

INTEGRATED VECTOR CONTROL STATION

BACKGROUND

5 FIELD OF THE INVENTION

The present invention generally relates to in-situ insect monitoring devices and, more particularly, to an integrated vector control and atmospheric monitoring station.

10 DESCRIPTION OF THE RELATED ART

A vector is an organism that carries a disease-causing organism or a parasite. Further, an organism that can harbor the parasite but currently is not harboring the parasite is referred to as a vulnerable organism. When the vector comes in contact with the vulnerable organism, the vector transfers the
15 parasite to the vulnerable organism. The vulnerable organism that harbors the parasite is a host. For example, it is well known that mosquitoes are vectors of malaria-causing parasite plasmodium and human beings are hosts to the malaria-causing parasite.

Diseases such as malaria are infectious and can spread rampantly, resulting in an epidemic. For
20 instance, one mosquito can transmit malaria to many hosts. Each host can then transmit the parasite to other hosts as well as to mosquitoes that come in contact with the host. Thus, hosts of malaria simple multiply and the disease spreads rapidly. Such rapid spread can lead to an outbreak of a malaria epidemic in a region.

As is rightly said “prevention is better than cure”; it is essential to detect the onset of an epidemic instead of treating the disease after the epidemic has occurred. A known method of detecting the outbreak of an epidemic is to monitor whether a medical condition of a host suffering from an infectious-disease is reported to medical authorities such as national medical authorities by local health care facilities of an area. For successful detection of the spread of disease, it is essential that
30 the host is diagnosed with the infectious disease. When the infectious disease is diagnosed correctly at a local health care facility, the national medical authorities are reported about the

presence of a host suffering from the infectious disease by the local health care facility authorities. The national medical authorities then monitor reports of such cases and initiate a counter measure against the spread of the infectious disease. One such counter measure is to reduce a population count of vectors in the area in which the medical case is reported. The counter measures includes spraying of aerosol insecticides specific to the vector species, immunization of the vulnerable organisms to reduce host population in the area, and creating awareness of preventive procedures to be followed to reduce the possibility of vulnerable organisms coming in contact with the vectors.

However, a disadvantage of the aforementioned method of detecting the onset of the epidemic is that the counter measures are initiated after the spread of the infectious disease has begun. This results in a damage control approach instead of active prevention of the spread of the infectious disease. Further, a considerable amount of time is required to detect the spread of the infectious disease. The time that lapses between the vulnerable organism contracting the disease to the diagnosis of the host and reporting the medical case may be so long that the infectious disease may spread to a significant number of hosts. Moreover, it is difficult to actively collect atmospheric information such as the season, wind speed, humidity content and the like of the area in which the vector thrives. This information helps predicting the onset of the epidemic and initiating preventive measures beforehand when such atmospheric conditions become prevalent in the area.

Thus, a vector monitoring system that consumes less time for detection of the onset of an epidemic and includes an active monitoring system to prevent the spread of an infectious disease is required. Further, the vector monitoring system has to be enabled with atmospheric data collecting abilities for predicting the onset of an epidemic based on environment variables, population of vectors, and the like.

SUMMARY

A system for detecting a pathogen carried by an insect that belongs to a target insect species includes a memory, a luring control system, at least one sensor, a processor, a fan, a compartment, and a biosensor. The compartment includes a zapper circuit, a light source, and an oxidizing catalyst. The memory stores predetermined physical parameters corresponding to the

target insect species as first data. The luring control system attracts an insect using first and second lures. The first and second lures are carbon dioxide and heat, respectively. The at least one sensor determines at least one physical parameter of the insect approaching the luring control system. Further, the at least one sensor generates second data based on the determined at least one physical parameter of the insect. The processor that is connected to the memory and the at least one sensor receives the first and second data, compares the first data with the second data, and generates an identification signal. The identification signal indicates whether a species of the insect matches the target insect species based on the comparison of the first and second data. The fan that is connected to the processor receives the identification signal and switches on based on the identification signal. The compartment that is connected to the fan facilitates killing of the insect by pulling the insect into the compartment.

The zapper circuit is connected to a high-voltage supply for killing the insect. The light source emits light that is incident on the killed insect. This results in generation of the second lure. The oxidizing catalyst catalyzes a photocatalytic process by which the killed insect is decomposed using the light and the oxidizing catalyst. Further, the photocatalytic process generates the first lure. The biosensor that is connected to the compartment and the processor identifies one or more pathogens carried by the killed insect. Further, the biosensor generates third data based on the one or more pathogens. The processor receives the third data and generates information including the third data and the number of identified insects that belong to the target insect species. The system further transmits the information to a data processing center. The data processing center generates a warning signal that indicates an onset of an epidemic based on the information. Thus, the system enables early detection of an epidemic and prevents spreading of an infectious disease. Moreover, the system gathers atmospheric information of the environment in which the insect, which is the carrier of the infectious disease, breeds. Thus, this information may be used to identify probable breeding areas of such dangerous insect species. Identification of such breeding areas definitely provides additional insights for detecting the onset of the epidemic in different areas having similar atmospheric conditions.

