

[DESCRIPTION]

[Invention Title]

CRACK DETECTION MONITORING DEVICE

[Technical Field]

The present disclosure relates to a crack detection monitoring device, and more particularly, to a crack detection monitoring device capable of detecting a crack in multiple stages.

[Background Art]

In general, cracks in and collapses of structures such as bridges and buildings as well as embankments and rocks often cause major damage. Cracks may be caused by an external impact, such as an earthquake or ground failure, or by the building itself, such as aging or poor construction. Cracks are small at first, but when the cracks gradually grow and reach a predetermined limit, the cracks may cause the collapse of the structure or rock.

Visual inspection is performed to detect these cracks, or a sensor is used to identify initial cracks.

However, there is a problem with this method in that this method only identifies the initial crack, and it is difficult to identify cracks at each stage of crack propagation in case that cracks further propagate.

In addition, in this regard, Korean Patent No. 10-1684375 (registered on December 2, 2016) has been proposed.

[Disclosure]

[Technical Problem]

The present disclosure has been made in response to the above-mentioned background technology, and an object of the present disclosure is to provide a crack detection monitoring device.

[Technical Solution]

To achieve the above-mentioned object, a crack detection monitoring device may include: a hollow housing member; first and second fixing members each having a lower portion installed on a structure, and an upper portion inserted into the housing member; a connection member provided on a lower surface in the housing member; at least one or more movable members coupled to the connection member and configured to move in response to a change in width between the first and second fixing members that is caused by a crack in the structure; and at least one or more detection units provided in the housing member and provided to respectively correspond to the at least one or more movable members.

Alternatively, the housing member may include: a first opening portion having an area corresponding to a cross-sectional area of the first fixing member and provided in a first region of a lower portion of the housing member and the first fixing member is inserted into the first opening portion; and a second opening portion having an area larger than a cross-sectional area of the second fixing member provided in a second region of the lower portion of the housing member and the second fixing member is inserted into the second opening portion.

Alternatively, the at least one or more movable members may include: at least one or more vertical movable bodies coupled to one side of the connection member in a direction perpendicular to the connection member; and at least one or more horizontal movable bodies each provided at the other side of each of the at least one or more vertical movable bodies.

Alternatively, the at least one or more movable members may include at least one or more rotary bodies configured to connect each of the at least one or more horizontal movable bodies to each of the at least one or more vertical movable bodies so that the at

least one or more horizontal movable bodies are rotatable.

The crack detection monitoring device may further include: a fixing clip member coupled to an outer surface of the housing member and installed on the structure.

Alternatively, the housing member may have coupling grooves having predetermined depths formed at two opposite sides of the outer surface, the fixing clip member may have a U shape, fixing protrusions may be respectively formed on two opposite inner surfaces of the fixing clip member and coupled to the coupling grooves, and a lower portion of the fixing protrusion may be installed on the structure.

To achieve the above-mentioned object, a crack detection monitoring device may include: a hollow housing member; first and second fixing members each having a lower portion installed on a structure, and an upper portion inserted into the housing member; a connection member provided on a lower surface in the housing member; a plurality of movable members coupled to the connection member and configured to move in response to a change in width between the first and second fixing members that is caused by a crack in the structure; and a plurality of detection units provided in the housing member and provided to respectively correspond to the plurality of movable members.

Alternatively, the plurality of movable members may be spaced apart from one another at predetermined intervals.

Alternatively, the plurality of movable members may be provided rearward of the second fixing member and spaced apart from one another at predetermined intervals, and the rearward direction of the second fixing member may be a direction that is not directed toward the first fixing member from the second fixing member.

Alternatively, the plurality of movable members may have different lengths.

Alternatively, the plurality of detection units may be provided on the same vertical line.

Alternatively, the plurality of movable members may have lengths corresponding to one another.

Alternatively, the plurality of detection units may be different in positions.

To achieve the above-mentioned object, a crack detection monitoring system may include: the crack detection monitoring device according to any one of claims 1 to 13; a relay device configured to receive a signal transmitted from the crack detection monitoring device; a network device configured to receive the signal transmitted from the relay device; and an application device configured to receive the signal transmitted from the network device, analyze the signal, store the signal as processing data, and provide the processing data to an external device.

[Advantageous Effects]

The present disclosure may provide a crack detection monitoring device capable of detecting a crack in multiple stages.

