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### ENERGY STORAGE STATION OPERATION MONITORING MANAGEMENT SYSTEM AND METHOD.

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The present invention discloses an energy storage station operation monitoring management system and method, comprising a data processing module, a data acquisition module, a data storage module, a human-machine interaction module, an online learning algorithm module, and an execution module. The data processing module is respectively connected to the data acquisition module, data storage module, human-machine interaction module, online learning algorithm module, and execution module; the method includes: Step 1, system initialization; Step 2, data acquisition; Step 3, data processing; Step 4, intelligent decision-making. The invention predicts the battery cell temperature using the battery surface temperature data and basic battery data, thus reflecting internal battery changes and avoiding delayed monitoring results. The invention scores the battery's safety status by integrating various environmental factors and battery data, improving the accuracy and reliability of the evaluation results. The invention can automatically adjust battery management strategies based on the battery safety status score to prevent potential safety accidents promptly.

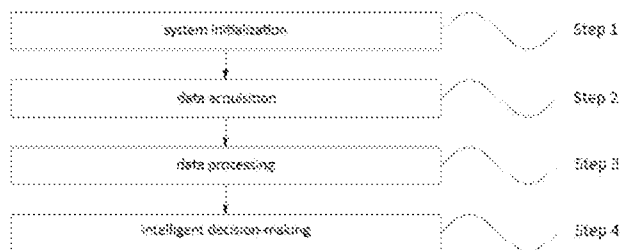


FIG.6

# ENERGY STORAGE STATION OPERATION MONITORING MANAGEMENT SYSTEM AND METHOD

## Technical Field

5           The present invention relates to the technical field of energy storage stations, specifically to an energy storage station operation monitoring management system and method.

## Background Technology

10           Energy storage stations are equipment systems that store, convert, and release recyclable electric energy through electrochemical batteries or electromagnetic energy storage media. In the existing technology, to ensure the operational safety of energy storage stations, monitoring management systems are employed to monitor the battery temperature to prevent safety accidents caused by thermal runaway.

15           However, existing monitoring management systems and methods have the following shortcomings: First, existing systems lack real-time response and intervention mechanisms and can only provide data monitoring and recording, making it impossible to promptly prevent potential safety accidents when abnormal battery temperatures occur; second, the operational environment of energy storage stations is very complex,

20           and environmental factors can interfere with the monitoring management system. Existing systems cannot provide accurate and reliable monitoring results under these complex environments; third, thermal runaway of the battery is generally caused by internal reactions within the battery cells. Existing systems only monitor the overall external parameters of the battery pack and cannot directly and accurately analyze the

25           internal changes of the battery pack, resulting in delayed monitoring results.

## Summary of the Invention

          The purpose of the present invention is to provide an energy storage station operation monitoring management system and method to solve the problems raised

in the background technology.

To achieve the above purpose, the present invention provides the following technical solution: An energy storage station operation monitoring management system, comprising a data processing module, a data acquisition module, a data storage module, a human-machine interaction module, an online learning algorithm module, and an execution module. The data processing module is respectively connected to the data acquisition module, data storage module, human-machine interaction module, online learning algorithm module, and execution module.

Preferably, the data processing module includes a battery cell temperature prediction submodule, a battery safety evaluation submodule, and an intelligent decision submodule, and the battery safety evaluation submodule is respectively connected to the battery cell temperature prediction submodule and the intelligent decision submodule.

Preferably, the intelligent decision submodule includes an evaluation result analysis unit and an adjustment command generation unit.

Preferably, the data acquisition module includes an environmental data acquisition submodule and a battery data acquisition submodule.

Preferably, the environmental data acquisition submodule includes a gas component data acquisition unit, an environmental temperature data acquisition unit, and an environmental humidity data acquisition unit. The battery data acquisition submodule includes a battery volume data acquisition unit, a battery surface temperature data acquisition unit, a voltage data acquisition unit, and a current data acquisition unit.

Preferably, the data storage module includes an algorithm library, a system database, a scheme library, and a battery database.

Preferably, the human-machine interaction module includes a display submodule and a command input submodule.

Preferably, the execution module includes an alarm reminder submodule, a battery charge and discharge strategy adjustment submodule, a battery cooling strategy adjustment submodule, and a faulty battery isolation submodule.

An energy storage station operation monitoring management method, comprising Step 1, system initialization; Step 2, data acquisition; Step 3, data processing; Step 4, intelligent decision-making;

5 In the above Step 1, train the battery cell temperature prediction algorithm model and deploy it to the battery cell temperature prediction submodule, train the battery safety evaluation algorithm model and deploy it to the battery safety evaluation submodule, preset the battery charge and discharge strategy and battery cooling strategy based on the battery safety status score, and store them in the scheme library;

10 In the above Step 2, use the data acquisition module to collect environmental data and battery data, and send them to the data processing module;

In the above Step 3, the battery cell temperature prediction submodule predicts the battery cell temperature based on the battery surface temperature data and the basic battery data stored in the battery database, and sends the result to the battery safety evaluation submodule. The battery safety evaluation submodule evaluates the  
15 battery safety status based on the battery cell temperature, environmental data, and battery data;

In the above Step 4, the intelligent decision submodule analyzes the battery safety status evaluation results obtained in Step 3, generates adjustment commands accordingly, and sends them to the execution module for execution.

