WILDLIFE DETECTION AND DETERRENT SYSTEM AND METHOD FOR ENVIRONMENTAL INSTRUMENTATION

Field of the Invention

[0001] The invention generally relates to systems and methods for deterring animals from the vicinity of an environment monitoring apparatus.

Background to the Invention

[0002] Remote automated sensing systems are increasingly used for weather monitoring, cloud and solar sensing, wind monitoring and security. In particular sky cameras are of increasing importance to solar farms. Like all systems installed outdoors it must be robust and resistant to the weather but additionally it must also not be affected by wildlife, especially birds.

Summary of the Invention

[0003] According to a first aspect of the present disclosure, there is provided a deterrence system for deterring animals from a vicinity of an environment monitoring apparatus, the system comprising: a detector system comprising at least one sensor configured to generate a presence signal indicative of the presence of an object within a predefined vicinity of the environment monitoring apparatus; a deterrence processing system; and a repulsion system, wherein the deterrence processing system is configured to: monitor the presence signal; determine, from the presence signal, the presence of an object within the predefined vicinity of the environment monitoring apparatus; and communicate a command for the repulsion system to perform a sequence of one or more repulsion events actions in response to determining that an object is present, and wherein the repulsion system is configured to: perform one or more repulsion events responsive to receipt of the command from the deterrence processing system.

[0004] The environment monitoring apparatus may be mounted on a pole and/or may be configured for obtaining sensor measurements of at least a portion of the sky, such as a skycam or pyranometer.

[0010] In an embodiment, the distance discrimination system is further configured to: determine a distance between the environment monitoring apparatus and a detected object; communicate a command for the repulsion system to perform one or more repulsion event only in response to determining that the object is further than a predefined minimum distance.

[0011] In an embodiment, the environment monitoring apparatus comprises an optical apparatus. The environment monitoring apparatus may comprise a substantially upward facing sensing portion.

[0012] The system may be configured to record in a log and/or the communicate to an external computer instances of undertaking one or more repulsion events actions. Optionally, the system further comprises a communication system configured to receive communications from an external computer, said communications including commands from the external computer via the communication system for controlling the deterrence processing system, environment monitoring apparatus and/or repulsion system remotely. Also, or alternatively, the system may also further comprise a communication system configured to send communications to an external computer, said communications including monitoring communications.

[0013] ~~According to another aspect of the present disclosure, t~~There is provided a deterrence method for deterring animals from a vicinity of an environment monitoring apparatus, comprising the steps of: generating a presence signal indicative of the presence of an object within a predefined vicinity of the environment monitoring apparatus; monitoring the presence signal; determining, from the presence signal, the presence of an object within the predefined vicinity of the environment monitoring apparatus; and performing one or more repulsion actions responsive to receipt of the command from the deterrence processing system.

[0014] ~~According to another aspect of the present disclosure, t~~There is provided a self-cleaning system for cleaning an environment monitoring apparatus, the system comprising: a cleaning arm having a nozzle; a drive unit configured to move the cleaning arm about a path; a reservoir in fluid communication with the nozzle; a pump; and a cleaning processing module configured to control operation of the drive unit and the pump, wherein the cleaning processing module is configured to: control the drive unit to move the cleaning arm about the path; and control the pump to cause a movement of liquid from the reservoir to the nozzle such that the liquid exits the nozzle, wherein the path and nozzle are configured such that the liquid is caused

[0022] In another embodiment, there is provided a self-cleaning system further comprising a communication system configured to communicate between an external computer and the self-cleaning system; and wherein the self-cleaning system is further configured to receive commands from the external computer via the communication system for controlling the cleaning processing system, environment monitoring apparatus and/or self-cleaning system remotely, and/or to communicate monitoring information.

[0023] The system may be further configured to record in a log and/or the communicate to an external computer instances of undertaking one or more repulsion events actions.