[Description of Drawings]

FIG. 1 is a block diagram illustrating a crack detection monitoring system according to an embodiment of the present disclosure.

FIG. 2 is a block diagram illustrating a crack detection monitoring device according to the embodiment of the present disclosure.

FIG. 3 is a view illustrating a front surface of the crack detection monitoring device according to the embodiment of the present disclosure.

FIG. 4 is a view illustrating an upper surface of the crack detection monitoring device according to the embodiment of the present disclosure.

FIG. 5 is a view illustrating a fixing clip member of the crack detection monitoring device according to the embodiment of the present disclosure.

FIGS. 6 and 7 are views illustrating internal cross-sections of the crack detection

monitoring device according to the embodiment of the present disclosure.

[Best Mode]

Various embodiments and/or various aspects will be disclosed with reference to the drawings. In the following descriptions, for explanation, multiple specific details are disclosed in order to provide overall understandings of one or more aspects. However, it will also be appreciated by those skilled in the art that this aspect(s) may be practiced without these specific details. The following descriptions and the accompanying drawings are provided for disclosing specific exemplary aspects of the one or more aspects in detail. However, these aspects are exemplary. Thus, some of the various methods in the principles of the various aspects may be used, and the descriptions are intended to include all such aspects and their equivalents. Specifically, "embodiment", "example", "aspect", "exemplary embodiment" and the like used in this specification may not be construed as any aspect or design described being better or more advantageous than other aspects or designs.

Hereinafter, the same or similar constituent elements are assigned with the same reference numerals regardless of reference numerals, and the repetitive description thereof will be omitted. In addition, in the description of the embodiment disclosed in the present specification, the specific descriptions of publicly known related technologies will be omitted when it is determined that the specific descriptions may obscure the subject matter of the embodiment disclosed in the present specification. In addition, the accompanying drawings are provided only to allow those skilled in the art to easily understand the embodiments disclosed in the present specification, and the technical spirit disclosed in the present specification is not limited by the accompanying drawings.

Unless otherwise defined, all terms (including technical and scientific terms) used in the present specification may be used as the meaning which may be commonly

understood by the person with ordinary skill in the art, to which the present disclosure belongs. In addition, terms defined in a generally used dictionary shall not be construed in ideal or excessively formal meanings unless they are clearly and specially defined in the present specification.

Moreover, the term "or" is intended to mean not an exclusive "or" but an inclusive "or". That is, unless specified or clear in context, "X uses A or B" is intended to mean one of the natural implicit substitutions. That is, "X uses A or B" can be applied to any of the cases where X uses A, X uses B, or X uses both A and B. Moreover, it is to be understood that the term "and/or" used in this specification refers to and includes all possible combinations of one or more of the listed related items.

It is to be understood that the terms "comprise (include)" and/or "comprising (including)" mean that the feature and/or a component is provided, but the presence or addition of one or more other features, other components and/or groups thereof are not excluded. In addition, unless specified or clear in the context of indicating a singular form, the singular in this specification and claims should generally be construed to mean "one or more".

Further, "at least one of A and B" should be interpreted as meaning a case in which "only A is included", a case in which "only B is included", and a case in which "A and B are combined".

When one constituent element is described as being "connected" or "coupled" to another constituent element, it should be understood that one constituent element can be connected or coupled directly to another constituent element, and an intervening constituent element can also be present between the constituent elements. When one constituent element is described as being "connected directly to" or "coupled directly to" another constituent element, it should be understood that no intervening constituent

element is present between the constituent elements.

The suffixes "module" and "unit" used to describe some constituent elements in the following description are used together or interchangeably in order to facilitate the description, but the suffixes themselves do not have distinguishable meanings or functions.

Objects and effects of the present disclosure and technical constituent elements for achieving the objects and effects will be clear with reference to the embodiments described in detail below together with the accompanying drawings. In addition, in the description of the present disclosure, the specific descriptions of publicly known functions or configurations will be omitted when it is determined that the specific descriptions may unnecessarily obscure the subject matter of the present disclosure. In addition, the terms used herein are defined considering the functions in the present disclosure and may vary depending on the intention or usual practice of a user or an operator.

