TERMITE MONITORING METHOD

Field of Invention

The present invention relates generally to a termite monitoring method utilising a termite monitoring system for providing an alert when presence of termite is suspected.

Background

Termites are the most important wood-destroying structural pests in the world. They normally live below ground and may move up into a structure where they cause damage. Termites are "social insects" as they live in a nest or colony which is typically found underground, often near a tree, stump, wood pile or other source of 'food' that contain cellulose.

Members of the termite colony forage for food and burrow galleries or passageways in the soil outwardly from the colony or nest, and portions of food located by foraging termites are returned to the nest. Termites can be very destructive because of their voracious appetites, especially for wood and other cellulose materials. The ability of termites to cause considerable damage is in part due to the fact that the termites are typically not seen until termite infestation is at a relatively advanced stage. Termites are difficult to detect and control because they are cryptic creatures that usually cause damage to the interiors of wooden structures, or otherwise in places that are not readily observable. Termites must have moisture and must transport food to the subterranean colonies in order to live. Consequently, they must return to the ground around or beside a building after they have eaten part of the wooden structures.

A typical but effective method to find, and being alerted to the presence of, termites is with a bait station installed in the ground. The bait stations are baited with blocks of wood (the bait or bait structure) which are consumable by termites. Bait stations are commonly spread around the foundation of structures, then monitored by bending over to open a cap and remove blocks of wood.

The baits may be provided in the form of bait cartridges containing compressed cellulose materials that act as monitors to detect termite activity before the “Toxin” is inserted. These

toxins (non-repellent insecticides) used in the baiting station are usually slow acting so that the toxin can be spread by the foraging worker termites to other members of the colony that do not collect their own food. This includes the reproductive 'king' and 'queen' and the soldier termites, as well as those workers that maintain the nest and tend to new offspring.

The typical bait stations require an intense labour involved maintenance program. The pest control technician must first find these devices, then bend over at every unit to open a cap and see if there are any termites present. Once the presence of termites is detected, the pest control technicians are required to introduce toxins into the bait stations or bait cartridges. This is an inefficacious approach as multiple devices may be used for each premise which will put a strain on manpower requirements as well as on the physical well-being of the pest control technicians. Therefore, there is an apparent need for a termite monitoring system for addressing the foregoing issues.

Summary

In accordance with a first aspect of the invention, there is disclosed a termite monitoring method comprising receiving sensor signals by a controller gateway from at least one sensor device being in data communication with the controller gateway, translating the received sensor signals into sensor data comprising a description of a sensor identifier uniquely identifying and an indication of an operative state of each of the at least one sensor device, and transmitting collated data by the controller gateway for receipt by a control backend, the collated data comprising the sensor data of the at least one sensor device and a corresponding at least one of date and time.

In accordance with a second aspect of the invention, there is disclosed a termite monitoring system comprising at least one sensor device and a controller gateway for receiving sensor signals sent by the at least one sensor device being in data communication with the controller gateway. The controller gateway further for translating the received sensor signals into sensor data comprising a description of a sensor identifier uniquely identifying and an indication of an operative state of each of the at least one sensor device. The collated data is transmittable by the controller gateway for receipt by a control backend, the collated data comprising the sensor data of the at least one sensor device and a corresponding at least one of date and time.

Brief Description of the Drawings

FIG. 1 shows a process flow diagram of a termite monitoring method in accordance with an aspect of the invention;

FIG. 2 shows a partial system diagram of a termite monitoring system which utilises the termite monitoring method of FIG. 1;

FIG. 3 shows a partial system diagram of a sensor device used in the termite monitoring system of FIG. 3; and

FIG. 4 shows a partial front sectional elevation of the sensor device of FIG. 4.

Detailed Description

Reference will now be made in detail to an exemplary embodiment of the present invention, examples of which are illustrated in the accompanying drawings. While the invention will be described in conjunction with the embodiment, it will be understood that they are not intended to limit the invention to these embodiments. On the contrary, the invention is intended to cover alternatives, modifications and equivalents, which may be included within the spirit and scope of the invention as defined by the appended claims. Furthermore, in the following detailed description of embodiments of the present invention, numerous specific details are set forth in order to provide a thorough understanding of the present invention. However, it will be recognized by one of ordinary skill in the art that the present invention may be practiced without these specific details. In other instances, well-known methods, procedures, components, and circuits have not been described in detail as not to unnecessarily obscure aspects of the embodiments of the present invention.

