

METHOD AND SYSTEM FOR MONITORING PROJECT STATUS BASED ON MULTIPLE CAMERA UNITS

TECHNICAL FIELD

The present application relates to the monitoring of status of construction projects, and more particularly to a method and system for monitoring project status based on multiple camera units.

BACKGROUND

Geological conditions significantly affect the safety of construction projects. Since the geological conditions often experience some subtle changes during the implementation of construction projects, real-time monitoring and automatic warning of the project status are particularly important. With the rapid development of engineering informatization and digitization, the digital methods are employed to collect data of the construction projects, and a full-information model of the construction project is automatically generated via a system algorithm, which can efficiently assist the supervision and business coordination on site, preventing the occurrence of project accidents.

At present, the project status monitoring technologies mainly include manual monitoring, semi-automatic monitoring and full-automatic monitoring. With respect to the manual monitoring, the project site data is manually collected by means of various monitoring apparatuses at a certain frequency, and the collected data is manually calculated and analyzed and then fed back to the project management department to assist the site management. In the semi-automatic monitoring, some monitoring apparatuses are set to automatically collect and transmit data, while the remaining monitoring apparatuses are required to be manually manipulated for data collection due to the constraints of the project site; and the collected data is calculated and analyzed and then fed back to the project management department to enable the semi-automatic monitoring of the project status. With regard to the full-automatic monitoring, all involved monitoring apparatuses are automatically operated to implement the data collection and transmission in accordance with preset procedures and frequencies, and the collected data is processed in time in the data processing center and the results are fed back to realize the full-automatic monitoring of the project status.

Although the foregoing monitoring technologies all employ a monitoring apparatus to collect

data of the project site, they can only satisfy the single monitoring feedback of the project status, and cannot achieve the multi-dimensional monitoring of the project status, failing to enable the comprehensive and precise monitoring of the project statuses.

SUMMARY

Based on this, it is necessary to provide a method and system for monitoring project status based on multiple camera units, which can achieve the multi-dimensional monitoring of the status of the construction project and ensure the comprehensive and precise monitoring.

Technical solutions of this application are described as follows.

In a first aspect, this application provides a method for monitoring project status based on multiple camera units, comprising:

loading an equal-scale building information modeling (BIM) 3D model of a project design into a system as a benchmark model;

performing virtual layout of the multiple camera units based on the benchmark model to determine layout location and attribute setting of the multiple camera units; according to the layout location and the attribute setting of the multiple camera units, performing actual layout and debugging of the multiple camera units at a project site corresponding to the benchmark model;

performing multi-dimensional and real-time collection of an image data of the project site based on the multiple camera units and transmitting the image data of the project site to the system; and analyzing the image data of the project site via a built-in algorithm of the system to build a real 3D model of the project site;

comparing the real 3D model with the benchmark model to complete difference analysis between the real 3D model and the benchmark model; and

determining change of a project status of the project site based on results of the difference analysis between the real 3D model and the benchmark model, so as to monitor the project status of the project site.

In an embodiment, the method further comprises:

after the equal-scale BIM 3D model is loaded as the benchmark model, defining a type of a project design object in the benchmark model according to an attribute information of the equal-scale BIM 3D model.

In an embodiment, the type of the project design object comprises at least one of terrain surface, excavation surface, building structure type and electromechanical device.

In an embodiment, the comparison between the real 3D model and the benchmark model is performed through steps of:

identifying a construction object and a surface feature object in the real 3D model;

associating the identified construction object with the project design object; and

comparing a project status of the construction object with the project status of the project design object, and determining whether the surface feature object exists in the benchmark model, so as to complete the difference analysis between the real 3D model and the benchmark model.

In an embodiment, the difference analysis between the real 3D model and the benchmark model includes object existence difference analysis, appearance difference analysis and geometric shape difference analysis.

In an embodiment, the comparison between the real 3D model and the benchmark model further comprises:

before the difference analysis between the real 3D model and the benchmark model,

analyzing and calculating the number, position coordinate, geometric shape, size and occurrence of the construction object.

In an embodiment, the attribute setting of the multiple camera units is determined through a step of:

determining a model, collection frequency and photography parameters of the multiple camera units.

In an embodiment, the multi-dimensional and real-time collection of the image data of the project site based on the multiple camera units is performed by automatic collection or manual collection.

