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(54) MONITORING SYSTEM AND METHOD FOR POWER PLANT CONSTRUCTION SITES.

(57) The present invention relates to the field of construction safety monitoring technology and specifically discloses a monitoring system and methodfor power plant construction sites. It includes a block management module, which acquires construction site data from the power plant, establishes a site model based on the construction site data, and determines the hazard level of each construction block based on the site model. A construction management module is used to acquire the construction process data of the current power plant project, and determines the hazard level of each construction process based on the construction process data. A personnel management module is used to acquire image information of construction personnel within the construction blocks, and determines the personnel hazard level based on the construction personnel image information. A monitoring and alarm module is responsible for alerting construction personnel based on the personnel hazard level, the block hazard level of the corresponding construction block, and the process hazard level within the block. This invention allows for real-time monitoring and alerting of personnel information on the construction site, ensuring site safety.

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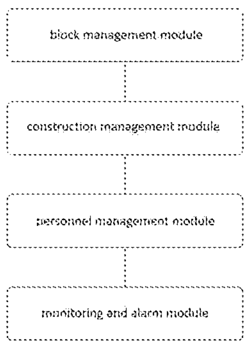

FIG.1

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MONITORING SYSTEM AND METHOD FOR POWER PLANT CONSTRUCTION SITES

Technical Field

This application relates to the field of construction safety monitoring technology, more specifically, it pertains to a monitoring system and method for power plant construction sites.

Background Technology

With the ongoing increase in global energy demands, the prospects for the development of power plants and electrical systems are very broad. The growth of power plants and electrical systems will be driven by the global increase in energy demand. As the world population and economies grow, the demand for electricity will also continue to rise. To meet this demand, power plants and electrical systems must continually improve their efficiency and reliability. Currently, renewable energy technologies, such as solar and wind power, are rapidly developing. These technologies will make power plants and electrical systems more environmentally friendly, efficient, and reliable. As an important part of the new energy sector, power plant construction is poised for more development opportunities.

However, due to the extensive scope and multitude of equipment at power plant construction sites, it is not possible to monitor risk control data and potential hazard data in real-time. Construction personnel are prone to non-compliance with regulations, and there is a lack of strong safety awareness, leading to poor management efficiency at construction sites.

Content of the Invention

The present invention provides a monitoring system for power plant construction sites for solving a problem of poor management efficiency of a power plant construction site in the existing technology, including:

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A block management module for acquiring construction site data of the power plant, establishing a site model based on the construction site data, and determining the hazard level of each construction block based on the site model;

A construction management module for acquiring construction process data of the current power plant project and determining the hazard level of each construction process based on the construction process data;

A personnel management module for acquiring image information of construction personnel within the construction blocks and determining the personnel hazard level based on the construction personnel image information;

A monitoring and alarm module for alerting construction personnel based on the personnel hazard level, the block hazard level of the corresponding construction block, and the process hazard level within the block.

Further, the block management module includes:

A block division module for evenly dividing the construction site into several blocks according to the site model and locating key equipment within the blocks;

A block calculation module for calculating the block density and block anomaly level;

A level determination module for determining the block hazard level based on the block density and block anomaly level.

Further, the block calculation module includes:

A density calculation module for calculating the block density through the formula $L = \frac{\alpha S}{\beta X}$, where L is the block density, S is the area occupied by key equipment within the block, X is the sum of distances from all key equipment to the block center, α is a preset first weight, and β is a preset second weight.

Further, the block calculation module further includes:

An anomaly calculation module for acquiring the number of uses and the number of failures of key equipment within the block during a preset period and calculating the ratio of the number of failures to the number of uses to determine the block anomaly level.

Further, the level determination process of the level determination module includes:

Multiplying the block density by the block anomaly level to obtain a level determination parameter Q;

If $Q < P_1$, setting the block hazard level to the first hazard level;

If $P_1 \leq Q \leq P_2$, setting the block hazard level to the second hazard level;

If $P_2 \leq Q$, setting the block hazard level to the third hazard level, where P_1 is the first preset threshold, P_2 is the second preset threshold, and $P_1 < P_2$.

Further, the process of determining the process hazard level in the construction management module includes:

Acquiring historical construction process data, using this data as standard training data, and annotating it with level labels;

Constructing a neural network model, training the neural network model with the standard training data and corresponding process level labels;

Marking the trained neural network model as a level assessment model, inputting current construction process data into the level assessment model, and outputting the corresponding process hazard level.