An exemplary embodiment of the present invention, a termite monitoring method 100 for utilising a termite monitoring system 20, is described hereinafter with reference to FIGS. 1-4. The termite monitoring system 20 comprises at least one sensor device 22 and a controller gateway 24 for receiving sensor signals sent by the at least one sensor device 22 which is in data communication with the controller gateway 24. The controller gateway 24 is further for translating the received sensor signals into sensor data comprising a description of a sensor identifier uniquely identifying and an indication of an operative state of each of the at least one sensor device 22. The collated data is then transmittable by the controller gateway 24 for receipt by a control backend 26. The termite monitoring system 20 may further comprise the control backend 26 with the collated data comprising the sensor data of the at least one sensor device 22 and a corresponding at least one of date and time.

In implementing the termite monitoring system 20, the termite monitoring method comprises a step 110 of receiving sensor signals by the controller gateway 24 from the at least one sensor device 22, a step 112 of translating the received sensor signals into sensor data comprising a description of a sensor identifier uniquely identifying and an indication of an operative state of each of the at least one sensor device 22, and a step 114 of transmitting

collated data by the controller gateway 24 for receipt by the control backend 26. This implementation of the termite monitoring method 100 when the termite monitoring system 20 is deployed at a particular location allows the at least one sensor device 22 to be remotely monitored and the operative state of the at least one sensor device 22 to be determined, on-demand. As the at least one sensor device 22 may be activated with the presence of termite being sensed thereby, the operative state of the corresponding at least one sensor device 22 will indicate the activation which will eventually be provided to the control backend 26 as a constituent of the collated data to alert the control backend 26 to the activation.

The control backend 26 may be a cloud server system or a control station setup which may be operated and accessed through one or more remote terminal, a standalone workstation or a computing device 27 such as a notebook, a tablet and a smartphone to access the collated data or a dashboard generated from or customised for the computing device.

It is preferred that the at least one of date and time corresponding to the sensor data of the at least one sensor device 22 being generated at least one of by the at least one sensor device 22 and further translatable from the sensor signals and by the controller gateway 24 upon receipt of the sensor signals from the at least one sensor device 22. It is also preferred that the collated data further comprising a location identifier uniquely identifying the controller gateway 24 and/or the location, relative position or geo-position of the controller gateway 24. This will allow the control backend and a user of the termite monitoring system 20 to specifically identify the location of the at least one sensor device 22 which has been activated.

The operative state of the at least one sensor device 22 comprising at least one of an activated state, a standby state, a low power state and a no power state, the standby state indicating non-activation and the activated state indicating activation of the at least one sensor device 22.

When the termite monitoring system 20 has been deployed, there may be occasions where the at least one sensor device 22 malfunctions or become signal silent for various reasons including faulty or low-charge batteries, weather compromised components or the inclusion

of external objects that affects or attenuate signal communication between the at least sensor device 22 and the controller gateway 24. Therefore, the termite monitoring method 100 further comprises a step 120 of determining absence of sensor signals from one of the at least one sensor device 22 for a predefined absence duration by the controller gateway 24, and a step 122 of transmitting an absence indicator as part of the collated data transmitted by the controller gateway 24 for receipt for the control backend 26. In addition to or alternative to the predefined absence duration, the controller gateway 24 may attempt to communicate with the at least one sensor device 22 for a predefined number of counts in a step 124 to solicit sensor signals from the at least one sensor device 22 before transmitting the absence indicator as part of the collated data transmitted by the controller gateway 24 in the step 122 for receipt for the control backend 26 should sensor signals be still absent from the at least one sensor device 22 at the last of the predefined number of counts.