BRIEF DESCRIPTION OF DRAWINGS

The features of the present invention, which are believed to be novel, are set forth with particularity in the appended claims. Embodiments of the present invention will hereinafter be described in conjunction with the appended drawings provided to illustrate and not to limit the scope of the claims, wherein like designations denote like elements, and in which:

Fig. 1A shows an illustrative embodiment of an integrated vector control and atmospheric monitoring station;

Fig. 1B shows another illustrative embodiment of the integrated vector control and atmospheric monitoring station of Fig. 1A;

Fig. 1C shows a schematic block diagram of the integrated vector control and atmospheric monitoring station of Fig. 1A according to an illustrative embodiment of the present invention; and

Fig. 2 shows a schematic block diagram of multiple integrated vector control and atmospheric monitoring stations connected to a data processing center according to an illustrative embodiment of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS

As used in the specification and claims, the singular forms “a”, “an” and “the” include plural references unless the context clearly dictates otherwise. For example, the term “an article” may include a plurality of articles unless the context clearly dictates otherwise.

Those with ordinary skill in the art will appreciate that the elements in the Figures are illustrated for simplicity and clarity and are not necessarily drawn to scale. For example, the dimensions of

some of the elements in the Figures may be exaggerated, relative to other elements, in order to improve the understanding of the present invention.

There may be additional components described in the foregoing application that are not depicted in one of the described drawings. In the event such a component is described, but not depicted in a drawing, the absence of such a drawing should not be considered as an omission of such design from the specification.

Before describing the present invention in detail, it should be observed that the present invention utilizes a combination of system components which constitutes an integrated vector control and atmospheric monitoring station. Accordingly, the components and the method steps have been represented, showing only specific details that are pertinent for an understanding of the present invention so as not to obscure the disclosure with details that will be readily apparent to those with ordinary skill in the art having the benefit of the description herein.

As required, detailed embodiments of the present invention are disclosed herein; however, it is to be understood that the disclosed embodiments are merely exemplary of the invention, which can be embodied in various forms. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the present invention in virtually any appropriately detailed structure. Further, the terms and phrases used herein are not intended to be limiting but rather to provide an understandable description of the invention.

Referring now to Fig. 1A, a side view of an integrated vector control and atmospheric monitoring station 100 (hereinafter referred to as “a station100”) according to an illustrative embodiment of the present invention is shown. The station 100 is deployed in an outdoor environment such as an area with water bodies (puddles, ponds, and the like) in the vicinity, a park, a camping area, and an area with high human population density. The aforementioned areas are areas that are potential breeding grounds for infectious-disease causing insects that belong to target insect species. Examples of the infectious-disease causing insects are mosquitoes, black flies and sand flies. The station 100 monitors the environment in such areas to detect the onset of

an epidemic. The station 100 further logs atmospheric conditions in such areas to identify probable breeding areas of the infectious-disease causing insects.

Referring now to Fig. 1B, a front view of the station 100 according to an alternate illustrative embodiment of the present invention is shown. The station 100 is deployed in an indoor environment such as a house to detect and kill infectious-disease causing insects.

The station 100 includes an entrance 102, a microwave radar sensor 104, a compartment 106 including zapper wires 107, a fan 108, a pollution sensor 110, a humidity sensor 112, a temperature sensor 114, a rain sensor 116, a solar cell 118, a solar intensity sensor 120, a wind speed sensor 122, a global positioning system (GPS) 124, an accelerometer 126, and first through fourth batteries 128a-128d (also referred to as “batteries 128”). In Fig. 1A, the station 100 includes multiple ultraviolet (UV) light sources 130, six of which are shown – first through sixth UV light sources 130a-130f. In Fig. 1B, the station 100 shows additional five UV light sources 130g-130k. The station 100 further includes a wire screen 132 and an additional compartment 134. The compartment 106 further includes a biosensor 135.

Fig. 1C shows a schematic block diagram of the station 100 in accordance of an embodiment of the present invention. The station 100 further includes a transmitter 136, a memory 138, a processor 140, a luring control system 142, multiple parameters detecting sensors two of which are shown in Fig. 1C – image and audio sensors 144a and 144b, the biosensor 135, a zapper circuit 146. Further, the station 100 is connected to a data processing center 148.