[0024] ~~According to another aspect of the present disclosure, t~~There is provided a self-cleaning method for cleaning an environment monitoring apparatus, comprising the steps of: moving a cleaning arm having a nozzle along a path; pumping liquid from a reservoir to the nozzle thereby causing the liquid to exit the nozzle as the cleaning arm moves along the path, wherein the path and nozzle are configured such that the liquid is caused to contact an active area of the environment monitoring apparatus, thereby causing cleaning of the environment monitoring apparatus.

[0025] In an embodiment, there is provided a self-cleaning method further comprising the steps of: providing at least one cleaning arm with multiple nozzles; controlling at least one valve to direct the pumped liquid from the reservoir to selected one or more nozzles in succession; and wherein the valve(s), nozzles and/or path are configured such that the liquid exits each nozzle in succession in a sequence of nozzle emissions to contact substantially the active area thereby causing cleaning of the optical apparatus with maximal water pressure from each nozzle.

[0026] Optionally, the pump, path and/or nozzle(s) can be configured to cause the liquid to exit the nozzle(s) at low pressure over substantially the active area thereby soaking the active area before cleaning of the optical apparatus.

[0027] ~~According to another aspect of the present disclosure, t~~There is provided a deterrence system for deterring animals from a vicinity of an environment monitoring apparatus, the system comprising: at least one sensor configured to detect the presence of an object within a predefined vicinity of the environment monitoring apparatus; a deterrence processing system; and a repulsion system for performing one or more repulsion actions for repelling the object,

wherein the deterrence processing system is configured to: determine the presence of an object within the predefined vicinity of the environment monitoring apparatus; and control the repulsion system to perform a sequence of one or more repulsion events actions in response to determining that an object is present.

[0028] According to ~~another~~ a second aspect of the present disclosure, there is provided a deterrence method for deterring animals from a vicinity of an environment monitoring apparatus, comprising the steps of: determining the presence of an object within the predefined vicinity of the environment monitoring apparatus; and performing one or more repulsion actions responsive to determining the presence of the object.

[0029] According to ~~another~~ a third aspect of the present disclosure, there is provided a solar farm comprising one or more deterrence systems according to the ~~above~~ first aspect~~s~~.

[0030] As used herein, the word "comprise" or variations such as "comprises" or "comprising" is used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the invention.

Brief Description of the Drawings

[0031] In order that the invention may be more clearly understood, embodiments will now be described, by way of example, with reference to the accompanying drawings, in which:

[0032] Figure 1 shows a deterrence system according to an embodiment;

[0033] Figure 2 shows an embodiment wherein an optical apparatus mounted atop a pole;

[0034] Figure 3 shows a method implemented by a deterrence processing module according to an embodiment

[0035] Figure 4 shows a self-cleaning system according to an embodiment;

[0036] Figure 5 shows a relationship between a cleaning processing module, a pump, and a drive unit;

Claims:

1. A deterrence system for deterring animals from a vicinity of an environment monitoring apparatus, the system comprising:

a detector system comprising at least one sensor configured to generate a presence signal indicative of the presence of an object within a predefined vicinity of the environment monitoring apparatus;

a deterrence processing system; and

a repulsion system,

wherein the deterrence processing system is configured to:

monitor the presence signal;

determine, from the presence signal, the presence of an object within the predefined vicinity of the environment monitoring apparatus; and

communicate a command for the repulsion system to perform a sequence of one or more repulsion events actions in response to determining that an object is present, and

wherein the repulsion system is configured to:

perform one or more repulsion events responsive to receipt of the command from the deterrence processing system.