However, the present disclosure is not limited to the embodiments disclosed herein but will be implemented in various forms. The embodiments of the present disclosure are provided so that the present disclosure is completely disclosed, and a person with ordinary skill in the art can fully understand the scope of the present disclosure. The present disclosure will be defined only by the scope of the appended claims. Therefore, the definition of the present disclosure should be made based on the entire contents of the present specification.

FIG. 1 is a block diagram illustrating a crack detection monitoring system according to an embodiment of the present disclosure.

With reference to FIG. 1, the crack detection monitoring system may include a crack detection monitoring device 100, a relay device 200, a network device 300, an

application device 400, and a network. However, to implement the crack detection monitoring system, the above-mentioned constituent elements may be larger or smaller in number than the constituent elements listed above.

The crack detection monitoring device 100 may be installed in a structure, detect a crack formed in the structure, generate a signal, and transmit the signal to the relay device 200 through the network.

In this case, one or more crack detection monitoring devices 100 may be provided to be respectively installed in one or more structures.

The crack detection monitoring device 100 will be specifically described in detail with reference to FIGS. 2 to 7.

With reference back to FIG. 1, the relay device 200 may receive the signal transmitted from the crack detection monitoring device 100.

In this case, the relay device 200 may receive signals from the one or more crack detection monitoring devices 100 and transmit the received signals to the network device 300 through the network.

In addition, one or more relay devices 200 may be provided, and the relay device 200, which is closest to the crack detection monitoring device 100, may receive the signal transmitted from the crack detection monitoring device 100. For example, when a first relay device and first to tenth crack detection monitoring devices are provided in a first zone and a second relay device and eleventh to twentieth crack detection monitoring devices are provided in a second zone, the first relay device, which is provided in the same zone as the first to tenth crack detection monitoring devices, may receive the signals transmitted from the first to ten crack detection monitoring devices, and the second relay device, which is provided in the same zone as the eleventh to twentieth crack detection monitoring device, may receive the signals transmitted from the eleventh to twentieth

crack detection monitoring devices.

The specific description of the relay devices and the crack detection monitoring devices is for illustrative purpose only, but the present disclosure is not limited thereto.

The network device 300 may receive the signals transmitted from the one or more relay devices 200 and transmit the received signals to the application device 400.

In this case, the network device 300 may set a data transmission rate of each of the one or more relay devices 200 differently depending on the state of the network. For example, in case that the network in the first zone is unstable, the network device 300 may set the data transmission rate of the first relay device provided in the first zone to the predetermined rate or lower. In case that the network in the second zone is stable, the network device 300 may relatively quickly set the data transmission rate of the second relay device provided in the second zone in comparison with the first relay device.

The specific description of the relay devices and the network devices is for illustrative purpose only, but the present disclosure is not limited thereto.

The application device 400 may receive a signal transmitted from the network device 300, analyze the signal, store the signal as processing data, and provide the processing data to an external device.

In this case, the application device 400 may extract at least one piece of information on the crack detection monitoring device 100 from the processing data through a user interface and display the information in case that the processing data are provided to the external device. For example, the application device 400 may divide the processing data into installation zones, installation information, collected information, notification setting, and data management of the crack detection monitoring device 100 and display the installation zones, the installation information, the collected information, the notification setting, and the data management of the crack detection monitoring device

100 on the user interface.

The specific description of the user interface of the application device is for illustrative purpose only, but the present disclosure is not limited thereto.

In addition, the network may include any type of wired/wireless communication network configured to transmit or receive any type of data and signals.

The crack detection monitoring device 100 will be described in detail below.

FIG. 2 is a block diagram illustrating the crack detection monitoring device according to the embodiment of the present disclosure. FIG. 3 is a view illustrating a front surface of the crack detection monitoring device according to the embodiment of the present disclosure. FIG. 4 is a view illustrating an upper surface of the crack detection monitoring device according to the embodiment of the present disclosure. FIG. 5 is a view illustrating a fixing clip member of the crack detection monitoring device according to the embodiment of the present disclosure. FIGS. 6 and 7 are views illustrating internal cross-sections of the crack detection monitoring device according to the embodiment of the present disclosure.

With reference to FIG. 2, the crack detection monitoring device 100 may include a housing member 110, a first fixing member 120, a second fixing member 130, a connection member 140, one or more movable members 150, one or more detection units 160, a central processing unit 170, a communication unit 180, and a power source unit 190. However, to implement the crack detection monitoring device 100, the above-mentioned constituent elements may be larger or smaller in number than the constituent elements listed above.