In an embodiment, the method further comprises:

after the monitoring of the project status of the project site,

generating an early warning if monitoring results of the project status of the project site do not meet preset requirements.

In a second aspect, this application also provides a system for monitoring project status based on multiple camera units, comprising:

a first module;
a second module;
a third module;
a fourth module; and
a fifth module;

wherein the first module is configured to load an equal-scale BIM 3D model of a project design into a system as a benchmark model;

the second module is configured to perform virtual layout of the multiple camera units to determine layout location and attribute setting of the multiple camera units, and to perform the actual layout and debugging of the multiple camera units at a project site corresponding to the benchmark model according to the layout location and the attribute setting of the multiple camera units;

the third module is configured to perform multi-dimensional and real-time collection of an image data of the project site based on the multiple camera units and transmit the image data to the system, and to analyze the image data via a built-in algorithm of the system to build a real 3D model of the project site;

the fourth module is configured to compare the real 3D model with the benchmark model to complete difference analysis between the real 3D model with the benchmark model; and

the fifth module is configured to determine change of the project status of the project site based on results of the difference analysis between the real 3D model and the benchmark model, so as to monitor the project status of the project site.

Compared to the prior art, this application has the following beneficial effects.

In the project status monitoring method provided herein, the multi-dimensional and real-time collection of the image data of the project site is performed based on the multiple camera units, and then the collected image data is analyzed via the built-in algorithm of the system to build a real 3D model of the project site; the real 3D model is compared with the benchmark model in an initial state to analyze the differences between the real 3D model and the benchmark model; and based on the differences between the real 3D model and the benchmark model, the change of the project status of the project site is determined to enable the multi-dimensional and real-time monitoring of the project status of the project site. As a consequence, the method can effectively assist the on site

monitoring of the project, and enables the comprehensive and precise monitoring of the project status.

In addition, through the arrangement of the multiple camera units, the method provided herein enables the real-time collection and rapid transmission of the image data of various statuses of the project site. The real-time 3D modeling is performed based on the real-time image data, which can effectively reflect the real project status and the project full view, and achieve the comparative analysis between project statuses of the project site, achieving the monitoring of any project status of the project site. Through the multi-dimensional and real-time collection of the image data of the project site using the multiple camera units, the monitoring of any implementation details of the project site is enabled.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to clearly illustrate the technical solutions of the embodiments of the present disclosure or the prior art, the drawings used in the embodiments will be briefly described below. Obviously, presented in the drawings are only some embodiments of the present disclosure. For those skilled in the art, other drawings can be obtained based on these drawings without paying any creative effort.

Fig. 1 schematically shows association between a method and system for monitoring project status based on multiple camera units according to an embodiment of the present disclosure;

Fig. 2 is a flowchart illustrating monitoring and early warning of project status of a tunnel excavation project in accordance with an embodiment of the present disclosure;

Fig. 3 is a structural diagram of a benchmark model (A) of a tunnel according to an embodiment of the present disclosure;

Fig. 4 is a structural diagram of a real 3D model (C) of the tunnel according to an embodiment of the present disclosure;

Fig. 5 schematically depicts layout of multiple camera units (B) in the tunnel according to an embodiment of the present disclosure; and

Fig. 6 schematically illustrates the layout of the multiple camera units (B) in the tunnel according to an embodiment of the present disclosure from another perspective.

In the drawings: 100, first module; 200, second module; 300, third module; 400, fourth module;

500, fifth module; and 600, sixth module.

The disclosure will be further described below with reference to the accompanying drawings and embodiments to make objects, technical features and advantages of the disclosure clear.

DETAILED DESCRIPTION OF EMBODIMENTS

The disclosure will be clearly and completely described below with reference to the accompanying drawings and embodiments. Obviously, described below are only some embodiments of the present disclosure, which are not intended to limit the disclosure. Other embodiments obtained by those skilled in the art based on the embodiments provided herein without paying creative effort shall fall within the scope of the present disclosure.

It should be noted that in the present disclosure, the benchmark model, the camera unit and the real 3D model are respectively defined as A, B and C. Besides, the method provided herein for monitoring project status based on the multiple camera units is suitable for the monitoring of project safety, quality, progress, and resources in the fields of manual excavation projects such as tunnel excavation, construction projects such as bridge construction and high-rise construction, and natural slope construction projects.