~~2. A deterrence system as claimed in claim 1, wherein the environment monitoring apparatus is mounted on a pole and/or configured for obtaining sensor measurements of at least a portion of the sky, such as a skycam or pyranometer.~~

~~3. A deterrence system as claimed in either claim 1 or claim 2, wherein the detector system comprising one or more of: an infrared detector; a motion detector; a time-of-flight camera; a microwave movement sensor; an ultrasonic sensor; a photoelectric sensor; a laser range-finding sensor; and a capacitive proximity sensor.~~

~~4. A deterrence system as claimed in any one of claims 1 to 3, wherein the detector system is mounted at a distance from the environment monitoring apparatus with at least one sensor facing the optical apparatus.~~

25. A deterrence system as claimed in any one of claims 1 to 4, wherein the deterrence processing system is further configured to:

perform a first temporal check to determine whether the presence signal has indicated the presence of the object for at least a first predefined time,

and wherein the command is only communicated when the temporal check determines that the object has been present for the predefined time.

6. A deterrence system as claimed in any one of claims 1 to 5, wherein the sequence comprises one repulsion event.

37. A deterrence system as claimed in claim 16, wherein the one repulsion event comprises one or more of: at least one non-physical repulsion action; and at least one physical repulsion action.

48. A deterrence system as claimed in claim 37, wherein the at least one non-physical repulsion actions are selected from a visual repulsion action and an audible repulsion action and/or wherein the at least one physical repulsion action includes moving an object into a vicinity of the optical apparatus.

9. A deterrence system as claimed in any one of claims 1 to 5, wherein the sequence comprises at least an initial repulsion event and a subsequent repulsion event.

510. A deterrence system as claimed in claim 19, wherein the sequence comprises at least an initial repulsion event and a subsequent repulsion event and wherein the deterrence processing system is further configured to:

communicate a first command for the repulsion system to perform the initial repulsion event in response to determining that an object is present;

perform a second temporal check to determine whether the presence signal has indicated the presence of the object for at least a second predefined time subsequent to the performance of the initial repulsion event;

communicate a second command for the repulsion system to perform the subsequent repulsion event in response to determining that the object is still present after the second predefined time.

611. A deterrence system as claimed in claim ~~10~~5, wherein the initial repulsion event comprises one or both of: a visual repulsion action; and an audible repulsion action.

712. A deterrence system as claimed in claim ~~10 or claim 11~~5, wherein the subsequent repulsion event comprises a physical repulsion action.

~~13. A deterrence system as claimed in any one of claims 1 to 12, wherein the environment monitoring apparatus comprises an optical apparatus.~~

~~14. A deterrence system as claimed in any one of claims 1 to 13, wherein the environment monitoring apparatus comprises a substantially upward facing sensing portion.~~

~~15. A deterrence system as claimed in any one of claims 1 to 14, further configured to record in a log and/or to communicate to an external computer instances of undertaking one or more repulsion events actions.~~

816. A deterrence system as claimed in ~~any one of~~ claim~~s~~ 71 ~~to 15~~, comprising a physical repulsion action comprising moving a cleaning arm of a self-cleaning system through a path in which at least a portion of the cleaning arm moves within the vicinity of the environment monitoring apparatus.

~~17. A deterrence system as claimed in any one of the claims 1 to 16, wherein the distance discrimination system is further configured to:~~

~~determine a distance between the environment monitoring apparatus and a detected object;~~

~~communicate a command for the repulsion system to perform one or more repulsion event only in response to determining that the object is further than a predefined minimum distance.~~

~~18. A deterrence system as claimed in any of one of claims 1 to 17, further comprising a communication system configured to receive communications from an external computer, said communications including commands from the external computer via the~~

~~communication system for controlling the deterrence processing system, environment monitoring apparatus and/or repulsion system remotely.~~

~~19. A deterrence system as claimed in any of one of claims 1 to 18, further comprising a communication system configured to send communications to an external computer, said communications including monitoring communications.~~

~~20. A deterrence method for deterring animals from a vicinity of an environment monitoring apparatus, comprising the steps of:~~

~~generating a presence signal indicative of the presence of an object within a predefined vicinity of the environment monitoring apparatus;~~

~~monitoring the presence signal;~~

~~determining, from the presence signal, the presence of an object within the predefined vicinity of the environment monitoring apparatus; and~~

