CLAIMS

What is claimed is:

1. A method of fault detection and diagnostic for a building management system, using at least one processor, the method comprising:

obtaining operational data in relation to a plurality of system parameters associated to a plurality of operational components of the building management system;

determining an operation status among a plurality of types of operation statuses, including a normal operation status and a plurality of types of fault operation statuses with respect to the operational data based on a fault condition repository configured based on expert knowledge information, the fault condition repository comprising a plurality of fault conditions in relation to the plurality of system parameters, wherein each fault condition corresponds to a type of fault operation status; and

labelling the operational data based on the operation status determined to produce labelled data in relation to the operation status determined,

wherein said determining an operation status with respect to the operational data based on the fault condition repository comprises determining a type of fault operation status, to produce a first detection result, and

the method further comprises:

invoking, for the type of fault operation status determined, a fault model associated to the type of fault operation status determined for detecting a fault corresponding to the type of fault operation status, to produce a second detection result;

matching the first detection result and the second detection result to obtain a match result;

determining whether the match result satisfies a predetermined fault condition repository update condition; and

updating the fault condition repository if the match result does not satisfy the predetermined fault condition repository update condition.

2. The method according to claim 1, wherein each system parameter of the plurality of system parameters comprises a threshold parameter associated to the system parameter defined in the fault condition repository, and each fault condition of the

plurality of fault conditions is configured based on one or more of the threshold parameters.

3. The method according to claim 2, wherein said determining a type of fault operation status comprises:

determining at least one violated system parameter of the plurality of system parameters corresponding to at least one threshold parameter respectively of the threshold parameters being violated based on the operational data;

in response to the at least one violated system parameter determined, determining whether there is an existing type of fault operation status corresponding to the at least one violated system parameter based on the plurality of fault conditions; and

in response to determining that there is an existing type of fault operation status corresponding to the at least one violated threshold parameter, determining the existing type of fault operation status as the operation status.

4. The method according to claim 3, wherein when there is no existing type of fault operation status corresponding to the at least one violated system parameter, further comprising creating a new fault condition in relation to an unknown type of fault operation status, wherein the new fault condition is created based on the at least one violated system parameter and one or more correlated system parameters correlating with the at least one violated system parameter.

5. The method according to claim 3, wherein the fault condition repository comprises correlation information of the plurality of system parameters, and fault type parameter association information of the plurality of types of fault operation statuses, wherein for each type of fault operation status, the fault type parameter association information indicates one or more system parameters of the plurality of system parameters being associated to the type of fault operation status, and the method further comprises:

determining, for each violated system parameter of the at least one violated system parameter, one or more correlated system parameters with which the at least one violated threshold parameter is correlated based on the correlation information;

determining, for each violated system parameter of the at least one violated system parameter, an existing type of fault operation status to which the one or more

correlated system parameters are associated based on the fault type parameter association information; and

associating, for each violated system parameter of the at least one violated system parameter, the violated system parameter to said existing type of fault operation status to produce an updated set of system parameters associated to said existing type of fault operation status in the fault condition repository.

6. The method according to claim 2, wherein said updating the fault condition repository if the match result does not satisfy the predetermined fault condition repository update condition comprises:

updating a fault condition associated to the type of fault operation status determined based on an objective function to obtain a maximum match result between the first detection result and the second detection result, wherein said updating the fault condition comprises adjusting one or more threshold parameters associated to one or more system parameters, respectively, corresponding to the fault condition.

7. The method according to claim 1, further comprising performing validation of the labelled data in relation to the operation status determined to produce validated labelled data for training a fault model.

8. The method according to claim 7, further comprising training the fault model based on the validated labelled data.

9. The method according to any one of claims 1 to 8, wherein the operational data comprises measured data in relation to the plurality of systems parameters of the plurality of operational components obtained from one or more sensors associated to the operational components.

