

application from a first computing device to a second computing device, terminating a software application, initiating a software application, initiating a virus protection strategy, creating a user permission, revoking a user permission, shutting down a computing device, adjusting an operating temperature, initiating a fire suppression system, turning on an air handler, shutting down an air handler, adjusting a fan speed, adjusting a valve, locking a door, unlocking a door, locking an access panel, and unlocking an access panel.

3. The method of claim 2, wherein at least one of a) the second computing device is in a separate physical location from the first computing device, b) at least one of the first computing device and the second computing device are virtual machines, c) the moving to a second computing device comprises creating a virtual computing device.

4. The method of claim 2, further comprising sending the first control instruction to a controller, wherein the controller executes the first control instruction.

5. The method of claim 4, further comprising, in response to the executing the first control instruction, verifying the change in the operational state.

6. The method of claim 5, wherein the verifying is based upon one of determining a control operation result and analyzing second point data.

7. The method of claim 6, wherein the control operation result is based upon the executing the first control instruction and wherein the second point data is obtained from the data collection points.

8. The method of claim 6, further comprising, obtaining the control operation result from at least one of the controller and a database.

9. The method of claim 6, further comprising, determining, based upon at least one of the control operation result, the second point data and the change in the operational state, a second operation.

10. The method of claim 6, further comprising, determining, based upon at least one of the control operation result, the second point data and the change in the operational state, a second expression.

11. The method of claim 1, further comprising retrieving the first point data from a database, wherein the database receives data from the data collection points.

12. The method of claim 1, wherein the receiving the first expression comprises at least one of retrieving the first expression from a database, receiving the first expression from an application, receiving the first expression via an application programming interface, and receiving the first expression from a controller.

13. The method of claim 1, wherein the first operation comprises at least one of sum, max, min, mean, and count.

14. The method of claim 1, wherein at least a subset of the data collection points comprises sensors.

15. The method of claim 14, wherein the sensors comprise at least one of a temperature sensor, a humidity sensor, a fire detector, a smoke detector, a moisture detector, a spot leak detector, a pressure sensor, an intrusion detector, a valve position indicator, a power monitor, a fan speed and a fan direction.

16. The method of claim 1, wherein at least a subset of the data collection points comprises at least one of information technology (IT) equipment, an IT equipment interface, a virtualization system, and external system data.

17. The method of claim 1, further comprising:
determining that point data from at least one of the data collection points has changed;
and

executing, based upon the point data, the machine code instructions to produce a second result of the first operation.

18. The method of claim 17, further comprising determining, by the DCICS and based upon the second result, a second control instruction, wherein executing the second control instruction causes a change in the operational state of one of the data center asset or the data center.

19. A data center infrastructure control system, comprising:
a memory in communication with a processor;
the processor when executing a computer program for data center control performs operations comprising:
receiving, by the processor, a first expression in a non-compiled form specifying an aggregation and analysis of data center operations data associated with data center assets;
determining, by the processor and based upon the first expression, a first operation and data collection points associated with the data center assets;
generating, by the processor, machine code instructions from the non-compiled form of the first expression, wherein the machine code instructions include instructions to obtain first point data and perform the first operation based upon the first point data, wherein the first point data is obtained from the data collection points;
executing, by the processor, the machine code instructions to produce a first result of the first operation, wherein the executing includes
determining at least one data center optimization dimension, wherein the determining includes selecting the at least one data center optimization dimension from at least a redundancy optimization dimension or a latency optimization dimension;
forecasting predictive data based on at least the first data point;
identifying a plurality of optimization actions based on at least the first data point and the predictive data;
determining, for each optimization action, a respective optimization score based upon the selected optimization dimension;

selecting, without operator interaction and based upon the selected optimization dimension, the predictive data, the input data, and the optimization scores, an optimization action as the first result;

determining, by the processor and based upon the first result, a first control instruction, wherein executing the first control instruction causes a change in an operational state of at least one of a data center asset or a data center.