The termite monitoring system 20 can be easily deployed for use at any selected location. To deploy the termite monitoring system 20, the termite monitoring method 100 further comprises a step 130 of initiating communication pairing between the controller gateway 24 and one of the at least one sensor device 22, a step 132 of generating at least one of a visual alert and an audible alert indicative of and in response to at least one of successful and unsuccessful communication pairing between the controller gateway 24 and one of the at least one sensor device 22, and a step 134 of assigning a unique enumerated identifier to the one of the at least one sensor device 22 in response to successful communication pairing between the controller gateway 24 and the one of the at least one sensor device 22.

The termite monitoring method 100 further comprises a step 136 of one of displaying and indicating the assigned unique enumerated identifier on at least one of the corresponding one of the at least one sensor device 22 and the controller gateway 24.

In the event where one or more of the at least one sensor device 22 needs to be replaced at a deployment location, the termite monitoring method 100 further comprises a step 140 of terminating communication pairing between the controller gateway 24 and the one of the at least one sensor device 22 with the unique enumerated identifier being unassigned from the one of the at least one sensor device 22, a step 142 of initiating communication pairing

between the controller gateway 24 and another one of the at least one sensor device 22, and a step 144 of assigning the unique enumerated identifier to the another one of the at least one sensor device 22 in response to successful communication pairing between the controller gateway 24 and the another one of the at least one sensor device 22.

Preferably, the step 114 of transmitting collated data by the controller gateway 24 for receipt by the control backend 26 comprises a step 150 of transmitting the collated data to a rebroadcast device 30 for transmission by the rebroadcast device 30 to the control backend 26. The controller gateway 24 being in signal communication with the rebroadcast device 30.

It is preferred that signal communication between the at least one sensor device 22 and the controller gateway 24 is one of by a wireless low-power network and by Bluetooth, and signal communication between controller gateway 24 and the control backend 26 being by one of wired network, wireless Wi-Fi network, wireless low-power network, for example the Lora network, and wireless cellular network such as the 5G cellular network.

Each of the at least one sensor device 22 comprises a switch 32 having an actuator 34 biased in a first actuator position and displaceable to a second actuator position by a bait structure 36 supported by a bait support 38. The bait support 38 and the switch 32 being inter-configured and the bait structure 36 being shaped and dimensioned for displacing the actuator 34 to the second actuator position when being supported on the bait support 38. Each of the at least one sensor device 22 further comprises sensor telemetry 40 in signal communication with the switch 32 for generating the sensor data and translating the sensor data into sensor signals for transmission to the controller gateway 24 in response to displacement of the actuator 34 towards the first actuator position being sensed thereby.

At least one of weakening and destruction of the bait structure causes the actuator 34 of the switch 32 to displace towards the first actuator position, the sensor signals for being receivable by the control backend 26 for registering displacement of the actuator 34 of the switch 32 towards the first actuator position with the sensor signals being translatable into the sensor data at least being indicative of the operative state being in an activated state when displacement of the actuator being 34 detected.

The at least one sensor device 22 further comprises the bait support 38 adapted for at least one of abutting, supporting, holding and substantially isolating movement of the bait structure 36 prior to being weakened. The bait structure 36 is elongated along a first axis 44 with the first axis 44 coinciding the bait support 38 and the actuator 34 when positioned therebetween to displace the actuator 34 towards the second actuator position. Besides being elongated, the bait structure 36 may take on other shapes such as planar and other rectilinear shapes that is able to be positioned for abutting the actuator, directly or indirectly, to displace the actuator 34 towards the second actuator position and where weakening or destruction of the bait structure 36 will release the actuator 34 from the second actuator position which in turn will allow the actuator 34 to displace towards the first actuator position wheretowards it is resiliently biased.

Preferably, the sensor telemetry 40 comprises a transducer circuit 46 for transducing displacement of the actuator 34 of the switch 32 into the sensor data, and a communication module 48 for transmitting the alert signal from the transducer circuit 46. The switch 32 may be calibrated and the transducer circuit 46 may be adapted to generate the alert signals when any displacement of the actuator 34 is detected, when the actuator 34 displaces from the second actuator position or when the actuator 34 reaches the first actuator position.