10. A system for fault detection and diagnostic for a building management system, the system comprising:

a memory; and

at least one processor communicatively coupled to the memory and configured to:

obtain operational data in relation to a plurality of system parameters associated to a plurality of operational components of the building management system;

determine an operation status among a plurality of types of operation statuses, including a normal operation status and a plurality of types of fault operation statuses with respect to the operational data based on a fault condition repository configured based on expert knowledge information, the fault condition repository comprising a plurality of fault conditions in relation to the plurality of system parameters, wherein each fault condition corresponds to a type of fault operation status; and

label the operational data based on the operation status determined to produce labelled data in relation to the operation status determined,

wherein said determine an operation status with respect to the operational data based on the fault condition repository comprises determining a type of fault operation status, to produce a first detection result, and

the at least one processor is further configured to:

invoke, for the type of fault operation status determined, a fault model associated to the type of fault operation status determined for detecting a fault corresponding to the type of fault operation status, to produce a second detection result;

match the first detection result and the second detection result to obtain a match result;

determine whether the match result satisfies a predetermined fault condition repository update condition; and

update the fault condition repository if the match result does not satisfy the predetermined fault condition repository update condition.

11. The system according to claim 10, wherein each system parameter of the plurality of system parameters comprises a threshold parameter associated to the system parameter defined in the fault condition repository, and each fault condition of the plurality of fault conditions is configured based on one or more of the threshold parameters.

12. The system according to claim 11, wherein said determine a type of fault operation status comprises:

determine at least one violated system parameter of the plurality of system parameters corresponding to at least one threshold parameter respectively of the threshold parameters being violated based on the operational data;

in response to the at least one violated system parameter determined, determine whether there is an existing type of fault operation status corresponding to the at least one violated system parameter based on the plurality of fault conditions; and

in response to determining that there is an existing type of fault operation status corresponding to the at least one violated threshold parameter, determining the existing type of fault operation status as the operation status.

13. The system according to claim 12, wherein when there is no existing type of fault operation status corresponding to the at least one violated system parameter, the at least one processor is further configured to create a new fault condition in relation to an unknown type of fault operation status, wherein the new fault condition is created based on the at least one violated system parameter and one or more correlated system parameters correlating with the at least one violated system parameter.

14. The system according to claim 12, wherein the fault condition repository comprises correlation information of the plurality of system parameters, and fault type parameter association information of the plurality of types of fault operation statuses, wherein for each type of fault operation status, the fault type parameter association information indicates one or more system parameters of the plurality of system parameters being associated to the type of fault operation status, and the at least one processor is further configured to:

determine, for each violated system parameter of the at least one violated system parameter, one or more correlated system parameters with which the at least one violated threshold parameter is correlated based on the correlation information;

determine, for each violated system parameter of the at least one violated system parameter, an existing type of fault operation status to which the one or more correlated system parameters are associated based on the fault type parameter association information; and

associate, for each violated system parameter of the at least one violated system parameter, the violated system parameter to said existing type of fault operation status

to produce an updated set of system parameters associated to said existing type of fault operation status in the fault condition repository.

15. The system according to claim 11, wherein said updating the fault condition repository if the match result does not satisfy the predetermined fault condition repository update condition comprises:

updating a fault condition associated to the type of fault operation status determined based on an objective function to obtain a maximum match result between the first detection result and the second detection result, wherein said updating the fault condition comprises adjusting one or more threshold parameters associated to one or more system parameters, respectively, corresponding to the fault condition.

16. The system according to claim 10, wherein the at least one processor is further configured to perform validation of the labelled data in relation to the operation status determined to produce validated labelled data for training a fault model.

17. The system according to claim 16, wherein the at least one processor is further configured to train the fault model based on the validated labelled data.

18. The system according to any one of claims 10 to 17, wherein the operational data comprises measured data in relation to the plurality of systems parameters of the plurality of operational components obtained from one or more sensors associated to the operational components.

19. A computer program product, embodied in one or more non-transitory computer-readable storage mediums, comprising instructions executable by at least one processor to perform a method of fault detection and diagnostic for a building management system according to any one of claims 1 to 9.