20 Preferably, in the above Step 1, the battery cell temperature prediction algorithm model uses a neural network algorithm, utilizing the battery surface temperature data, basic battery data, and battery cell temperature data for model training. The battery safety evaluation algorithm model scores the battery safety status by integrating gas components, environmental humidity, battery volume changes, battery cell  
25 temperature, voltage, and current characteristics.

The beneficial effects of the present invention compared to the existing technology are: The present invention predicts the battery cell temperature using the battery surface temperature data and basic battery data, thus reflecting internal battery changes and avoiding delayed monitoring results. The invention scores the  
30 battery's safety status by integrating various environmental factors and battery data,

improving the accuracy and reliability of the evaluation results. The invention can automatically adjust battery management strategies based on the battery safety status score to prevent potential safety accidents promptly.

## 5 Description of the Drawings

FIG.1 is a system structure block diagram of the present invention;

FIG.2 is a data acquisition module structure block diagram of the present invention;

FIG.3 is a data storage module structure block diagram of the present invention;

10 FIG.4 is an execution module structure block diagram of the present invention;

FIG.5 is a system flowchart of the present invention;

FIG.6 is a method flowchart of the present invention.

In the figures: 1, data processing module; 11, battery cell temperature prediction submodule; 12, battery safety evaluation submodule; 13, intelligent decision  
15 submodule; 131, evaluation result analysis unit; 132, adjustment command generation unit; 2, data acquisition module; 21, environmental data acquisition submodule; 211, gas component data acquisition unit; 212, environmental temperature data acquisition unit; 213, environmental humidity data acquisition unit; 22, battery data acquisition submodule; 221, battery volume data acquisition unit; 222, battery surface  
20 temperature data acquisition unit; 223, voltage data acquisition unit; 224, current data acquisition unit; 3, data storage module; 31, algorithm library; 32, system database; 33, scheme library; 34, battery database; 4, human-machine interaction module; 41, display submodule; 42, command input submodule; 5, online learning algorithm module; 6, execution module; 61, alarm reminder submodule; 62, battery charge and  
25 discharge strategy adjustment submodule; 63, battery cooling strategy adjustment submodule; 64, faulty battery isolation submodule.

## Specific Embodiments

The technical solutions in the embodiments of the present invention will be  
30 clearly and completely described in conjunction with the accompanying drawings in

the embodiments of the present invention. Obviously, the described embodiments are only a part of the embodiments of the present invention, not all of them. Based on the embodiments of the present invention, all other embodiments obtained by those of ordinary skill in the art without making creative efforts fall within the scope of protection of the present invention.

Please refer to FIGs. 1-5. An embodiment provided by the present invention is an energy storage station operation monitoring management system, including a data processing module 1, a data acquisition module 2, a data storage module 3, a human-machine interaction module 4, an online learning algorithm module 5, and an execution module 6. The data processing module 1 is respectively connected to the data acquisition module 2, the data storage module 3, the human-machine interaction module 4, the online learning algorithm module 5, and the execution module 6. The data processing module 1 is used for analyzing and processing data, the data acquisition module 2 is used for collecting environmental data and battery data, the data storage module 3 is used for storing data, the human-machine interaction module 4 is used for data visualization and manual input of instructions, the online learning algorithm module 5 is used for online updating of algorithms, and the execution module 6 is used for executing adjustment instructions generated by the data processing module 1. The data processing module 1 includes a battery cell temperature prediction submodule 11, a battery safety evaluation submodule 12, and an intelligent decision submodule 13. The battery safety evaluation submodule 12 is respectively connected to the battery cell temperature prediction submodule 11 and the intelligent decision submodule 13. The battery cell temperature prediction submodule 11 is used for predicting the battery cell temperature. The battery safety evaluation submodule 12 is used for scoring the battery safety status. The intelligent decision submodule 13 is used for generating battery management strategy adjustment instructions based on the scores. The intelligent decision submodule 13 includes an evaluation result analysis unit 131 and an adjustment command generation unit 132. The evaluation result analysis unit 131 is used for analyzing the battery safety status scores. The adjustment command generation unit 132 is used for