Preferably, the at least one sensor device 22 further comprises a battery module 50 for storing energy and for discharging the electrical energy to power the sensor telemetry 40. The at least one sensor device 22 may further comprise a photovoltaic device 42 for generating electrical energy in the presence of light for charging the battery module 50. Additional or alternative to the photovoltaic module, the at least one sensor device 22 can further comprise an inductive charging device to enable the battery module 50 to be inductively charged, or a connector, for example a USB adaptor or connector to enable direct charging of the battery module 50 via an external power source.

The communication module 48 includes wireless communication circuitry that defines wireless communication node. Specifically, the wireless communication circuitry includes RF transceiver that in turn includes transmitter and receiver. The wireless communication circuitry further includes communication antenna. It should be appreciated that at least a

portion of transmitter and receiver can be provided in the same integral unit. For example, commonly shared aspects would include antenna and/or RF front-end circuitry. However, in other arrangements transceiver is defined by independent transmitter and receiver units that collectively provide both transmission and reception functionality.

The at least one sensor device 22 is controlled by a controller module 54 with the transducer circuit 46 and the communication module 48 being constituents thereof. The controller module 54 can include include memory and can comprise one or more components, including digital circuitry, analog circuitry, or both. The controller module 54 may be a software and/or firmware programmable type; a hardwired, dedicated state machine; or a combination of these. In one embodiment, controller module 54 is a programmable microcontroller solid-state integrated circuit that integrally includes a processing unit and memory. The controller module 54 functions in accordance with operating logic defined by software and/or firmware programming, hardware, or a combination of these. At least one of the controller module 54 and the communication module 48 can include signal conditioners, signal format converters (such as analog-to-digital and digital-to-analog converters), limiters, clamps, filters, dedicated timers, and the like as needed to perform various operations described in the present application. In one form, the controller module 54, wireless communication circuitry and power management circuitries are at least partially defined by the same integrated circuit device.

In an exemplary deployment of the termite monitoring system 20 using the termite monitoring method 100, a user, such as a deployment technician, estimates the quantity of the sensor devices 22 required for a selected location to be monitored for termite activities. The sensor devices 22 and the controller gateway 24 are then brought or transported to the selected location by the deployment technician. At the selected location, the controller gateway 24 is brought near the specific point where it is to be installed. The controller gateway 24 may be powered by an external power source, for example by connecting to a wall power plug and/or by an internal battery source to facilitate deployment. The gateway controller 24 is then powered up to establish signal communication with the control backend 26 either by wired or wireless, for example Wi-Fi, connection with on-location internet services, or via a cellular link. Next, the gateway controller 24 is switched to a pairing mode

while the sensor devices 22 are powered up. The sensor devices 22 are then operated to pair with the controller gateway 24 one at a time and then installed at various points around the selected location. A visual indicator, for example an LED indicator, on each of the sensor devices 24 provides indication that the particular sensor device 24 has been successfully paired with the controller backend 24 and that signal communication therebetween is still being maintained during locating of a particular one of the sensor device 22 to a desired point around the selected location. Once signal communication breaks during movement of the sensor device 22, the deployment technician can back-trace his steps or repositions the sensor device 22 until signal communication with the controller backend 24 is re-established. The deployment technician may carry deployment computing device 60, such as a tablet or a smartphone, running a web-based, hybrid or native software application that communicates with the control backend 26 or directly with the controller gateway 24 to receive feedback on pairing and signal communication status between the sensor devices 22 and the controller gateway 24, as required in the steps 130, 132 and 134.

An identifier, for example a number, is preferably sequentially assigned to each of the sensor devices 22 during pairing which is used to preferably used for marking an electronic floorplan in the software application on the deployment computing device 60 or on a hardcopy floorplan as performed in the step 136. This will allow easy identification of a particular one or more of the sensor devices 22 which has been activated according to the steps 110, 112 and 114, or which requires troubleshooting or replacement according to the steps 120, 122 and 124. The identifier may be displayed on the deployment computing device 60 or on a UI 62 in signal communication with the controller module 54, for example an LCD or LED display, on each of the sensor device 22, showing up during pairing of and assigning of the unique identifier to the corresponding one of the sensor devices 22.