In one embodiment, the station 100 attracts an insect towards it and directs the insect to enter the entrance 102. In another embodiment, the insect wanders around the station 100 and enters the entrance 102. The memory 138 stores predetermined physical parameters such as wingbeat frequencies of insects of various target insect species as first data. The microwave radar sensor 104 that is placed at the entrance 102 detects a movement and a wingbeat frequency of the insect. The wingbeat frequency of the insect is second data. The processor 140 compares the wingbeat frequency of the insect with the predetermined wingbeat frequencies of insects and generates an identification signal (IDN Signal). The fan 108 pulls the insect into the compartment 106 based on

the identification signal (IDN Signal). Thus, the compartment 106 traps the insect. The zapper circuit 146 includes the zapper wires 107 (also referred to as a grid of wires), a switch (not shown), and a capacitor (not shown) that are connected to the batteries 128 and the processor 140. The zapper wires 107 are connected to the capacitor and the batteries 128 by way of the switch. The zapper circuit 146 receives the identification signal (IDN Signal). When the zapper circuit 146 receives the identification signal (IDN Signal), the batteries 128 provide a voltage supply to the zapper wires 107 such that the zapper circuit 146 is at a high voltage level. When the insect comes in contact with the zapper circuit 146 that is at a high potential, the insect gets killed. Further, the UV light sources 130 generate light and heat in the compartment 106. The compartment 106 is coated with an oxidizing catalyst such as titanium dioxide. When UV light is incident on the killed insect in the presence of the oxidizing catalyst, the killed insect is decomposed in a photocatalytic process. The photocatalytic process results in generation of carbon dioxide. The carbon dioxide is used as a first lure and the heat from the UV light sources 130 is used as a second lure to attract the insect of a target insect species to the station 100. The luring control system 142 receives and outputs heat from the LED lights to lure the target insect species.

The temperature sensor 114 senses temperature values of the heat generated by the UV light sources 130 and transmits the temperature values (Temp Signal) to the luring control system 142. Further, the luring control system 142 generates an intensity signal (INT Signal) based on the temperature values (Temp Signal) received from the temperature sensor 114. The luring control system 142 outputs the intensity signal (INT Signal) to control the amount of heat emitted from the station 100, thereby controlling the temperature of the station 100. The UV light sources 130 that are connected to the luring control system 142 receive the intensity signal (INT Signal) and either increase or decrease the intensity of UV light emitted therefrom based on the intensity signal (INT Signal). In an embodiment, the luring control system 142 maintains the temperature of the heat emitted from the station 100 at 37° Celsius. Thus, the heat generated from the UV light sources 130 is used to lure the target insect species. The biosensor 135 facilitates the determination of the presence of a pathogen in the killed insect.

The station 100 further is used to determine atmospheric parameters of an area in which it is placed. The pollution sensor 110 measures a number and size of particles suspended in air in the

vicinity of the station 100. The humidity sensor 112 measures humidity in the environment. The temperature sensor 114 also measures temperature values of the environment of the area. The rain sensor 116 monitors rainfall in the area. In one embodiment, when the processor 140 receives rain fall value from the rain sensor 116, the processor 140 compares the rainfall value with a rainfall threshold value, which is stored in the memory 138. When the rainfall value exceeds the rainfall threshold value, the processor 140 transmits supply-off information to the zapper circuit 146. The zapper circuit 146 receives the supply-off information and disables the voltage supply to the zapper wires 107 by way of the switch. This prevents shorting of the zapper wires 107 by water droplets during heavy rainfall. The solar cell 118 powers the station 100. The solar cell 118 is also referred to as an energy harvesting system. The solar intensity sensor 120 detects an intensity of sun light received by the solar cell 118. Further, the solar intensity sensor 120 measures the intensity of sun light or light intensity in the area. The wind speed sensor 122 measures wind speed in the area. The global positioning system (GPS) 124 and the accelerometer 126 detect the movement of the station 100 *i.e.* location and acceleration of the station 100, thereby preventing theft of the station 100. The processor 140 generates collective data that includes a count and type of insects belonging to the target insect species identified and the atmospheric parameters of the area. The collective data may also include location and acceleration of the station 100. The transmitter 136 receives and transmits the collective data.

In addition to using the microwave radar sensor 104 to detect the wingbeats frequency of the approaching insect, the image sensor 144a is used to identify whether the insect belongs to the target insect species using known in the art image processing techniques. Further, the audio sensor 144b determines an audio signal generated by the wingbeats of the insect. The processor 140 processes the audio signal to determine whether the insect belongs to the target insect species using known in the art audio signal processing techniques.

Fig. 2 illustrates a schematic block diagram of multiple stations 100 connected to the data processing center 148 according to an illustrative embodiment of the present invention. For illustrative purpose, first through fourth stations 100a-100d are shown in the Fig. 2. The data processing center 148 includes a receiver 202, an information processor 204, and a display 206.