generating battery management strategy adjustment instructions based on the scoring results. The data acquisition module 2 includes an environmental data acquisition submodule 21 and a battery data acquisition submodule 22. The environmental data acquisition submodule 21 is used for collecting environmental data of the battery, and the battery data acquisition submodule 22 is used for collecting battery data. The environmental data acquisition submodule 21 includes a gas component data acquisition unit 211, an environmental temperature data acquisition unit 212, and an environmental humidity data acquisition unit 213. The battery data acquisition submodule 22 includes a battery volume data acquisition unit 221, a battery surface temperature data acquisition unit 222, a voltage data acquisition unit 223, and a current data acquisition unit 224. The gas component data acquisition unit 211 is used for collecting environmental gas component and content data. The environmental temperature data acquisition unit 212 is used for collecting environmental temperature data. The environmental humidity data acquisition unit 213 is used for collecting environmental humidity data. The battery volume data acquisition unit 221 is used for collecting the actual volume data of the battery. The battery surface temperature data acquisition unit 222 is used for collecting the battery surface temperature data. The voltage data acquisition unit 223 is used for collecting the actual charge and discharge voltage data of the battery. The current data acquisition unit 224 is used for collecting the actual charge and discharge current data of the battery. The data storage module 3 includes an algorithm library 31, a system database 32, a scheme library 33, and a battery database 34. The algorithm library 31 is used for storing algorithms required for data processing and analysis. The system database 32 is used for storing data generated during system operation. The scheme library 33 is used for storing preset battery management scheme data. The battery database 34 is used for storing basic data of the battery. The human-machine interaction module 4 includes a display submodule 41 and a command input submodule 42. The display submodule 41 is used for data visualization, and the command input submodule 42 is used for manual data input. The execution module 6 includes an alarm reminder submodule 61, a battery charge and discharge strategy adjustment submodule 62, a

battery cooling strategy adjustment submodule 63, and a faulty battery isolation submodule 64. The alarm reminder submodule 61 is used for battery abnormality alarms. The battery charge and discharge strategy adjustment submodule 62 is used for adjusting the battery charge and discharge strategy. The battery cooling strategy adjustment submodule 63 is used for adjusting the battery cooling strategy. The faulty battery isolation submodule 64 is used for isolating faulty batteries.

Please refer to FIG.6. An embodiment provided by the present invention is an energy storage station operation monitoring management method, including Step 1, system initialization; Step 2, data acquisition; Step 3, data processing; Step 4, intelligent decision-making;

In the above Step 1, train the battery cell temperature prediction algorithm model and deploy it to the battery cell temperature prediction submodule 11, train the battery safety evaluation algorithm model and deploy it to the battery safety evaluation submodule 12, preset the battery charge and discharge strategy and battery cooling strategy based on the battery safety status score, and store them in the scheme library 33. The battery cell temperature prediction algorithm model uses a neural network algorithm, utilizing the battery surface temperature data, basic battery data, and battery cell temperature data for model training. The battery safety evaluation algorithm model scores the battery safety status by integrating gas components, environmental humidity, battery volume changes, battery cell temperature, voltage, and current characteristics.

In the above Step 2, use the data acquisition module 2 to collect environmental data and battery data, and send them to the data processing module 1.

In the above Step 3, the battery cell temperature prediction submodule 11 predicts the battery cell temperature based on the battery surface temperature data and the basic battery data stored in the battery database 34, and sends the result to the battery safety evaluation submodule 12. The battery safety evaluation submodule 12 evaluates the battery safety status based on the battery cell temperature, environmental data, and battery data.

In the above Step 4, the intelligent decision submodule 13 analyzes the battery



safety status evaluation results obtained in Step 3, generates adjustment commands accordingly, and sends them to the execution module 6 for execution.

Based on the above, the advantages of the present invention are that, when in use, the environmental data acquisition submodule 21 of the data acquisition module 2 first collects environmental data, and the battery volume data acquisition unit 221 collects battery data, specifically: using the gas component data acquisition unit 211 to collect environmental gas component and content data, using the environmental temperature data acquisition unit 212 to collect environmental temperature data, using the environmental humidity data acquisition unit 213 to collect environmental humidity data, using the battery volume data acquisition unit 221 to collect the actual volume data of the battery, using the battery surface temperature data acquisition unit 222 to collect the battery surface temperature data, using the voltage data acquisition unit 223 to collect the actual charge and discharge voltage data of the battery, and using the current data acquisition unit 224 to collect the actual charge and discharge current data of the battery. Then, the collected data is sent to the data processing module 1. The battery cell temperature prediction submodule 11 in the data processing module 1 predicts the battery cell temperature based on the battery surface temperature data and the basic battery data stored in the battery database 34, and sends the result to the battery safety evaluation submodule 12. The battery safety evaluation submodule 12 evaluates the battery safety status based on the battery cell temperature, environmental data, and battery data. The intelligent decision submodule 13 uses the evaluation result analysis unit 131 to analyze the battery safety status scores, and the adjustment command generation unit 132 generates adjustment commands based on the analysis results and sends them to the execution module 6. The execution module 6 executes the adjustment commands, specifically: using the alarm reminder submodule 61 for battery abnormality alarms, using the battery charge and discharge strategy adjustment submodule 62 to adjust the battery charge and discharge strategy, using the battery cooling strategy adjustment submodule 63 to adjust the battery cooling strategy, and using the faulty battery isolation submodule 64 to isolate faulty batteries. The algorithm library 31 in the data

storage module 3 is used for storing algorithms required for data processing and analysis. The system database 32 is used for storing data generated during system operation. The scheme library 33 is used for storing preset battery management scheme data. The battery database 34 is used for storing basic data of the battery. The  
5 display submodule 41 in the human-machine interaction module 4 is used for data visualization, and the command input submodule 42 is used for manual data input. The online learning algorithm module 5 is used for online updating of algorithms.