Referring to an embodiment shown in Fig. 1, a method for monitoring project status based on multiple camera units is provided, which is specifically described as follows.

(S1) Loading of benchmark model (A)

An equal-scale BIM 3D model of a project design is loaded into a system as a benchmark model.

(S2) Layout and debugging of multiple camera units (B)

The virtual layout of the multiple camera units is performed based on the benchmark model (A) to determine the layout location and attribute setting of the multiple camera units (B), and at the same time, according to the layout location and attribute setting of the multiple camera units (B), the actual layout and debugging of the multiple camera units (B) are performed at the project site corresponding to the benchmark model (A).

(S3) Building of real 3D model (C)

The multi-dimensional and real-time collection of image data of the project site is performed based on the multiple camera units (B), and the image data is transmitted to the system, and

analyzed via the built-in algorithm of the system to build a real 3D model (C) of the project site.

(S4) Comparison between real 3D model (C) and benchmark model (A)

The real 3D model (C) is compared with the benchmark model (A) so as to analyze the differences between the real 3D model (C) and the benchmark model (A).

(S5) Monitoring of project status of project site

Change of the project status of the project site is determined based on results of the difference analysis between the real 3D model (C) and the benchmark model (A), so as to monitor the project status of the project site.

In the method provided herein, the multi-dimensional and real-time collection of the image data of the project site is performed based on the multiple camera units (B), and then the collected image data is analyzed via the built-in algorithm of the system to build the real 3D model (C) of the project site; and the real 3D model (C) is compared with the benchmark model (A) to analyze the difference between the real 3D model (C) and the benchmark model (A) to determine the change of the project status of the project site, thereby completing the multi-dimensional and real-time monitoring of the project status of the project site. As a consequence, the method of the disclosure can effectively assist the monitoring of the project site, and facilitates enabling the comprehensive and precise monitoring of the project status.

In addition, with the help of the multiple camera units (B), the image data of the project site under various statuses can be collected in real time and rapidly transmitted and calculated to perform real-time 3D modeling, which can effectively reflect the real project status and the project full view, and achieve the comparative analysis between project statuses of the project site, achieving the monitoring of any project status of the project site.

Further, using multiple camera units (B) to collect the image data of the project site can ensure the monitoring of any implementation details of the project site.

Specifically, in this embodiment, after the step (S1), the following step is performed.

(S11) The type of the project design object in the benchmark model (A) is defined according to the attribute information of the equal-scale BIM 3D model.

Specifically, in this embodiment, the attribute collection of the equal-scale BIM 3D model is also loaded into the system while loading the equal-scale BIM 3D model of the project design into the system, where the attribute collection refers to the collection of all the attribute information of

the equal-scale BIM 3D model. The foregoing equal-scale BIM 3D model is used as the benchmark model (A), and the attribute information in the attribute collection is used for defining the type of each project design object in the benchmark model (A). The benchmark model (A) is a combination of the equal-scale BIM 3D model of the overall project and the project attribute information, and is completely consistent with the real project in terms of 3D size, spatial relationship, and appearance. At the same time, by defining the type of each project design object in the benchmark model (A), a corresponding analysis algorithm can be used for the collected image data of each project design object according to the specific type, thereby ensuring the reliability and accuracy of the subsequent model comparison analysis. Further, the type of the project design object includes at least one of terrain surface, excavation surface, building structure, and electromechanical device.

In an embodiment, in step (S2), the attribute setting of the multiple camera units (B) is determined by determining the model, collection frequency and photography parameters of the multiple camera units.

In this embodiment, the step (S2) is specifically performed as follows. The virtual layout of the multiple camera units is performed based on the benchmark model (A) loaded in step (S1) to determine the layout location and attribute setting of the multiple camera units (B), where the attribute setting includes setting of model, collection frequency and photography parameters. After the virtual layout, according to the determined layout location and model, the actual installation of the multiple camera units (B) is performed at the project site corresponding to the benchmark model (A) and, and then the multiple camera units (B) are debugged according to the determined collection frequency and photography parameters.