In this case, in the crack detection monitoring device 100, other components 120 to 190 provided, inserted, or coupled in the housing member 110. For example, the first fixing member 120 and the second fixing member 130 may be inserted into the housing

member 110. The connection member 140 may be provided on a lower surface in the housing member. The first fixing member 120, the second fixing member 130, and the one or more movable members 150 are coupled to the connection member 140. The one or more detection units 160, the central processing unit 170, the communication unit 180, and the power source unit 190 may be provided in the housing member 110 so as to be connected to one another.

Further, the crack detection monitoring device 100 may be installed in a structure and detect a crack formed in the structure. For example, when a crack is formed in the structure between the first fixing member 120 and the second fixing member 130, a width between the first fixing member 120 and the second fixing member 130 is changed by the crack in the structure. As the width changes, the second fixing member 130 moves, and the connection member 140 connected to the second fixing member 130 also moves, such that the one or more movable members 150 connected to the connection member 140 may also move. Therefore, the one or more movable members 150 may come into contact with the one or more detection units 160 while moving. When the one or more detection units 160 transmit the signals to the central processing unit 170, the central processing unit 170 processes the signals to transmit the signals to the external device and transmit the processed signals to the external device through the communication unit 180.

However, to implement the crack detection monitoring device 100, the above-mentioned constituent elements may be larger or smaller in number than the constituent elements listed above.

The components of the crack detection monitoring device 100 will be described in detail below.

With reference to FIGS. 3 and 4, the housing member 110 may be formed in a hollow shape and made of a waterproof material (e.g., plastic, rubber, etc.) having a

predetermined strength to withstand the external impact.

In this case, the housing member 110 may include coupling grooves 111 and housing bolts 112.

The coupling grooves 111 may be formed at two opposite sides of an outer surface of the housing member 110 and has a predetermined depth (e.g., 1 cm). A fixing clip member 10 to be described below may be coupled to the coupling grooves 111.

In this case, the coupling groove 111 may be concavely recessed inward.

At least one of the housing bolts 112 is coupled to an upper surface of the housing member 110 and increases a coupling force of the housing member 110. In this case, at least one housing hole may be formed in an upper portion of the housing member 110, and the housing bolt 112 is coupled to the housing hole. The housing bolts 112 may correspond in number to the housing holes.

In this case, a first screw thread may be formed on an inner surface of the housing hole, and a second screw thread may be formed on an outer surface of the housing bolt 112 so as to correspond to the first screw thread. When the housing bolt 112 is inserted and coupled into the housing hole, the first screw thread of the housing hole engages with the second screw thread of the housing bolt 112, thereby increasing a coupling force.

In this case, the housing member 110 may have an integrated shape, and the at least one housing hole may be formed in the upper portion of the housing member 110. According to another embodiment, a separable cover may be separately provided on the housing member 110, and the at least one housing hole is formed in the upper portion of the housing member 110. A cover hole is formed in the cover and provided at a position corresponding to the housing hole, such that the at least one housing bolt 112 may be coupled to the housing hole while penetrating the cover hole.

The specific description of the housing member is for illustrative purpose only,

but the present disclosure is not limited thereto.

With reference to FIG. 5, the crack detection monitoring device 100 may include the fixing clip member 10.

The fixing clip member 10 may be coupled to the outer surface of the housing member 110 and installed on the structure. More specifically, the fixing clip member 10 may have a U shape, and fixing protrusions 11 may be respectively formed on two opposite inner surfaces of the fixing clip member 10. The fixing protrusion 11 is coupled to the coupling groove 111 of the housing member 110. A lower portion of the fixing clip member may be installed on the structure.

In this case, a clip opening portion 12 is formed in the lower portion of the fixing clip member 10, and a clip bolt may be fixed to the structure while penetrating the clip opening portion 12. In addition, the clip bolt may be provided in the form of a screw. An upper portion of the clip bolt may be fixed to the clip opening portion 12, and a lower portion of the clip bolt may be fixed to the structure, such that the fixing clip member 10 may be installed on the structure.

With reference to FIG. 6, the housing member 110 may include a first opening portion 113, a second opening portion 114, and a housing fixing ring 115.