Further, the process of determining the personnel hazard level in the personnel management module includes:

Determining real-time behavior profiles of construction personnel based on image information within the construction block and comparing these with preset dangerous behavior profiles stored in a storage module;

Comparing the real-time behavior profile with the preset dangerous behavior profile to determine the matching degree;

Calculating the ratio of the preset permissible matching degree to the matching degree between the real-time behavior profile and the preset dangerous behavior profile to determine the personnel hazard level.

Further, the monitoring and alarm module includes:

A threshold setting module for obtaining the block hazard levels of each construction block and setting danger thresholds based on the block hazard levels;

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A danger calculation module for calculating the personnel hazard level of construction personnel within each block and acquiring the process hazard level within the block, multiplying the process hazard level with the personnel hazard level to derive an alert parameter;

An alert judgment module for determining if the alert parameter exceeds the danger threshold, and if so, alerting the construction personnel.

In order to realize the above purpose, the present invention also provides a monitoring method for power plant construction sites, including:

Acquiring construction site data of the power plant, establishing a site model based on the construction site data, and determining the hazard level of each construction block based on the site model;

Acquiring construction process data of the current power plant project and determining the hazard level of each construction process based on the construction process data;

Acquiring image information of construction personnel within the construction blocks and determining the personnel hazard level based on the construction personnel image information;

Alerting construction personnel based on the personnel hazard level, the block hazard level of the corresponding construction block, and the process hazard level within the block.

The beneficial effects of this invention include:

Through the application of the above technical solutions, this invention divides the power plant construction site into blocks and conducts real-time collection of construction process data and construction personnel image data within each block. It can promptly alert construction personnel with high hazard levels, ensuring the timeliness of alerts, enhancing the management efficiency of power plant construction, and ensuring the safety of personnel on site.

Description of the Drawings

To clarify the technical solutions in the embodiments of this application more clearly, the following will briefly introduce the drawings necessary for describing the embodiments. It is evident that the following drawings are only some embodiments of this application, and for those skilled in the art, other drawings can be obtained based on these drawings without creative efforts.

FIG.1: a schematic structure of the monitoring system for power plant construction sites proposed by an embodiment of the invention;

FIG.2: an overall flowchart of the monitoring method for power plant construction sites proposed by an embodiment of the invention.

Specific Embodiments

The technical solutions in the embodiments of the present application will be described clearly and completely in the following in conjunction with the accompanying drawings in the embodiments of the present application, and it is obvious that the described embodiments are only a part of the embodiments of the present application and not all of the embodiments. Based on the embodiments in this application, all other embodiments obtained by a person of ordinary skill in the art without making creative labor fall within the scope of protection of this application.

The embodiment of the present application provides a monitoring system for power plant construction sites, as shown in FIG.1, including:

A block management module for acquiring construction site data of the power plant, establishing a site model based on the construction site data, and determining the hazard level of each construction block based on the site model;

A construction management module for acquiring construction process data of the current power plant project and determining the hazard level of each construction process based on the construction process data;

A personnel management module for acquiring image information of construction personnel within the construction blocks and determining the personnel hazard level based on the construction personnel image information;

A monitoring and alarm module for alerting construction personnel based on the personnel hazard level, the block hazard level of the corresponding construction block, and the process hazard level within the block.

In some embodiments of the present application, the block management module includes:

A block division module for evenly dividing the construction site into several blocks according to the site model and locating key equipment within the blocks; A block calculation module for calculating the block density and block anomaly level; A level determination module for determining the block hazard level based on the block density and block anomaly level.

In this embodiment, key equipment includes high-risk equipment such as cranes and rebar processing equipment.

In some embodiments of the present application, the block calculation module includes:

A density calculation module for calculating the block density through the formula $L = \frac{\alpha S}{\beta X}$, where L is the block density, S is the area occupied by key equipment within the block, X is the sum of distances from all key equipment to the block center, α is a preset first weight, and β is a preset second weight.

In some embodiments of the present application, the block calculation module further includes: an anomaly calculation module for acquiring the number of uses and the number of failures of key equipment within the block during a preset period and calculating the ratio of the number of failures to the number of uses to determine the block anomaly level.

In some embodiments of the present application, the level determination process of the level determination module includes:Multiplying the block density by the block anomaly level to obtain a level determination parameter Q; If $Q < P_1$, setting the block hazard level to the first hazard level; If $P_1 \leq Q \leq P_2$, setting the block hazard level to the second hazard level; If $P_2 \leq Q$, setting the block hazard level to the third hazard level, where P_1 is the first preset threshold, P_2 is the second preset threshold, and $P_1 < P_2$.