In this embodiment, the layout location, number and attribute setting of the multiple camera units (B) are simulated based on the benchmark model (A) loaded in step (S1), so that different types of camera units (B) can be integrated at the same time, and the collection frequency and photography parameters of different camera units (B) can be adjusted to select a combination of multiple camera units (B) with the widest coverage, highest collection efficiency, better durability, and lower cost by virtual layout, so as to achieve the optimal collection effect and the longest use time at the lowest cost. After the virtual layout, the system outputs a list of the combination of multiple camera units (B), a layout diagram of the camera units (B), and a worksheet of different camera units (B), etc., so as to guide the procurement, fixed-point installation and debugging of the

camera units (B) at the project site.

Specifically, the step (S3) in this embodiment is performed as follows. Each of the multiple camera units (B) installed in step (S2) performs multi-dimensional and real-time collection of image data of the project site according to the collection frequency and photography parameters set in step (S2) and transmits the image data to the system. The collected image data is analyzed through the built-in algorithm of the system to identify the image data of the project site under the same project status, and the image data of the project site under the same project status is employed to build the real 3D model (C) of the project site in this project status.

Further, in step (S3) of this embodiment, the collection of the image data of the project site based on the multiple camera units (B) is performed by automatic collection or manual collection. With respect to the automatic collection, the image data of the project site is automatically collected and uploaded to the system in real time according to the collection frequency and photography parameters preset in step (S2). For the manual collection, the camera units (B) are manually and remotely controlled according to specific time and location requirements to synchronously collect the image data of the project site and transmit it to the system.

In this embodiment, the camera units (B) can be, but are not limited to artificial intelligence (AI) camera. The AI camera can intelligently recognize and process the collected image data of the project site at the collection end in real time. By analyzing the characteristic change of the same target object at different moments (project status), the change of the target object during this period can be identified, and the compliance of the target object is indirectly determined. Then the compliant target object and the image data of its changes are transmitted to the system to accelerate the analysis and modeling.

In an embodiment, the step (S4) is specifically performed as follows.

(S41) Identification of construction object and surface feature object in the real 3D model (C) is performed.

Specifically, the identification can be performed by human-computer interaction or machine learning.

The foregoing construction object includes at least one of terrain surface, excavation surface, building structure type, and electromechanical device, and the surface feature object includes at least one of personnel, machinery, and stockpile.

(S42) The identified construction object is associated with the project design object.

Specifically, the project design object defined in the benchmark model (A) is automatically associated with the construction object identified in the real 3D model (C) according to the attribute information, location, etc., to form a one-to-one correspondence.

(S43) The project status of the associated construction object is compared with that of the project design object, and at the same time, whether the unassociated surface feature object exists in the benchmark model (A) is determined, so as to complete the difference analysis between the real 3D model (C) and the benchmark model (A).

Specifically, the comparison in the step (S43) can be made by human-computer interaction geometric measurement or machine identification.

In this embodiment, before the step (S43), the number, position coordinates, geometric shape, size and occurrence of the construction object are analyzed and calculated, where the occurrence refers to the position where the construction object is formed and the relationship with the surrounding area.

Further, the difference analysis between the real 3D model (C) and the benchmark model (A) includes object existence difference analysis, appearance difference analysis, and geometry difference analysis.

The foregoing object existence difference analysis includes: determining whether the project design object in the benchmark model (A) exists in the real 3D model (C); determining whether the construction object and the surface feature object in the real 3D model (C) exist in the benchmark model (A); and determining the differences between the associated construction object in the real 3D model (C) and the project design object in the benchmark model (A) in type and quantity. By analyzing the object existence difference between the real 3D model (C) and the benchmark model (A), the analysis and monitor of the project progress, project outlook, resource input, and safety risk assessment can be implemented.

The foregoing appearance difference analysis includes: determining the difference between the associated construction object in the real 3D model (C) and the project design object in the benchmark model (A) in color and appearance. By analyzing the appearance difference between the real 3D model (C) and the benchmark model (A), the process and water seepage function of the project can be analyzed and monitored.

The foregoing geometry difference analysis includes determining the difference between the associated construction object in the real 3D model (C) and the project design object in the benchmark model (A) in number, position coordinates, geometric shape, size and appearance. By analyzing the geometry difference between the real 3D model (C) and the benchmark model (A), the project design object positioning, overbreak and underbreak of excavation surface, ground subsidence, structural deformation, and project progress can be analyzed and monitored.

In an embodiment, the method further includes the following steps after the step (S5).