The first opening portion 113 may have an area corresponding to a cross-sectional area of the first fixing member 120 and be provided in a first region of a lower portion of the housing member 110. The first fixing member 120 may be inserted into the first opening portion 113.

The second opening portion 114 may have an area larger than a cross-sectional area of the second fixing member 130 and be provided in a second region of the lower portion of the housing member 110. The second fixing member 130 may be inserted into the second opening portion 114.

In this case, because the area of the second opening portion 114 is larger than the cross-sectional area of the second fixing member 130, the connection member 140 and the movable member 150 move as the second fixing member 130 moves in case that a crack is formed in the structure, such that the movable member 150 may come into contact with the detection unit 160, and a signal related to the occurrence of the crack may be generated.

In addition, the first region may be a left lower region based on a boundary in case that a boundary is defined in a vertical direction at a center of the housing member 110.

Further, the second region may be a right lower region based on the boundary in case that the boundary is defined in the vertical direction at the center of the housing member 110.

To improve durability of the housing member 110, the housing fixing ring 115 may be provided on or coupled to an inner surface of the upper portion of the housing member 110, and the housing fixing ring 115 may be made of an elastic material (e.g., rubber) and have a ring shape so as to surround the housing member 110 in a horizontal direction.

The first fixing member 120 may be inserted into the housing member 110 through the first opening portion 113 and include a first fixing part 121, a first fixing nut 122, and a first fixing ring 123.

The first fixing part 121 is formed in a column (e.g., quadrangular column, circular column) shape. A lower portion of the first fixing part 121 is installed on the structure, and an upper portion of the first fixing part 121 may be inserted into the housing member 110 through the first opening portion 113.

The first fixing nut 122 may be coupled to the upper portion of the first fixing

part 121 and fix the first fixing part 121 in the housing member 110.

The first fixing ring 123 may be coupled to the upper portion of the first fixing part 121 and provided between the first fixing part 121 and the first fixing nut 122, thereby increasing a coupling force between the first fixing part 121 and the first fixing nut 122.

The second fixing member 130 may be inserted into the housing member 110 through the second opening portion 114 and include a second fixing part 131, a second fixing nut 132, and a second fixing ring 133.

The second fixing part 131 is formed in a column (e.g., quadrangular column, circular column) shape. A lower portion of the second fixing part 131 is installed on the structure, and an upper portion of the second fixing part 131 may be inserted into the housing member 110 through the second opening portion 114.

The second fixing nut 132 may be coupled to the upper portion of the second fixing part 131 and fix the second fixing part 131 to the connection member 140.

The second fixing ring 133 may be coupled to the upper portion of the second fixing part 131 and provided between the second fixing part 131 and the second fixing nut 132, thereby increasing a coupling force between the second fixing part 131 and the second fixing nut 132.

The connection member 140 may be provided or coupled onto the lower surface in the housing member 110.

In this case, the connection member 140 may have a plate shape and be coupled to the second fixing member 130. A predetermined area of the connection member 140 may be formed as an empty space in a space in which the second fixing member 130 moves, such that the second fixing member 130 may smoothly move along a crack. More specifically, the empty space may be formed to correspond to the area of the second opening portion 114.

With reference to FIG. 7, the movable member 150 may be coupled to the connection member 140 and move in response to a change in width between the first fixing member 120 and the second fixing member 130 that is caused by a crack in the structure.

According to the embodiment of the present disclosure, one or more movable members 150 may be provided. The one or more movable members 150 may include one or more vertical movable bodies 151, one or more horizontal movable bodies 152, and one or more rotary bodies 153.

One side of each of the one or more vertical movable bodies 151 may be coupled to the connection member 140 in a direction perpendicular to the connection member 140.

The one or more horizontal movable bodies 152 may each be provided at the other side of each of the vertical movable bodies 151.

The one or more rotary bodies 153 may each connect each of the one or more horizontal movable bodies 152 to each of the one or more vertical movable bodies 151 so that the one or more horizontal movable bodies 152 are rotatable. Specifically, in case that the one or more vertical movable bodies 151 move as the second fixing member 130 moves, the one or more horizontal movable bodies 152 may respectively come into contact with the corresponding one or more detection units 160 while rotating.

The specific description of the one or more rotary bodies 153 is for illustrative purpose only, but the present disclosure is not limited thereto.