The pairing and replacement process of the steps 140, 142 and 144 and the used of assigned and re-assignable identifiers for each of the paired sensor devise 22 also allows easy replacement of activated or faulty one of the sensor devices 22 without the need to re-establish pairing between the other of the sensor devices 22 which has already been paired with the controller gateway 24.

In a forgoing manner, a termite monitoring method is described according to an exemplary embodiment of the invention. Although only one embodiment of the invention is disclosed in this document, it will be apparent to one skilled in the art in view of this disclosure that numerous changes and/or modifications can be made to the disclosed embodiment without departing from the scope and spirit of the invention.

Claims

1. A termite monitoring method comprising:

receiving sensor signals by a controller gateway from at least one sensor device being in data communication with the controller gateway;

translating the received sensor signals into sensor data comprising a description of a sensor identifier uniquely identifying and an indication of an operative state of each of the at least one sensor device; and

transmitting collated data by the controller gateway for receipt by a controller backend, the collated data comprising the sensor data of the at least one sensor device and a corresponding at least one of date and time.

2. The termite monitoring method as in claim 1, the at least one of date and time corresponding to the sensor data of the at least one sensor device being generated at least one of by the at least one sensor device and further translatable from the sensor signals and by the controller gateway upon receipt of the sensor signals from the at least one sensor device.

3. The termite monitoring method as in claim 1, the collated data further comprising a location identifier uniquely identifying the controller gateway.

4. The termite monitoring method as in claim 1, the operative state of the at least one sensor device comprising at least one of an activated state, a standby state, a low power state and a no power state, the standby state indicating non-activation and the activated state indicating activation of the at least one sensor device.

5. The termite monitoring method as in claim 1, further comprising:

determining absence of sensor signals from one of the at least one sensor device for a predefined duration; and

transmitting an absence indicator as part of the collated data transmitted by the controller gateway for receipt for the controller backend.

6. The termite monitoring method as in claim 1, further comprising:

initiating communication pairing between the controller gateway and one of the at least one sensor device;

generating at least one of a visual alert and an audible alert indicative of and in response to at least one of successful and unsuccessful communication pairing between the controller gateway and one of the at least one sensor device; and

assigning a unique enumerated identifier to the one of the at least one sensor device in response to successful communication pairing between the controller gateway and the one of the at least one sensor device.

7. The termite monitoring method as in claim 6, further comprising:

one of displaying and indicating the assigned unique enumerated identifier on at least one of the corresponding one of the at least one sensor device and the controller gateway.

8. The termite monitoring method as in claim 6, further comprising:

terminating communication pairing between the controller gateway and the one of the at least one sensor device, the unique enumerated identifier being unassigned from the one of the at least one sensor device;

initiating communication pairing between the controller gateway and another one of the at least one sensor device; and

assigning the unique enumerated identifier to the another one of the at least one sensor device in response to successful communication pairing between the controller gateway and the another one of the at least one sensor device.

9. The termite monitoring method as in claim 1, transmitting collated data by the controller gateway for receipt by a controller backend comprising:

transmitting the collated data to a rebroadcast device for transmission by the rebroadcast device to the controller backend, the controller gateway being in signal communication with the rebroadcast device.

10. The termite monitoring method as in claim 1, each of the at least one sensor device comprising:

a switch having an actuator biased in a first actuator position and displaceable to a second actuator position by a bait structure supported by a bait support, the bait support and the switch being inter-configured and the bait structure being shaped and dimensioned for displacing the actuator to the second actuator position when being supported on the bait support; and

sensor telemetry in signal communication with the switch for generating the sensor data and translating the sensor data into sensor signals for transmission to the controller gateway in response to displacement of the actuator towards the first actuator position being sensed thereby,

wherein at least one of weakening and destruction of the bait structure causes the actuator of the switch to displace towards the first actuator position, the sensor signals for being receivable by the controller backend for registering displacement of the actuator of the switch towards the first actuator position, the sensor signals being translatable into the sensor data at least being indicative of the operative state being in an activated state when displacement of the actuator being detected.