For those skilled in the art, it is obvious that the present invention is not limited to the details of the above exemplary embodiments and can be implemented in other  
10 specific forms without departing from the spirit or basic features of the invention. Therefore, from any perspective, the embodiments should be considered exemplary rather than restrictive. The scope of the invention is defined by the appended claims rather than the above description, and it is intended to include within the scope of the invention all equivalents to the claims' meanings and scope. No reference numerals in  
15 the claims should be considered as limiting the claims involved.

## CLAIMS

1. An energy storage station operation monitoring management system, comprising a data processing module (1), a data acquisition module (2), a data storage module (3), a human-machine interaction module (4), an online learning algorithm module (5), and an execution module (6), characterized in that: the data processing module (1) is respectively connected to the data acquisition module (2), data storage module (3), human-machine interaction module (4), online learning algorithm module (5), and execution module (6).

2. The energy storage station operation monitoring management system according to claim 1, characterized in that: the data processing module (1) includes a battery cell temperature prediction submodule (11), a battery safety evaluation submodule (12), and an intelligent decision submodule (13), and the battery safety evaluation submodule (12) is respectively connected to the battery cell temperature prediction submodule (11) and the intelligent decision submodule (13).

3. The energy storage station operation monitoring management system according to claim 2, characterized in that: the intelligent decision submodule (13) includes an evaluation result analysis unit (131) and an adjustment command generation unit (132).

4. The energy storage station operation monitoring management system according to claim 1, characterized in that: the data acquisition module (2) includes an environmental data acquisition submodule (21) and a battery data acquisition submodule (22).

5. The energy storage station operation monitoring management system according to claim 4, characterized in that: the environmental data acquisition submodule (21) includes a gas component data acquisition unit (211), an

environmental temperature data acquisition unit (212), and an environmental humidity data acquisition unit (213). The battery data acquisition submodule (22) includes a battery volume data acquisition unit (221), a battery surface temperature data acquisition unit (222), a voltage data acquisition unit (223), and a current data acquisition unit (224).

6. The energy storage station operation monitoring management system according to claim 1, characterized in that: the data storage module (3) includes an algorithm library (31), a system database (32), a scheme library (33), and a battery database (34).

7. The energy storage station operation monitoring management system according to claim 1, characterized in that: the human-machine interaction module (4) includes a display submodule (41) and a command input submodule (42).

8. The energy storage station operation monitoring management system according to claim 1, characterized in that: the execution module (6) includes an alarm reminder submodule (61), a battery charge and discharge strategy adjustment submodule (62), a battery cooling strategy adjustment submodule (63), and a faulty battery isolation submodule (64).

9. An energy storage station operation monitoring management method, comprising Step 1, system initialization; Step 2, data acquisition; Step 3, data processing; Step 4, intelligent decision-making; characterized in that:

In the above Step 1, train the battery cell temperature prediction algorithm model and deploy it to the battery cell temperature prediction submodule (11), train the battery safety evaluation algorithm model and deploy it to the battery safety evaluation submodule (12), preset the battery charge and discharge strategy and battery cooling strategy based on the battery safety status score, and store them in the scheme library (33);

In the above Step 2, use the data acquisition module (2) to collect environmental data and battery data, and send them to the data processing module (1);

In the above Step 3, the battery cell temperature prediction submodule (11) predicts the battery cell temperature based on the battery surface temperature data and the basic battery data stored in the battery database (34), and sends the result to the battery safety evaluation submodule (12). The battery safety evaluation submodule (12) evaluates the battery safety status based on the battery cell temperature, environmental data, and battery data;

In the above Step 4, the intelligent decision submodule (13) analyzes the battery safety status evaluation results obtained in Step 3, generates adjustment commands accordingly, and sends them to the execution module (6) for execution.

10. The energy storage station operation monitoring management method according to claim 9, characterized in that: in the above Step 1, the battery cell temperature prediction algorithm model uses a neural network algorithm, utilizing the battery surface temperature data, basic battery data, and battery cell temperature data for model training. The battery safety evaluation algorithm model scores the battery safety status by integrating gas components, environmental humidity, battery volume changes, battery cell temperature, voltage, and current characteristics.