In this embodiment, the hazard levels of the first, second, and third danger levels increase progressively; the higher the value of the level determination parameter Q, the higher the block hazard level.

In some embodiments of the present application, the process of determining the process hazard level in the construction management module includes: Acquiring historical construction process data, using this data as standard training data, and annotating it with level labels; Constructing a neural network model, training the neural network model with the standard training data and corresponding process level labels; Marking the trained neural network model as a level assessment model, inputting current construction process data into the level assessment model, and outputting the corresponding process hazard level.

In this embodiment, the construction process levels are assessed more accurately based on the neural network model.

In some embodiments of the present application, the process of determining the personnel hazard level in the personnel management module includes: Determining real-time behavior profiles of construction personnel based on image information within the construction block and comparing these with preset dangerous behavior profiles stored in a storage module; Comparing the real-time behavior profile with the preset dangerous behavior profile to determine the matching degree; Calculating the ratio of the preset permissible matching degree to the matching degree between the real-time behavior profile and the preset dangerous behavior profile to determine the personnel hazard level.

In this embodiment, high-definition cameras are placed near the construction site, continuously collecting image data of the construction blocks, thereby capturing the real-time behavior of the construction personnel, including dangerous behaviors such as not wearing safety helmets.

In some embodiments of the present application, the monitoring and alarm module includes: A threshold setting module for obtaining the block hazard levels of each construction block and setting danger thresholds based on the block hazard levels; A danger calculation module for calculating the personnel hazard level of construction personnel within each block and acquiring the process hazard level within the block, multiplying the process hazard level with the personnel hazard level to derive an alert parameter; An alert judgment module for determining if the alert parameter exceeds the danger threshold, and if so, alerting the construction personnel.

In this embodiment, different danger thresholds are set according to the block hazard level, and these thresholds can be adjusted in real-time by management personnel.

Based on the same technical idea, as shown in FIG.2, the present invention also provides a monitoring method for power plant construction sites, including:

S101: Acquiring construction site data of the power plant, establishing a site model based on the construction site data, and determining the hazard level of each construction block based on the site model;

S102: Acquiring construction process data of the current power plant project and determining the hazard level of each construction process based on the construction process data;

S103: Acquiring image information of construction personnel within the construction blocks and determining the personnel hazard level based on the construction personnel image information;

S104: Alerting construction personnel based on the personnel hazard level, the block hazard level of the corresponding construction block, and the process hazard level within the block.

Lastly, it should be noted: The above examples are only to illustrate the technical solutions of this application and not to limit them; although the application has been described in detail with reference to the foregoing embodiments, it will be apparent to those skilled in the art that they can still modify the technical solutions recorded in the foregoing embodiments, or equivalently replace some of the technical features therein; these modifications or replacements do not make the essence of the corresponding technical solutions deviate from the spirit and scope of the technical solutions of the embodiments of this application.

CLAIMS

1. A monitoring system for power plant construction sites, characterized by comprising:

A block management module for acquiring construction site data of the power plant, establishing a site model based on the construction site data, and determining the hazard level of each construction block based on the site model;

A construction management module for acquiring construction process data of the current power plant project and determining the hazard level of each construction process based on the construction process data;

A personnel management module for acquiring image information of construction personnel within the construction blocks and determining the personnel hazard level based on the construction personnel image information;

A monitoring and alarm module for alerting construction personnel based on the personnel hazard level, the block hazard level of the corresponding construction block, and the process hazard level within the block.

2. The power plant construction site monitoring system according to claim 1, wherein the block management module comprises:

A block division module for evenly dividing the construction site into several blocks according to the site model and locating key equipment within the blocks;

A block calculation module for calculating the block density and block anomaly level;

A level determination module for determining the block hazard level based on the block density and block anomaly level.

3. The power plant construction site monitoring system according to claim 2, wherein the block calculation module comprises:

A density calculation module for calculating the block density through the formula $L = \frac{\alpha S}{\beta X}$, where L is the block density, S is the area occupied by key equipment within the block, X is the sum of distances from all key equipment to the block center, α is a preset first weight, and β is a preset second weight.