(S6) Early warning of project status of project site

If the monitoring results of the project status of the project site do not meet the preset requirements, an early warning is issued.

Specifically, in this embodiment, the steps (S5) and S6 are described as follows. According to the difference part and difference data between the real 3D model (C) and the benchmark model (A) obtained through the comparison in the step (S4), the project status corresponding to the difference part and the difference data is determined. Then according to the difference data obtained by comparing the benchmark model (A) and the real 3D model (C) at a certain moment (a certain project status) or the difference variation trend and the difference variation speed obtained by comparing the real 3D model (C) and the benchmark model (A) at multiple moments (multiple project statuses), the monitoring of the project status is enabled, and when the difference data exceeds a preset threshold or the difference variation trend and the difference variation speed exceed a preset control range, the system automatically generates an early warning.

More specifically, when the comparison between the benchmark model (A) and the real 3D model (C) is made at a certain moment (a certain project status), the existence and appearance of the associated construction object and project design object are analyzed, and the differences between the associated construction object and the project design object in position coordinates, geometry, size, occurrence and quantity are calculated. In this case, if the analysis result is abnormal or the calculation result exceeds the preset threshold, the system will automatically generate the project status warning. When the comparison between the real 3D model (C) and the benchmark model (A) is made at multiple moments (multiple project statuses), the variation trend and speed of the differences between the associated construction object and the project design object in position coordinates, geometry, size, occurrence and quantity are analyzed and calculated. In this case, if the

difference variation trend and the difference variation speed exceed the preset control range, the system will automatically issue an early warning, enabling the monitoring and early warning of the project status.

Referring to Fig. 1, an embodiment of the disclosure also provides a system for monitoring project status based on multiple camera units, which includes a first module 100, a second module 200, a third module 300; a fourth module 400 and a fifth 500. The first module 100 is configured to load the equal-scale BIM 3D model of the project design into the system as a benchmark model (A); the second module 200 is configured to perform virtual layout of the multiple camera units (B) based on the benchmark model (A) so as to determine the layout position and attribute setting of the multiple camera units (B), meanwhile, the second module 200 is perform actual layout and debugging of the multiple camera units (B) at the project site corresponding to the benchmark model (A) according to the layout position and attribute setting of the multiple camera units (B); the third module 300 is configured to perform multi-dimensional and real-time collection of the image data of the project site based on the multiple camera units (B) and transmit the image data to the system, and is also configured to analyze the collected image data by the built-in algorithm of the system to build a real 3D model (C) of the project site; the fourth module 400 is configured to compare the real 3D model (C) with the benchmark model (A) so as to analyze the differences therebetween; the fifth module 500 is configured to determine the change of the project status of the project site based on results of the difference analysis between the real 3D model (C) and the benchmark model (A), so as to monitor the project status of the project site.

In an embodiment, the system also includes a sixth module 600, which is configured to issue an early warning when the monitoring results of the project status of the project site do not meet the preset requirements.

Referring to Figs. 2-6, a tunnel excavation project is exemplarily illustrated.

(S1) As shown in Fig. 3, a benchmark model (A) of a tunnel is loaded via the first module 100, and a top surface type of the tunnel is defined as the tunnel excavation surface (i.e., project design object).

(S2) As shown in Figs. 5 and 6, the virtual layout of the multiple camera units (B) is performed via the second module 200 so as to determine the layout location, model, collection frequency and photography parameters of the multiple camera units (B). According to the location and model

determined above, the corresponding camera units (B) are purchased, and installed at the corresponding location in the tunnel. Meanwhile, the corresponding camera units (B) are debugged according to the determined collection frequency and photography parameters.

In the process of virtual layout of the multiple camera units (B), in order to ensure the optimal monitoring and early warning effect of the tunnel excavation, it is required to simulate the tunnel in terms of different directions and depths so as to achieve complete coverage of the tunnel and overlapping sampling and eliminate the dead corner of the tunnel. In the actual installation of the multiple camera units (B), it is feasible to offset the installation position or add new installation positions according to the excavation status of the tunnel site to optimize the collection effect and coverage of the camera units (B) and make the camera units (B) less affected by the environmental and construction factors. The shaded part in Figs. 5-6 represents the coverage range of the camera units (B).