## REVENDEICATIONS

1. Un système de gestion de la surveillance de l'exploitation d'une station de stockage d'énergie, comprenant un module de traitement des données (1), un module  
5 de collecte des données (2), un module de stockage des données (3), un module d'interaction homme-machine (4), un module d'algorithme d'apprentissage en ligne (5), et un module d'exécution (6), caractérisé en ce que : le module de traitement des données (1) est respectivement connecté au module de collecte des données (2), au module de stockage des données (3), au module d'interaction homme-machine (4), au  
10 module d'algorithme d'apprentissage en ligne (5), et au module d'exécution (6).

2. Le système de gestion de la surveillance de l'exploitation d'une station de stockage d'énergie selon la revendication 1, caractérisé en ce que : le module de traitement des données (1) comprend un sous-module de prédiction de la tempé  
15 rature des cellules de batterie (11), un sous-module d'évaluation de la sécurité des batteries (12), et un sous-module de décision intelligente (13), et le sous-module d'évaluation de la sécurité des batteries (12) est respectivement connecté au sous-module de prédiction de la température des cellules de batterie (11) et au sous-module de décision intelligente (13).

20

3. Le système de gestion de la surveillance de l'exploitation d'une station de stockage d'énergie selon la revendication 2, caractérisé en ce que : le sous-module de décision intelligente (13) comprend une unité d'analyse des résultats d'évaluation

(131) et une unité de génération de commandes de réglage (132).

4. Le système de gestion de la surveillance de l'exploitation d'une station de stockage d'énergie selon la revendication 1, caractérisé en ce que : le module de  
5 collecte des données (2) comprend un sous-module de collecte des données environnementales (21) et un sous-module de collecte des données de batterie (22).

5. Le système de gestion de la surveillance de l'exploitation d'une station de stockage d'énergie selon la revendication 4, caractérisé en ce que : le sous-module de  
10 collecte des données environnementales (21) comprend une unité de collecte des données de composition gazeuse (211), une unité de collecte des données de température environnementale (212), et une unité de collecte des données d'humidité environnementale (213). Le sous-module de collecte des données de batterie (22)  
comprend une unité de collecte des données de volume de batterie (221), une unité  
15 de collecte des données de température de surface de batterie (222), une unité de collecte des données de tension (223), et une unité de collecte des données de courant (224).

6. Le système de gestion de la surveillance de l'exploitation d'une station de  
20 stockage d'énergie selon la revendication 1, caractérisé en ce que : le module de stockage des données (3) comprend une bibliothèque d'algorithmes (31), une base de données système (32), une bibliothèque de schémas (33), et une base de données de batteries (34).

7. Le système de gestion de la surveillance de l'exploitation d'une station de stockage d'énergie selon la revendication 1, caractérisé en ce que : le module d'interaction homme-machine (4) comprend un sous-module d'affichage (41) et un sous-module de saisie de commandes (42).

5

8. Le système de gestion de la surveillance de l'exploitation d'une station de stockage d'énergie selon la revendication 1, caractérisé en ce que : le module d'exécution (6) comprend un sous-module de rappel d'alarme (61), un sous-module de réglage de la stratégie de charge et de décharge des batteries (62), un sous-module de r  
10 églage de la stratégie de refroidissement des batteries (63), et un sous-module d'isolation des batteries défectueuses (64).

9. Un procédé de gestion de la surveillance de l'exploitation d'une station de stockage d'énergie, comprenant l'Étape 1, initialisation du système ; Étape 2, collecte  
15 des données ; Étape 3, traitement des données ; Étape 4, prise de décision intelligente ; caractérisé en ce que :

Dans l'Étape 1 ci-dessus, entraîner le modèle d'algorithme de prédiction de la température des cellules de batterie et le déployer dans le sous-module de prédiction de la température des cellules de batterie (11), entraîner le modèle d'algorithme d'é  
20 valuation de la sécurité des batteries et le déployer dans le sous-module d'évaluation de la sécurité des batteries (12), prédéfinir la stratégie de charge et de décharge des batteries et la stratégie de refroidissement des batteries en fonction de la note de sécurité des batteries, et les stocker dans la bibliothèque de schémas (33) ;



Dans l'Étape 2 ci-dessus, utiliser le module de collecte des données (2) pour collecter les données environnementales et les données des batteries, et les envoyer au module de traitement des données (1) ;

5 Dans l'Étape 3 ci-dessus, le sous-module de prédiction de la température des cellules de batterie (11) prédit la température des cellules de batterie en fonction des données de température de surface de batterie et des données de base de batterie stockées dans la base de données de batteries (34), et envoie le résultat au sous-module d'évaluation de la sécurité des batteries (12). Le sous-module d'évaluation de la sécurité des batteries (12) évalue l'état de sécurité des batteries en fonction de la  
10 température des cellules de batterie, des données environnementales, et des données des batteries ;

Dans l'Étape 4 ci-dessus, le sous-module de décision intelligente (13) analyse les résultats d'évaluation de l'état de sécurité des batteries obtenus à l'Étape 3, génère les commandes de réglage en conséquence, et les envoie au module d'exécution (6)  
15 pour exécution.