4. The power plant construction site monitoring system according to claim 2, wherein the block calculation module further comprises:

An anomaly calculation module for acquiring the number of uses and the number of failures of key equipment within the block during a preset period and calculating the ratio of the number of failures to the number of uses to determine the block anomaly level.

5. The power plant construction site monitoring system according to claim 4, wherein the level determination process of the level determination module comprises:

Multiplying the block density by the block anomaly level to obtain a level determination parameter Q;

If $Q < P_1$, setting the block hazard level to the first hazard level;

If $P_1 \leq Q \leq P_2$, setting the block hazard level to the second hazard level;

If $P_2 \leq Q$, setting the block hazard level to the third hazard level, where P_1 is the first preset threshold, P_2 is the second preset threshold, and $P_1 < P_2$.

6. The power plant construction site monitoring system according to claim 1, wherein the process of determining the process hazard level in the construction management module comprises:

Acquiring historical construction process data, using this data as standard training data, and annotating it with level labels;

Constructing a neural network model, training the neural network model with the standard training data and corresponding process level labels;

Marking the trained neural network model as a level assessment model, inputting current construction process data into the level assessment model, and outputting the corresponding process hazard level.

7. The power plant construction site monitoring system according to claim 1, wherein the process of determining the personnel hazard level in the personnel management module comprises:

Determining real-time behavior profiles of construction personnel based on image information within the construction block and comparing these with preset dangerous behavior profiles stored in a storage module;

Comparing the real-time behavior profile with the preset dangerous behavior profile to determine the matching degree;

Calculating the ratio of the preset permissible matching degree to the matching degree between the real-time behavior profile and the preset dangerous behavior profile to determine the personnel hazard level.

8. The power plant construction site monitoring system according to claim 1, wherein the monitoring and alarm module comprises:

A threshold setting module for obtaining the block hazard levels of each construction block and setting danger thresholds based on the block hazard levels;

A danger calculation module for calculating the personnel hazard level of construction personnel within each block and acquiring the process hazard level within the block, multiplying the process hazard level with the personnel hazard level to derive an alert parameter;

An alert judgment module for determining if the alert parameter exceeds the danger threshold, and if so, alerting the construction personnel.

9. A monitoring method for power plant construction sites, characterized by comprising:

Acquiring construction site data of the power plant, establishing a site model based on the construction site data, and determining the hazard level of each construction block based on the site model;

Acquiring construction process data of the current power plant project and determining the hazard level of each construction process based on the construction process data;

Acquiring image information of construction personnel within the construction blocks and determining the personnel hazard level based on the construction personnel image information;

Alerting construction personnel based on the personnel hazard level, the block hazard level of the corresponding construction block, and the process hazard level within the block.

REVENDICATIONS

1. Un système de surveillance de chantier pour la construction d'une centrale électrique, caractérisé en ce qu'il comprend :

Un module de gestion des blocs, utilisé pour obtenir les données de chantier de la centrale électrique, établir un modèle de site en fonction des données de chantier de la centrale électrique et déterminer le niveau de danger des blocs de construction en fonction du modèle de site ;

Un module de gestion de la construction, utilisé pour obtenir les données de processus de construction du projet de centrale électrique actuel, et déterminer le niveau de danger des processus de construction en fonction des données de processus de construction ;

Un module de gestion du personnel, utilisé pour obtenir des informations d'image du personnel de construction dans les blocs de construction, et déterminer le niveau de danger du personnel en fonction des informations d'image du personnel de construction ;

Un module d'alarme de surveillance, utilisé pour alerter le personnel de construction en fonction du niveau de danger du personnel, du niveau de danger du bloc correspondant et du niveau de danger du processus de construction dans le bloc.

2. Le système de surveillance de chantier pour la construction d'une centrale électrique selon la revendication 1, caractérisé en ce que le module de gestion des blocs comprend :

Un module de division des blocs, utilisé pour diviser uniformément le chantier en plusieurs blocs en fonction du modèle de site, et localiser l'équipement clé dans les blocs ;

Un module de calcul des blocs, utilisé pour calculer la densité des blocs et le degré d'anomalie des blocs ;

Un module de détermination du niveau, utilisé pour déterminer le niveau de danger des blocs en fonction de la densité des blocs et du degré d'anomalie des blocs.