The detection units 160 may be provided in the housing member 110 while corresponding to the one or more movable members 150. For example, when the number of movable members 150 is 1, the number of detection units 160 is 1. When the number of movable members 150 is 5, the number of detection units 160 is 5. Therefore, the detection units 160 may correspond in number to the movable members 150.

In this case, the detection unit 160 may be connected to at least one inner surface of the housing member 110 (e.g., an upper surface in the housing member 110, a lower surface in the housing member 110, or a lateral surface in the housing member 110) and positioned in one space in the housing member 110.

In addition, the detection unit 160 may include a switch or sensor. The detection unit 160 may include a signal generator that generates a signal when the movable member 150 comes into contact with the switch or sensor.

In this case, the switch may include a body, a pin, and a spring. A lower portion of the pin is inserted into the body, and an upper portion of the pin is coupled to protrude to the outside of the body, such that the pin moved upward or downward by external pressure. Further, the spring may be coupled between the body and the pin and move the pin, which has been moved downward by pressure, to an original position. For example, when the movable member 150 comes into contact with the pin of the switch, the pin is moved downward by pressure. When the pin is moved downward, the signal generator may generate a signal and transmit the signal to the central processing unit 170.

The specific description of the switch of the detection unit 160 is for illustrative purpose only, but the present disclosure is not limited thereto.

According to another embodiment of the present disclosure, the movable member 150 may be provided as a plurality of movable members 150, the detection unit 160 may be provided as a plurality of detection units 160, and the plurality of movable members 150 may be spaced apart from one another at predetermined intervals. More specifically, the plurality of movable members 150 may be provided rearward of the second fixing member 130 and spaced apart from one another at predetermined intervals.

In this case, a forward direction of the second fixing member 130 may be a direction that is directed toward the first fixing member 120 of the second fixing member

130, and a rearward direction of the second fixing member 130 may be a direction that is not directed toward the first fixing member 120 of the second fixing member 130.

According to a first embodiment of the present disclosure, the movable member 150 may be provided as a plurality of movable members 150, the detection unit 160 may be provided as a plurality of detection units 160, the plurality of movable members 150 has different length, and the plurality of detection units 160 may be provided on the same vertical line.

More specifically, in one embodiment, the plurality of vertical movable bodies 151 of the plurality of movable members 150 may have different lengths. The lengths of the plurality of horizontal movable bodies 152 correspond to one another. The plurality of detection units 160 may be provided on the same vertical line. The plurality of vertical movable bodies 151 may have different lengths, such that the plurality of corresponding detection units 160 may respectively come into contact with the plurality of vertical movable bodies 151 in response to critical values of widths of different cracks. For example, a first movable member, a second movable member, and a third movable member may be provided in order of proximity to the second fixing member 130, and the first vertical movable body, the second vertical movable body, and the third vertical movable body may be respectively designated to the first movable member, the second movable member, and the third movable member. In this case, when the second vertical movable body is longer than the first vertical movable body and the third vertical movable body is longer than the second vertical movable body, the first movable member may come into contact with the detection unit 160 that corresponds to the first movable member when a critical value of a width of a crack is 0.1 mm, the second movable member may come into contact with the detection unit 160 that corresponds to the second movable member when a critical value of a width of a crack is 0.3 mm, and the third

movable member may come into contact with the detection unit 160 that corresponds to the third movable member when a critical value of a width of a crack is 0.5 mm.

As another embodiment, the plurality of vertical movable bodies 151 of the plurality of movable members 150 may have lengths corresponding to one another, the plurality of horizontal movable bodies 152 may have different length, and the plurality of detection units 160 may be provided on the same vertical line. The plurality of horizontal movable bodies 152 may have different lengths, such that the plurality of corresponding detection units 160 may respectively come into contact with the plurality of horizontal movable bodies 152 in response to critical values of widths of different cracks. For example, a first movable member, a second movable member, and a third movable member may be provided in order of proximity to the second fixing member 130, and the first horizontal movable body, the second horizontal movable body, and the third horizontal movable body may be respectively designated to the first movable member, the second movable member, and the third movable member. In this case, when the second horizontal movable body is longer than the first horizontal movable body and the third horizontal movable body is longer than the second horizontal movable body, the first movable member may come into contact with the detection unit 160 that corresponds to the first movable member when a critical value of a width of a crack is 0.1 mm, the second movable member may come into contact with the detection unit 160 that corresponds to the second movable member when a critical value of a width of a crack is 0.3 mm, and the third movable member may come into contact with the detection unit 160 that corresponds to the third movable member when a critical value of a width of a crack is 0.5 mm.