10. Le procédé de gestion de la surveillance de l'exploitation d'une station de stockage d'énergie selon la revendication 9, caractérisé en ce que : dans l'Étape 1 ci-dessus, le modèle d'algorithme de prédiction de la température des cellules de  
20 batterie utilise un algorithme de réseau neuronal, en utilisant les données de température de surface de batterie, les données de base de batterie, et les données de température des cellules de batterie pour l'entraînement du modèle. Le modèle d'algorithme d'évaluation de la sécurité des batteries attribue une note à l'état de s

é curit é des batteries en int é grant les composants gazeux, l'humidit é environnementale, les variations de volume de batterie, la température des cellules de batterie, les caractéristiques de tension, et de courant.

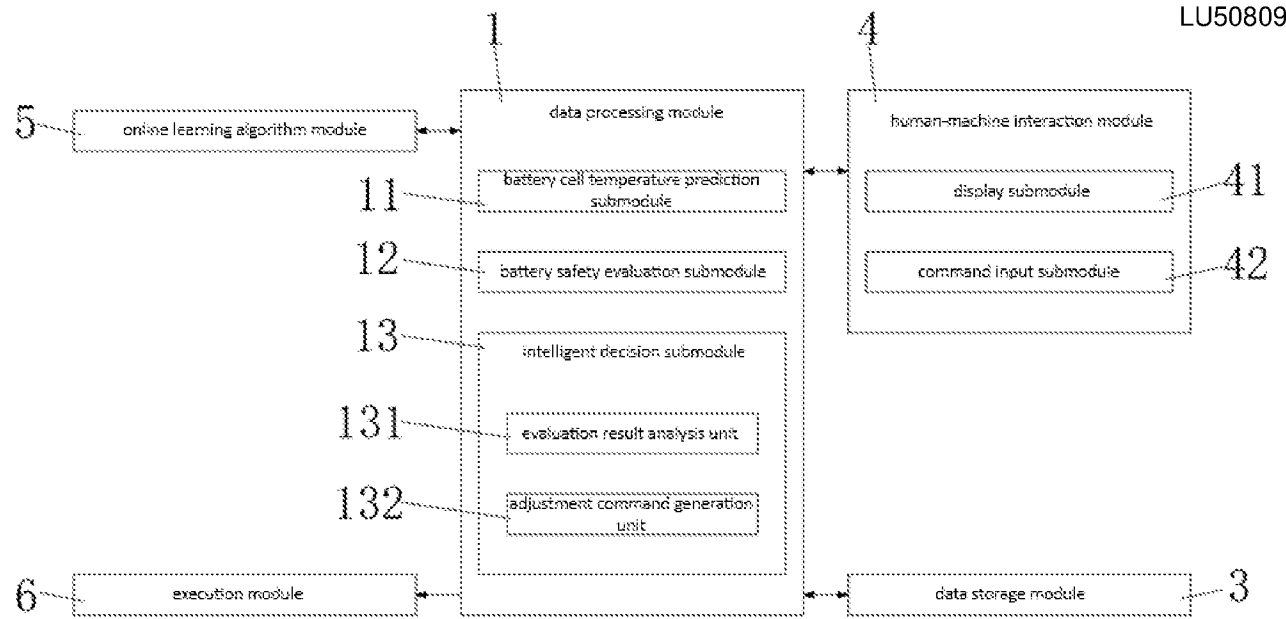


FIG.1

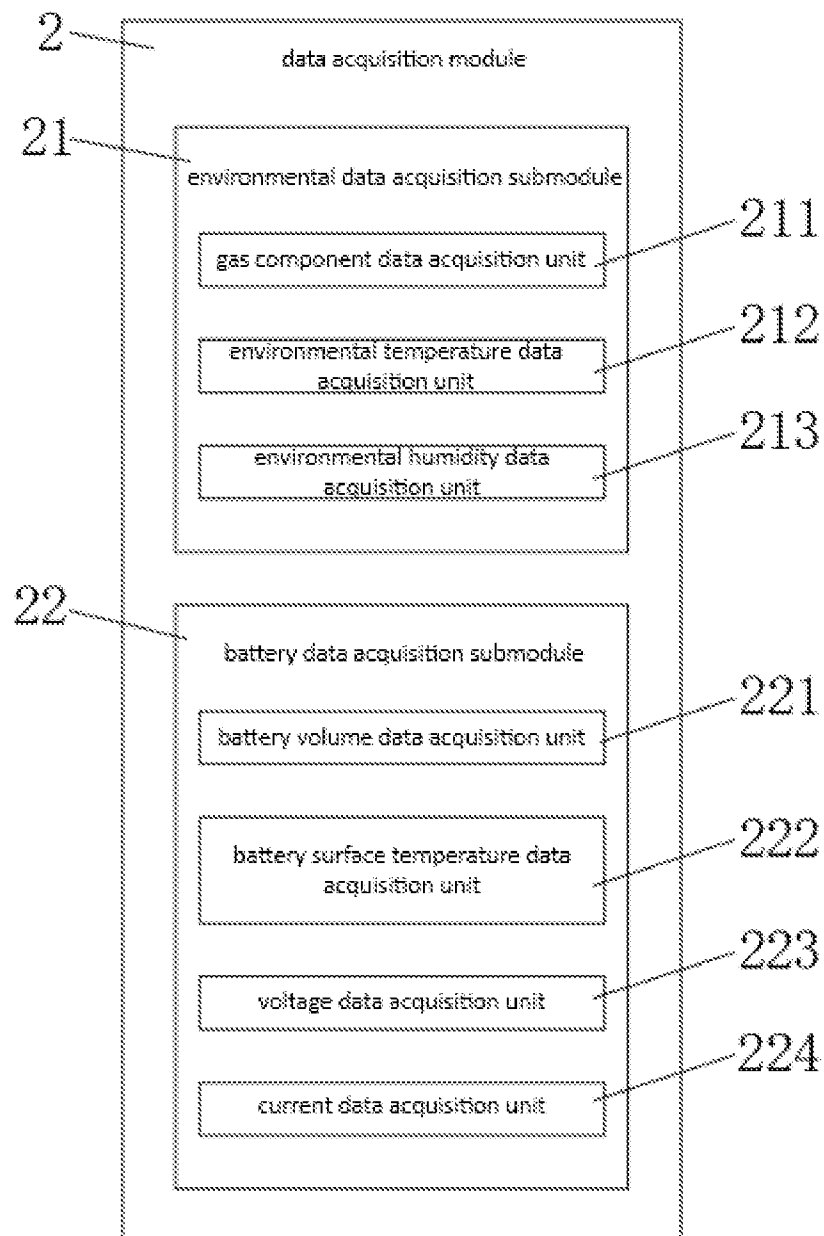


FIG.2

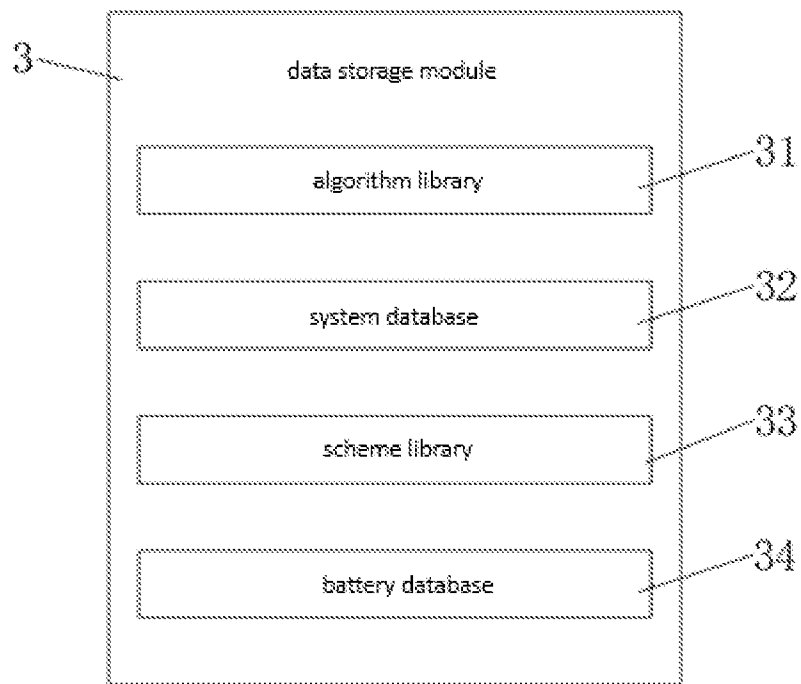


FIG.3

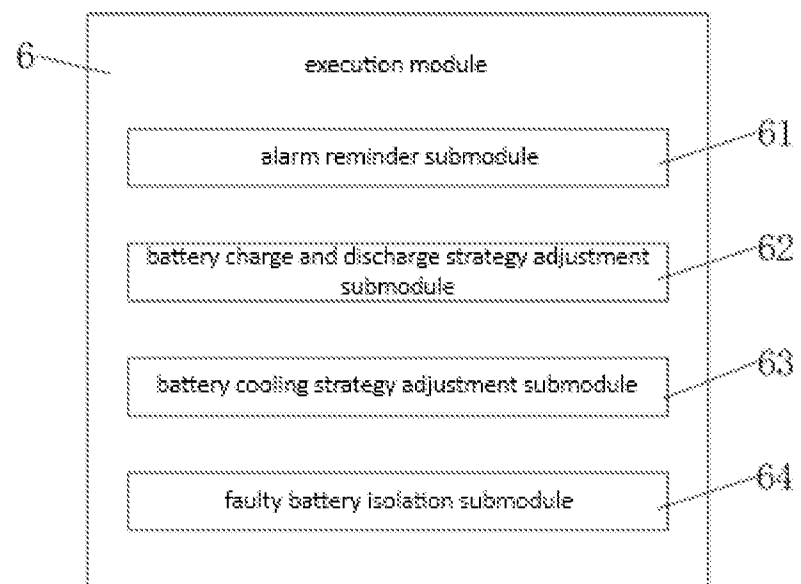


FIG.4

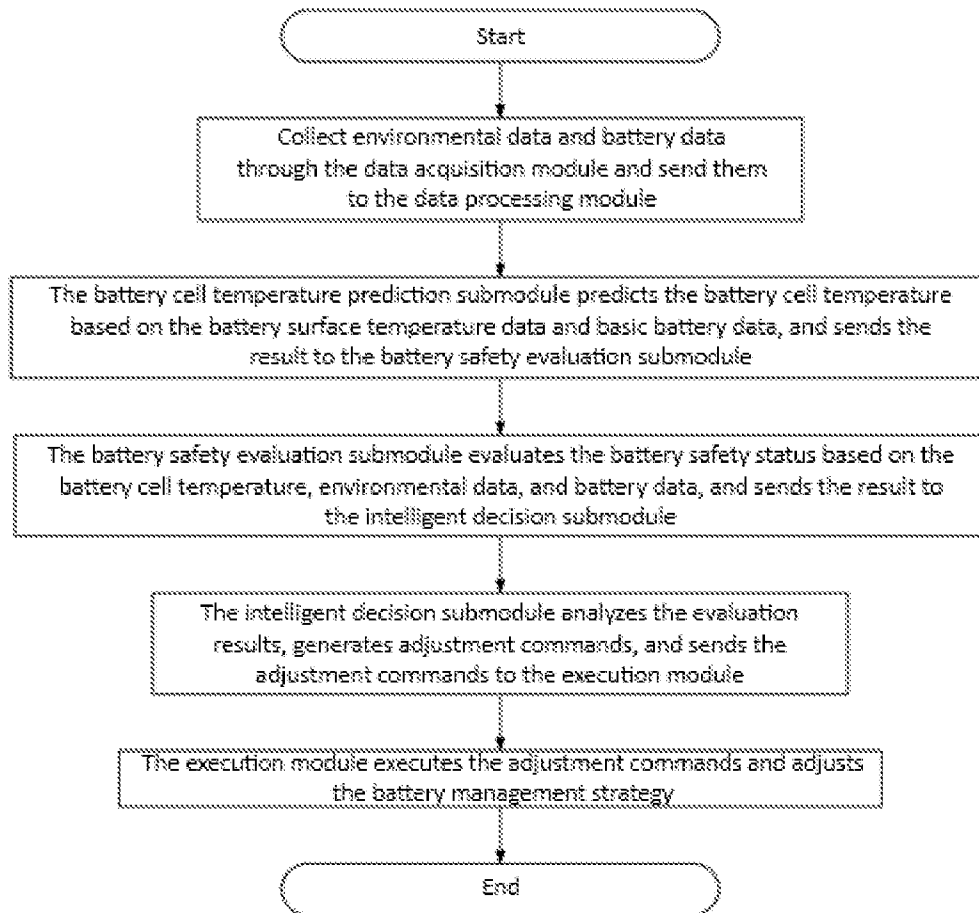


FIG.5

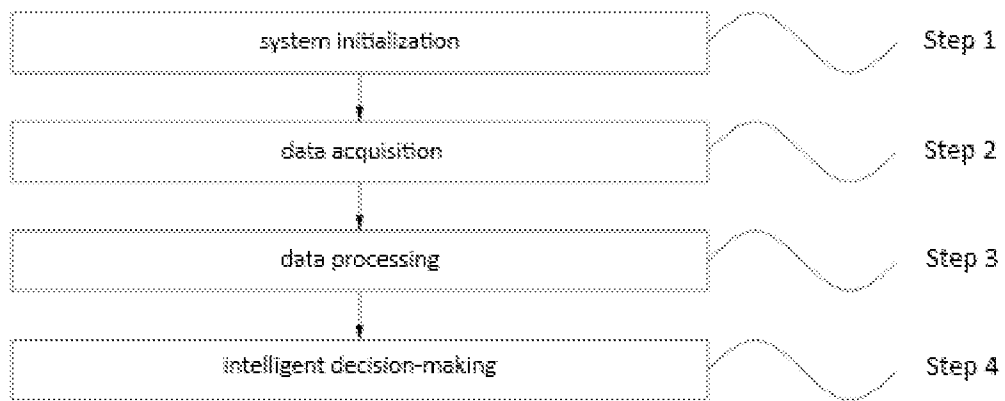


FIG.6