3. Le système de surveillance de chantier pour la construction d'une centrale électrique selon la revendication 2, caractérisé en ce que le module de calcul des blocs comprend :

Un module de calcul de densité, utilisé pour calculer la densité des blocs à l'aide de la formule $L = \frac{\alpha S}{\beta X}$, où L représente la densité des blocs, S représente la surface occupée par l'équipement clé dans les blocs, X représente la somme des distances entre tout l'équipement clé et le point central des blocs, α est un premier poids prédéfini, et β est un second poids prédéfini.

4. Le système de surveillance de chantier pour la construction d'une centrale électrique selon la revendication 2, caractérisé en ce que le module de calcul des blocs comprend également :

Un module de calcul du degré d'anomalie, utilisé pour obtenir le nombre d'utilisations de l'équipement clé dans les blocs pendant une période prédéfinie et le nombre de pannes de cet équipement pendant la même période, et calculer le rapport entre le nombre de pannes et le nombre d'utilisations pour obtenir le degré d'anomalie des blocs.

5. Le système de surveillance de chantier pour la construction d'une centrale électrique selon la revendication 4, caractérisé en ce que le processus de détermination du niveau du module de détermination du niveau comprend :

Multiplier la densité des blocs par le degré d'anomalie des blocs pour obtenir un paramètre de détermination du niveau Q ;

Si $Q < P_1$, le niveau de danger des blocs est défini comme le premier niveau de danger ;

Si $P_1 \leq Q \leq P_2$, le niveau de danger des blocs est défini comme le deuxième niveau de danger ;

Si $P_2 \leq Q$, le niveau de danger des blocs est défini comme le troisième niveau de danger, où P_1 est un premier seuil prédéfini, P_2 est un deuxième seuil prédéfini, et $P_1 < P_2$.

6. Le système de surveillance de chantier pour la construction d'une centrale électrique selon la revendication 1, caractérisé en ce que le processus de détermination du niveau de danger du module de gestion de la construction comprend :

Obtenir des données de processus de construction historiques, utiliser ces données comme données d'entraînement standard, et étiqueter ces données avec des étiquettes de niveau ;

Construire un modèle de réseau neuronal, entraîner le modèle de réseau neuronal avec les données d'entraînement standard et les étiquettes de niveau correspondantes ;

Marquer le modèle de réseau neuronal entraîné comme un modèle d'évaluation de niveau, entrer les données de processus de construction actuelles dans le modèle d'évaluation de niveau, et sortir le niveau de danger de processus correspondant.

7. Le système de surveillance de chantier pour la construction d'une centrale électrique selon la revendication 1, caractérisé en ce que le processus de détermination du niveau de danger du personnel du module de gestion du personnel comprend :

Déterminer le profil comportemental en temps réel du personnel de construction en fonction des informations d'image du personnel de construction dans les blocs de construction, ainsi que le profil comportemental de danger prédéfini stocké dans le module de stockage ;

Comparer le profil comportemental en temps réel du personnel avec le profil comportemental de danger prédéfini, et obtenir le degré de correspondance entre le profil comportemental en temps réel et le profil comportemental de danger prédéfini ;

Calculer le rapport entre le degré de correspondance prédéfini permis et le degré de correspondance entre le profil comportemental en temps réel et le profil comportemental de danger prédéfini pour obtenir le niveau de danger du personnel.

8. Le système de surveillance de chantier pour la construction d'une centrale électrique selon la revendication 1, caractérisé en ce que le module d'alarme de surveillance comprend :

Un module de réglage du seuil, utilisé pour obtenir le niveau de danger des blocs de construction sur le chantier et définir un seuil de danger en fonction du niveau de danger des blocs ;

Un module de calcul du danger, utilisé pour obtenir le niveau de danger du personnel de construction dans chaque bloc de construction et obtenir le niveau de danger du processus de construction dans chaque bloc, multiplier le niveau de danger du processus avec le niveau de danger du personnel, et obtenir le paramètre d'alarme correspondant pour le personnel de construction ;

Un module de jugement d'alarme, utilisé pour déterminer si le paramètre d'alarme dépasse le seuil de danger, et si c'est le cas, alerter le personnel de construction.

9. Un procédé de surveillance de chantier pour la construction d'une centrale électrique, caractérisé en ce qu'il comprend :

Obtenir les données de chantier de la centrale électrique, établir un modèle de site en fonction des données de chantier de la centrale électrique, et déterminer le niveau de danger des blocs de construction en fonction du modèle de site ;

Obtenir les données de processus de construction du projet de centrale électrique actuel, déterminer le niveau de danger des processus de construction en fonction des données de processus de construction ;

Obtenir des informations d'image du personnel de construction dans les blocs de construction, déterminer le niveau de danger du personnel en fonction des informations d'image du personnel de construction ;

Alerter le personnel de construction en fonction du niveau de danger du personnel, du niveau de danger du bloc correspondant, et du niveau de danger du processus de construction dans le bloc.