(S3) As shown in Figs. 4-6, the multiple camera units (B) used herein are AI cameras, which can perform the comprehensive, intelligent and automatic collection and data analysis of the image data inside the tunnel according to the layout location, preset collection frequency and photography parameters, and transmit the image data to the system. Additionally, these AI cameras also support the manual remote control, and can collect the image data of the specified location in the tunnel at the specified time, and transmit the data to the system. Then the image data collected and transmitted at the same time is filtered out via the third module 300, and processed and calculated by means of the built-in algorithm of the system to automatically generate the tunnel real 3D model (C) at this moment, thereby obtaining the real 3D model (C) of the tunnel at all moments.

(S4) Based on the benchmark model (A) loaded in step (S1) and the real 3D model (C) generated in step (S3), the identification, association and comparative analysis of the target object are performed via the fourth module 400.

(1) The target object identification refers to the identification of construction objects (such as tunnel excavation surface) and surface feature objects (such as personnel and equipment) in the real 3D model (C).

(2) In the target object association, the construction objects in the real 3D model (C) are associated with the project design objects in the benchmark model (A) to form a corresponding mapping relationship.

(3) The target object comparative analysis includes: calculating the number, position coordinates, geometry, size and occurrence of construction objects in the real 3D model (C); determining the differences between the associated construction object in the real 3D model (C) and the project design objects in the benchmark model (A) in number, position coordinates, geometry, size and occurrence, where the differences reflect the geometric variation of the tunnel excavation project; and identifying and analyzing the newly added surface feature objects in the real 3D model (C) to show the variation difference in the object existence in different construction stages of the tunnel excavation project. The partial difference can be manually determined by human-computer interaction geometric measurement and comparison, and the data of the same part of the artificially calculated real 3D model (C) and the benchmark model (A) can be compared to analyze the difference.

(S5) Based on a comparison between the real 3D model (C) and the benchmark model (A) in the step S4, the difference part, difference data, difference variation trend and difference variation speed are analyzed via the fifth module and the sixth module to determine a change of the project status. Through the combination of time dimension, the analysis results can be used to simulate an actual excavation progress of the tunnel excavation project, and the tunnel excavation process is fully displayed in the system to monitor the tunnel excavation project in real time. Meanwhile, when the difference data between the real 3D model (C) and the benchmark model (A) exceeds the preset threshold or the difference variation trend and the difference variation speed exceed the preset control range, the system automatically generates an early warning to remind relevant responsible persons and relevant departments to check and correct deviations.

In addition, the object existence difference analysis, such as a positioning of construction person and equipment, is performed to determine whether the construction personnel enter the restricted area illegally or the equipment is placed illegally, such that a safety risk estimation, monitoring and early warning of the tunnel excavation project are performed. A numerical analysis of the surface feature object is performed to determine a rationality of human and material resource input in the tunnel excavation project, and guide a compliant and civilized construction. Position coordinates, geometric shape, size and appearance of the tunnel excavation surface are analyzed to analyze a project progress of the tunnel excavation project and overbreak-underbreak of excavation surface, and when a difference between the actual excavation volume and the preset excavation

volume exceeds a reasonable value, the system generates an early warning. A color of the tunnel excavation surface in the real 3D model (C) at different moments (project status) is analyzed to determine the water seepage condition of the tunnel excavation surface, such that the monitoring and early warning of the tunnel leakage are performed.

A real-time monitoring and early warning of the tunnel excavation project are performed by the foregoing five steps.

In the method provided herein, the multi-dimensional and real-time collection of the image data of the project site is performed based on the multiple camera units (B), and then the collected image data is analyzed via the built-in algorithm of the system to build the real 3D model (C) of the project site; and the real 3D model (C) is compared with the benchmark model (A) to analyze the difference between the real 3D model (C) and the benchmark model (A) to determine the change of the project status of the project site, thereby completing the multi-dimensional and real-time monitoring of the project status of the project site. As a consequence, the method of the disclosure can effectively assist the monitoring of the project site, and facilitates enabling the comprehensive and precise monitoring of the project status.

The technical features of the above embodiments can be combined arbitrarily. In order to simplify the description, only some combinations of the technical features in the above embodiments are described herein. However, it should be understood that as long as there is no contradiction in the combination of these technical features, such a combination should be considered to fall within the scope of the disclosure.