~~performing one or more repulsion actions responsive to receipt of the command from the deterrence processing system.~~

9~~21~~. A deterrence system as claimed in claim 8 wherein the self-cleaning system for cleaning an environment monitoring apparatus ~~, the system~~ comprises~~ing~~:

the~~a~~ cleaning arm having one or more nozzles;

a drive unit configured to move the cleaning arm about a path;

a reservoir in fluid communication with the nozzle;

a pump; and

a cleaning processing module configured to control operation of the drive unit and the pump,

wherein the cleaning processing module is configured to:

control the drive unit to move the cleaning arm about the path; and

control the pump to cause a movement of liquid from the reservoir to the one or more nozzles such that the liquid exits the one or more nozzles,

wherein the path and one or more nozzles are configured such that the liquid is caused to contact an active area of the environment monitoring apparatus, thereby causing cleaning of the environment monitoring apparatus.

10~~22~~. A ~~self-cleaning~~deterrence system as claimed in claim ~~21~~9, wherein the environment monitoring apparatus is mounted on a structure, such as a pole, and/or configured for obtaining sensor measurements of at least a portion of the sky, such as a skycam or pyranometer.

11~~23~~. A deterrence ~~self-cleaning~~ system as claimed in claim 9~~22~~, wherein the cleaning arm and nozzle is located in proximity to the environment monitoring apparatus and wherein the reservoir is found in proximity to a base of the structure.

12~~4~~. A deterrence ~~self-cleaning~~ system as claimed in ~~any one of~~ claim~~s~~ 9~~21 to 23~~, wherein the cleaning processing module is configured to control cleaning of the environment monitoring apparatus periodically and/or according to a predefined schedule.

~~25. A self-cleaning system as claimed in any one of claims 21 to 24, wherein the fluid communication comprises flexible and/or non-flexible tubing.~~

13~~26~~. A ~~self-cleaning~~deterrence system as claimed in ~~any one of~~ claim~~s 21 to 25~~ 9, wherein the environment monitoring apparatus comprises an optical apparatus or a substantially upward facing sensing portion.

~~27. A self-cleaning system as claimed in any one of claims 21 to 26, wherein the environment monitoring apparatus comprises a substantially upward facing sensing portion.~~

14~~28~~. A ~~self-cleaning~~deterrence system as claimed in ~~any one of~~ claim~~s~~ 9~~21 to 27~~, wherein the nozzle is one of multiple nozzles, the system further comprising a valve system comprising at least one valve for controlling activation of the multiple nozzles, wherein an activated nozzle allows liquid to exit, and

wherein the cleaning processing module is further configured to:

control the pump and valve(s) to cause a movement of liquid from the reservoir to selected one or more nozzles such that the liquid exits said selected nozzle(s) to contact a part of the active area of the environment monitoring apparatus,

and thereafter cause a further movement of liquid to another selected one or more of the multiple nozzles such that the liquid contacts another part of the active area.

15~~29~~. A deterrence ~~self-cleaning~~ system as claimed in claim 14~~28~~ wherein the cleaning processing module is configured to control the pump and valve(s) to cause movement of liquid such that it is directed to individual nozzles in succession thereby performing a sequence of nozzle emissions such that the substantially the entire active area is contacted.

16~~30~~. A deterrence ~~self-cleaning~~ system as claimed in claim ~~28 or 29~~14, wherein the cleaning arm is one of multiple cleaning arms and/or the sensing portion is one of multiple sensing portions.

17~~31~~. A ~~self-cleaning~~deterrence system as claimed in ~~any one of~~ claim~~s~~ 14~~28 to 30~~, wherein the or each cleaning arm has multiple nozzles or heads for cleaning the multiple sensing portions.