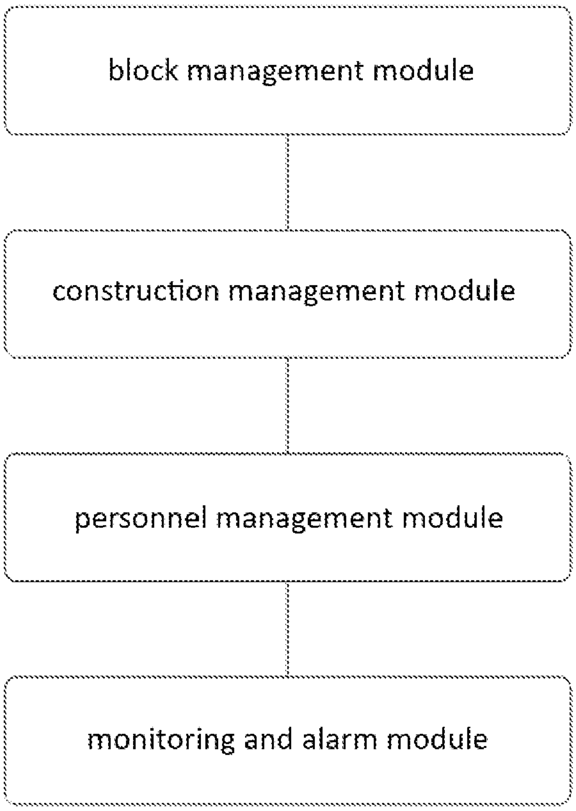
block management module
construction management module
personnel management module
monitoring and alarm module

FIG.1

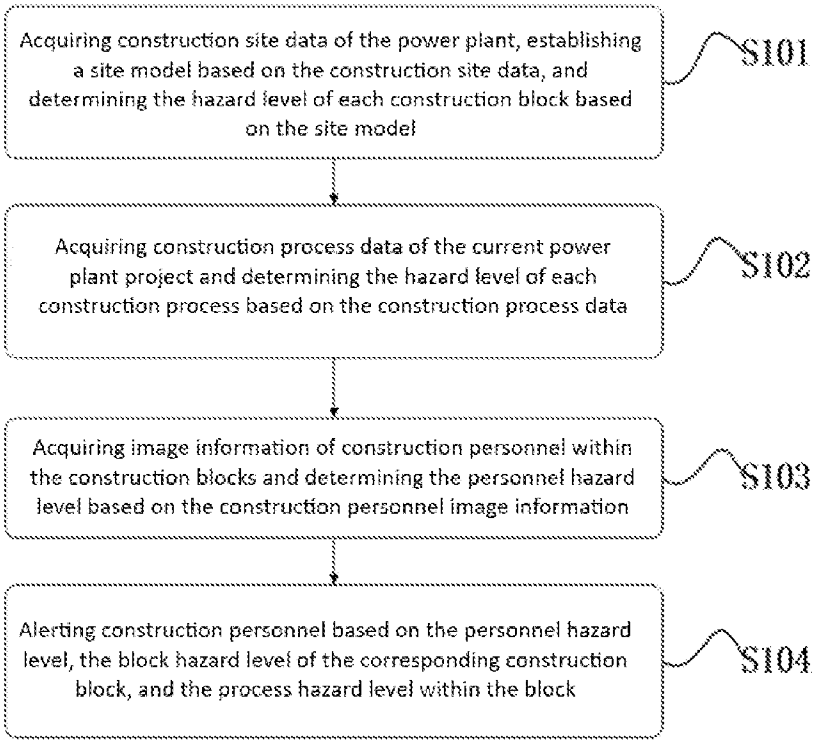
Acquiring construction site data of the power plant, establishing a site model based on the construction site data, and determining the hazard level of each construction block based on the site model
S101
Acquiring construction process data of the current power plant project and determining the hazard level of each construction process based on the construction process data
S102
Acquiring image information of construction personnel within the construction blocks and determining the personnel hazard level based on the construction personnel image information
S103
Alerting construction personnel based on the personnel hazard level, the block hazard level of the corresponding construction block, and the process hazard level within the block
S104

FIG.2