As still another embodiment, the plurality of vertical movable bodies 151 of the plurality of movable members 150 may have different lengths, the plurality of horizontal

movable bodies 152 may have different length, and the plurality of detection units 160 may be provided on the same vertical line. The plurality of vertical movable bodies 151 and the plurality of horizontal movable bodies 152 may have different lengths, such that the plurality of corresponding detection units 160 may respectively come into contact with the plurality of vertical movable bodies 151 and the plurality of horizontal movable bodies 152 in response to critical values of widths of different cracks.

According to the second embodiment of the present disclosure, the movable member 150 may be provided as a plurality of movable members 150, the detection unit 160 may be provided as a plurality of detection units 160, the plurality of movable members 150 may have lengths corresponding to one another, and the plurality of detection units 160 may be different in positions.

More specifically, the plurality of movable members 150 may be positioned on the same vertical line of the housing member 110 when a horizontal length in FIG. 7 is defined as a horizontal length of the housing member 110, a width of the housing member 110 in FIG. 3, i.e., a vertical length in FIG. 4 is defined as a vertical length of the housing member 110, and a vertical length in FIG. 7 is defined as a vertical length of the housing member 110. Further, the plurality of detection units may be positioned differently depending on a critical value of a width of a crack.

Then, the plurality of movable members 150 moves in response to a change in width of the crack, and the plurality of detection units 160 is positioned differently depending on the critical value of the width of the crack, such that the plurality of movable members 150 may respectively come into contact with the plurality of detection units 160 depend on the critical values of the widths of the different cracks.

With reference back to FIG. 2, the central processing unit 170 may include a processor and a memory.

The processor may include one or more cores, process a signal received from the detection unit, and transmit the processed signal to the external device through the communication unit 180.

In addition, the processor may control the crack detection monitoring device 100 according to the embodiment of the present disclosure to read out a computer program stored in the memory, detect a crack, and transmit a signal.

Further, the processor may transmit a signal to the outside at a predetermined time (e.g., 10 minutes) by using a real-time clock. The processor may use a small amount of power from the power source unit by transmitting signals only at predetermined times.

A memory may store information in any form created or determined by the processor. In this case, the memory may include at least one storage medium among a flash type memory, a hard disc type memory, a multimedia card micro type memory, a card-type memory (e.g., an SD or XD memory), a random access memory (RAM), a static random access memory (SRAM), a read-only memory (ROM), an electrically erasable programmable read-only memory (EEPROM), a programmable read-only memory (PROM), a magnetic memory, a magnetic disc, and an optical disc. The description of the above-mentioned memory is for illustrative purposes only, and the present disclosure is not limited thereto.

The communication unit 180 may transmit the signal, which has been processed by the central processing unit 170, to the external device. Here, the communication unit 180 may include any communication aspect, such as wired and wireless communication and include various communication networks, such as a personal area network (PAN), a wide area network (WAN), and the like. In addition, the communication unit 180 may be the publicly-known World Wide Web (WWW) and may use wireless transmission

technologies, which are used for short-range communication, such as Infrared Data Association (IrDA) or Bluetooth. In addition, the communication unit 180 may include any type of wired/wireless communication network configured to be controlled by the control unit and transmit or receive any type of data and signals.

The power source unit 190 may include a power supply body (e.g., a battery or a rechargeable battery) and supply power to the central processing unit 170 through the power supply body. The power source unit 190 supplies power only in case that the central processing unit 170 is operated. In case that the central processing unit 170 is not operated, the power source unit 190 may reduce power consumption by allowing the state thereof to enter a sleep state.

Various embodiments discussed herein may be implemented as methods, devices, or articles manufactured by using standard programming and/or engineering techniques. The term "manufactured article" includes a computer program, carrier, or media accessible from any computer-readable storage device. For example, computer-readable storage media include, but are not limited to, magnetic storage devices (e.g., hard disks, floppy disks, magnetic strips, etc.), optical disks (e.g., CDs, DVDs, etc.), smart cards, and flash memory devices (e.g., EEPROMs, cards, sticks, key drives, etc.). In addition, the various storage media presented herein include one or more devices and/or other machine-readable media for storing information.