18~~32~~. A deterrence~~self-cleaning~~ system as claimed in ~~any of one of~~ claim~~s~~ ~~28 to 31~~9, further comprising a communication system configured to communicate between an external computer and the self-cleaning system; and

wherein the self-cleaning system is further configured to receive commands from the external computer via the communication system for controlling the cleaning processing system, environment monitoring apparatus and/or self-cleaning system remotely, and/or to communicate monitoring information.

19~~33~~. A deterrence ~~self-cleaning~~ system as claimed in ~~any one of~~ claim~~s~~ ~~28 to 24~~18, further configured to record in a log and/or the communicate to the or an external computer instances of cleaning of the environment monitoring apparatus and/or the water level of the reservoir.

~~34. A self-cleaning method for cleaning an environment monitoring apparatus, comprising the steps of:~~

~~moving a cleaning arm having a nozzle along a path;~~

~~pumping liquid from a reservoir to the nozzle thereby causing the liquid to exit the nozzle as the cleaning arm moves along the path,~~

~~wherein the path and nozzle are configured such that the liquid is caused to contact an active area of the environment monitoring apparatus, thereby causing cleaning of the optical apparatus.~~

~~35. A self-cleaning method for cleaning an environment monitoring apparatus as claimed in claim 34, further comprising the steps of:~~

~~providing at least one cleaning arm with multiple nozzles;~~

~~controlling at least one valve to direct the pumped liquid from the reservoir to selected one or more nozzles in succession; and~~

~~wherein the valve(s), nozzles and/or path are configured such that the liquid exits each nozzle in succession in a sequence of nozzle emissions to contact substantially the active area thereby causing cleaning of the optical apparatus with maximal water pressure from each nozzle.~~

~~36. A self-cleaning method for cleaning an environment monitoring apparatus as claimed in claim 34 or 35 wherein the pump, path and/or nozzle(s) are configured to cause the liquid to exit the nozzle(s) at low pressure over substantially the active area thereby soaking the active area before cleaning of the optical apparatus.~~

~~37. A deterrence system as claimed in claim 19, wherein the self-cleaning system is as claimed in any one of claims 21 to 33.~~

~~38. A deterrence system for deterring animals from a vicinity of an environment monitoring apparatus, the system comprising:~~

~~at least one sensor configured to detect the presence of an object within a predefined vicinity of the environment monitoring apparatus;~~

~~a deterrence processing system; and~~

~~a repulsion system for performing one or more repulsion actions for repelling the object,~~

~~wherein the deterrence processing system is configured to:~~

~~determine the presence of an object within the predefined vicinity of the environment monitoring apparatus; and~~

~~control the repulsion system to perform a sequence of one or more repulsion events actions in response to determining that an object is present.~~

20~~39~~. A deterrence method for deterring animals from a vicinity of an environment monitoring apparatus, comprising the steps of:

determining the presence of an object within the predefined vicinity of the environment monitoring apparatus; and

performing one or more repulsion actions responsive to determining the presence of the object.

21~~40~~. A solar farm comprising one or more deterrence systems, wherein each deterrence system is as claimed in ~~any one of~~ claim~~s~~ 1 ~~to 18, 37, or 38~~.

22. A deterrence system as claimed in claim 9, comprising a physical repulsion action comprising moving a cleaning arm of a self-cleaning system through a path in which at least a portion of the cleaning arm moves within the vicinity of the environment monitoring apparatus.

23. A deterrence system as claimed in claim 1, wherein the distance discrimination system is further configured to:

determine a distance between the environment monitoring apparatus and a detected object;

communicate a command for the repulsion system to perform one or more repulsion event only in response to determining that the object is further than a predefined minimum distance.

24. A deterrence system as claimed in claim 1, further comprising a communication system configured to receive communications from an external computer, said communications including commands from the external computer via the communication system for controlling the deterrence processing system, environment monitoring apparatus and/or repulsion system remotely.

25. A deterrence system as claimed in claim 1, further comprising a communication system configured to send communications to an external computer, said communications including monitoring communications.