11. The termite monitoring method as in claim 1, signal communication between the at least one sensor device and the controller gateway being one of by a wireless low-power network and by Bluetooth, and signal communication between controller gateway and the controller backend being by one of wired network, wireless Wi-Fi network, wireless low-power network and wireless cellular network.

12. A termite monitoring system comprising:

at least one sensor device; and

a controller gateway for receiving sensor signals sent by the at least one sensor device being in data communication with the controller gateway, the controller gateway further for translating the received sensor signals into sensor data comprising a description of a sensor identifier uniquely identifying and an indication of an operative state of each of the at least one sensor device,

wherein the collated data is transmittable by the controller gateway for receipt by a controller backend, the collated data comprising the sensor data of the at least one sensor device and a corresponding at least one of date and time.

13. The termite monitoring system as in claim 12, the at least one of date and time corresponding to the sensor data of the at least one sensor device being generated at least one of by the at least one sensor device and further translatable from the sensor signals and by the controller gateway upon receipt of the sensor signals from the at least one sensor device.

14. The termite monitoring system as in claim 12, the collated data further comprising a location identifier uniquely identifying the controller gateway,

wherein the operative state of the at least one sensor device comprising at least one of an activated state, a standby state, a low power state and a no power state, the standby state indicating non-activation and the activated state indicating activation of the at least one sensor device, and

wherein transmitting the collated data to a rebroadcast device for transmission by the rebroadcast device to the controller backend, the controller gateway being in signal communication with the rebroadcast device.

15. The termite monitoring system as in claim 12, the controller gateway further for:

determining absence of sensor signals from one of the at least one sensor device for a predefined duration; and

transmitting an absence indicator as part of the collated data transmitted by the controller gateway for receipt for the controller backend.

16. The termite monitoring system as in claim 12, at least one of the controller gateway and the at least one sensor device being operable for:

initiating communication pairing between the controller gateway and one of the at least one sensor device;

generating at least one of a visual alert and an audible alert indicative of and in response to at least one of successful and unsuccessful communication pairing between the controller gateway and one of the at least one sensor device;

assigning a unique enumerated identifier to the one of the at least one sensor device in response to successful communication pairing between the controller gateway and the one of the at least one sensor device; and

one of displaying and indicating the assigned unique enumerated identifier on at least one of the corresponding one of the at least one sensor device and the controller gateway.

17. The termite monitoring system as in claim 16, at least one of the controller gateway and the at least one sensor device being further operable for:

terminating communication pairing between the controller gateway and the one of the at least one sensor device, the unique enumerated identifier being unassigned from the one of the at least one sensor device;

initiating communication pairing between the controller gateway and another one of the at least one sensor device; and

assigning the unique enumerated identifier to the another one of the at least one sensor device in response to successful communication pairing between the controller gateway and the another one of the at least one sensor device.

18. The termite monitoring system as in claim 12, each of the at least one sensor device comprising:

a switch having an actuator biased in a first actuator position and displaceable to a second actuator position by a bait structure supported by a bait support, the bait support and the switch being inter-configured and the bait structure being shaped and

dimensioned for displacing the actuator to the second actuator position when being supported on the bait support; and

sensor telemetry in signal communication with the switch for generating the sensor data and translating the sensor data into sensor signals for transmission to the controller gateway in response to displacement of the actuator towards the first actuator position being sensed thereby,

wherein at least one of weakening and destruction of the bait structure causes the actuator of the switch to displace towards the first actuator position, the sensor signals for being receivable by the controller backend for registering displacement of the actuator of the switch towards the first actuator position, the sensor signals being translatable into the sensor data at least being indicative of the operative state being in an activated state when displacement of the actuator being detected.

19. The termite monitoring system as in claim 12, signal communication between the at least one sensor device and the controller gateway being one of by a wireless low-power network and by Bluetooth, and signal communication between controller gateway and the controller backend being by one of wired network, wireless Wi-Fi network, wireless low-power network and wireless cellular network.