The description of the provided embodiments is provided to enable any person skilled in the art of the present disclosure to carry out or use the present disclosure. Various modifications to the embodiments will be apparent to those skilled in the art of the present disclosure, and the generic principles defined herein may be applied to other embodiments without departing from the scope of the present disclosure. Accordingly, it should be understood that the present disclosure is not limited to the embodiments

presented herein but should be construed in the broadest scope consistent with the principles and novel features presented herein.

[Mode for Invention]

As described above, the related contents have been described in the best mode for carrying out the invention.

[Industrial Applicability]

The present disclosure may be used for the crack detection monitoring system.

[CLAIMS]

[Claim 1]

A crack detection monitoring device comprising:

a hollow housing member;

first and second fixing members each having a lower portion installed on a structure, and an upper portion inserted into the housing member;

a connection member provided on a lower surface in the housing member;

at least one or more movable members coupled to the connection member and configured to move in response to a change in width between the first and second fixing members that is caused by a crack in the structure; and

at least one or more detection units provided in the housing member and provided to respectively correspond to the at least one or more movable members.

[Claim 2]

The crack detection monitoring device of claim 1, wherein the housing member comprises:

a first opening portion having an area corresponding to a cross-sectional area of the first fixing member and provided in a first region of a lower portion of the housing member and the first fixing member is inserted into the first opening portion; and

a second opening portion having an area larger than a cross-sectional area of the second fixing member provided in a second region of the lower portion of the housing member and the second fixing member is inserted into the second opening portion.

[Claim 3]

The crack detection monitoring device of claim 1, wherein the at least one or more movable members comprise:

at least one or more vertical movable bodies coupled to one side of the connection

member in a direction perpendicular to the connection member; and

at least one or more horizontal movable bodies each provided at the other side of each of the at least one or more vertical movable bodies.

[Claim 4]

The crack detection monitoring device of claim 3, wherein the at least one or more movable members comprise at least one or more rotary bodies configured to connect each of the at least one or more horizontal movable bodies to each of the at least one or more vertical movable bodies so that the at least one or more horizontal movable bodies are rotatable.

[Claim 5]

The crack detection monitoring device of claim 1, further comprising:

a fixing clip member coupled to an outer surface of the housing member and installed on the structure.

[Claim 6]

The crack detection monitoring device of claim 5, wherein the housing member has coupling grooves having predetermined depths formed at two opposite sides of the outer surface,

wherein the fixing clip member has a U shape,

wherein fixing protrusions are respectively formed on two opposite inner surfaces of the fixing clip member and coupled to the coupling grooves, and

wherein a lower portion of the fixing protrusion is installed on the structure.

[Claim 7]

A crack detection monitoring device comprising:

a hollow housing member;

first and second fixing members each having a lower portion installed on a

structure, and an upper portion inserted into the housing member;

a connection member provided on a lower surface in the housing member;

a plurality of movable members coupled to the connection member and configured to move in response to a change in width between the first and second fixing members that is caused by a crack in the structure; and

a plurality of detection units provided in the housing member and provided to respectively correspond to the plurality of movable members.

[Claim 8]

The crack detection monitoring device of claim 7, wherein the plurality of movable members are spaced apart from one another at predetermined intervals.

[Claim 9]

The crack detection monitoring device of claim 8, wherein the plurality of movable members are provided rearward of the second fixing member and spaced apart from one another at predetermined intervals, and the rearward direction of the second fixing member is a direction that is not directed toward the first fixing member from the second fixing member.

[Claim 10]

The crack detection monitoring device of claim 7, wherein the plurality of movable members have different lengths.

[Claim 11]

The crack detection monitoring device of claim 10, wherein the plurality of detection units are provided on the same vertical line.

[Claim 12]

The crack detection monitoring device of claim 7, wherein the plurality of movable members have lengths corresponding to one another.

[Claim 13]

The crack detection monitoring device of claim 12, wherein the plurality of detection units are different in positions.

[Claim 14]

A crack detection monitoring system comprising:

the crack detection monitoring device according to any one of claims 1 to 13;

a relay device configured to receive a signal transmitted from the crack detection monitoring device;

a network device configured to receive the signal transmitted from the relay device; and

an application device configured to receive the signal transmitted from the network device, analyze the signal, store the signal as processing data, and provide the processing data to an external device.