Described above are merely preferred embodiments of the disclosure, which are illustrative of the technical solutions of the disclosure and are not intended to limit the disclosure. It should be noted that any modifications and improvements made by those skilled in the art without departing from the spirit of the disclosure should fall within the scope of the disclosure defined by the appended claims.

CLAIMS

What is claimed is:

1. A method for monitoring project status based on multiple camera units, comprising:

loading an equal-scale building information modeling (BIM) 3D model of a project design into a system as a benchmark model;

performing virtual layout of the multiple camera units based on the benchmark model to determine layout location, number and attribute setting of the multiple camera units; the layout location, number and attribute setting of the multiple camera units are simulated based on the benchmark model so that different types of camera units can be integrated at the same time, and the collection frequency and photography parameters of different camera units can be adjusted to select a combination of multiple camera units with the widest coverage, highest collection efficiency, better durability, and lower cost by the virtual layout, then according to the layout location, number and the attribute setting of the multiple camera units, performing actual layout and debugging of the multiple camera units at a project site corresponding to the benchmark model;

performing multi-dimensional and real-time collection of an image data of the project site based on the multiple camera units and transmitting the image data of the project site to the system; and analyzing the image data of the project site via a built-in algorithm of the system to build a real 3D model of the project site;

comparing the real 3D model with the benchmark model to complete difference analysis between the real 3D model and the benchmark model; and

determining change of a project status of the project site based on results of the difference analysis between the real 3D model and the benchmark model, so as to monitor the project status of the project site.

2. The method of claim 1, further comprising:

after the equal-scale BIM 3D model is loaded as the benchmark model, defining

a type of a project design object in the benchmark model according to an attribute information of the equal-scale BIM 3D model.

3. The method of claim 2, wherein the type of the project design object comprises at least one of terrain surface, excavation surface, building structure type, and electromechanical device.

4. The method of claim 2, wherein the comparison between the real 3D model and the benchmark

model is performed through steps of:

identifying a construction object and a surface feature object in the real 3D model;

associating the identified construction object with the project design object; and

comparing a project status of the construction object with the project status of the project design object, and determining whether the surface feature object exists in the benchmark model, so as to complete the difference analysis between the real 3D model and the benchmark model.

5. The method of claim 4, wherein the difference analysis between the real 3D model and the benchmark model comprises object existence difference analysis, appearance difference analysis and geometric shape difference analysis.

6. The method of claim 4, wherein the comparison between the real 3D model and the benchmark model further comprises:

before the difference analysis between the real 3D model and the benchmark model, analyzing and calculating the number, position coordinate, geometric shape, size and occurrence of the construction object.

7. The method of claim 1, wherein the attribute setting of the multiple camera units is determined through a step of:

determining a model, collection frequency and photography parameters of the multiple camera units.

8. The method of claim 1, wherein the multi-dimensional and real-time collection of the image data of the project site based on the multiple camera units is performed by automatic collection or manual collection.

9. The method of claim 1, further comprising:

after the monitoring of the project status of the project site, generating an early warning if monitoring results of the project status of the project site do not meet preset requirements.

10. A system for monitoring project status based on multiple camera units, comprising:

- a first module;
- a second module;
- a third module;
- a fourth module; and
- a fifth module;

wherein the first module is configured to load an equal-scale BIM 3D model of a project design into a system as a benchmark model;

the second module is configured to perform virtual layout of the multiple camera units to determine layout location, number and attribute setting of the multiple camera units, the layout location, number and attribute setting of the multiple camera units are simulated based on the benchmark model so that different types of camera units can be integrated at the same time, and the collection frequency and photography parameters of different camera units can be adjusted to select a combination of multiple camera units with the widest coverage, highest collection efficiency, better durability, and lower cost by the virtual layout, and the second module is also configured to perform the actual layout and debugging of the multiple camera units at a project site corresponding to the benchmark model according to the layout location and the attribute setting of the multiple camera units;

the third module is configured to perform multi-dimensional and real-time collection of an image data of the project site based on the multiple camera units and transmit the image data to the system, and to analyze the image data via a built-in algorithm of the system to build a real 3D model of the project site;

the fourth module is configured to compare the real 3D model with the benchmark model to complete difference analysis between the real 3D model with the benchmark model; and

the fifth module is configured to determine change of the project status of the project site based on results of the difference analysis between the real 3D model and the benchmark model, so as to monitor the project status of the project site.