The receiver 202 receives the collective data and outputs the collective data. The information processor 204 analyzes the collective data and detects the onset of an epidemic based on the collective data using machine learning algorithms such as artificial neural network (ANN) and K-nearest neighbor algorithm (K-NN) and the like. The information processor 204 generates a warning signal based on the collective data. The information processor 204 further outputs analyzed data based on the collective data. The display 206 displays the analyzed data and a warning message based on the warning signal.

During rainy season, especially during heavy showers, water gets accumulated at many places in puddles and open tanks. More than often, the puddles and open tanks act as breeding grounds for mosquitoes, in particular, anopheles species of the mosquitoes. It is well known that anopheles mosquitoes are vectors of parasites of genus plasmodium, which cause malaria to humans. Thus, the anopheles mosquitoes belong to the target insect species of anopheles. In one embodiment, the station 100 is installed in a densely populated area to monitor and determine the proliferation of anopheles mosquitoes in the area during the rainy season. The anopheles mosquito has a wingbeat frequency of 600 Hertz (Hz). The memory 138 stores this value of 600Hz of the wingbeat frequency corresponding to the anopheles species. Similarly, the memory 138 stores wingbeat frequencies of possible target insect species. The station 100 attracts an anopheles mosquito (henceforth referred to as “mosquito”) towards it by using the first and second lures.

The microwave radar sensor 104 includes a millimeter frequency-modulated continuous-wave (FM-CW) chip radar sensor. The millimeter frequency-modulated continuous-wave (FM-CW) chip radar sensor is well known in the art. The microwave radar sensor 104 continuously emits a millimeter frequency wave, which gets reflected on the insect body. Further, the microwave radar sensor 104 receives the reflected millimeter frequency wave. The microwave radar sensor 104 may be operated at frequencies ranging from 24 GHz to 140 GHz. For instance, the microwave radar sensor 104 continuously emits a millimeter frequency wave and receives a reflected millimeter frequency wave having frequencies ranging from 24 GHz to 31 GHz, which is a sweep range of 7GHz. Further, the microwave radar sensor 104 processes the reflected millimeter frequency wave. Generally, when the microwave radar sensor 104 receives the reflected millimeter frequency wave, the microwave radar sensor 104 eliminates a carrier frequency from the reflected millimeter

frequency wave and generates a processed frequency wave. The microwave radar sensor 104 further includes a signal processing circuit (not shown) that de-clutters the processed frequency wave for eliminating noise from the reflected millimeter frequency wave.

- 5 When the mosquito is at the entrance 102, the microwave radar sensor 104 emits the millimeter frequency wave. The millimeter frequency wave gets reflected at all body parts of the mosquito. The microwave radar sensor 104 receives the reflected millimeter frequency wave or a radar cross section, along with the wingbeat frequency of the mosquito, which is 600Hz. The microwave radar sensor 104 generates a processed frequency wave based on the reflected millimeter frequency wave. The signal processing circuit includes a set of filters and amplifier circuits (not shown) to de-clutter the processed frequency wave. The process of de-cluttering the processed frequency wave includes passing the processed frequency wave through the set of filters and the amplifier circuits and isolating the wingbeat frequency of the mosquito. Further, parameters of the set of filters and the amplifier circuits may be tuned to isolate a defined set of wingbeat frequencies of insects of the target insect species. In the preferred embodiment of the present invention, the set of filters and the amplifier circuits are tuned to isolate the wingbeat frequency of the anopheles mosquito. The signal processing circuit further transmits the isolated wingbeat frequency of the mosquito to the processor 140.
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- 15
- 20 The processor 140 receives the isolated wingbeat frequency and compares it with the predetermined wingbeat frequencies. Further, the processor 140 generates the identification signal (IDN Signal) when the isolated wingbeat frequency matches one of the predetermined wingbeat frequencies. The fan 108 receives the identification signal (IDN Signal) and switches on. When the fan 108 is switched on, the fan 108 generates a force that pulls the mosquito into the compartment 106.
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The structure and functioning of the zapper circuit 146 is well known in the art. The switch of the zapper circuit 146 is controlled by the identification signal (IDN Signal). When the switch receives the identification signal (IDN Signal), the switch connects the high supply voltage from the batteries 128 to the capacitor. Thus, the capacitor is charged using a dc-dc boost circuit (not shown). Further, the capacitor supplies high supply voltage to the zapper wires 107. The mosquito

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is tossed around on the zapper wires 107 by the force generated by the fan 108. Thus, the mosquito is killed by an electric current that passes through the mosquito when the mosquito is in contact with the zapper wires 107 and hence, completes the circuit between the zapper wires 107.

- 5 When the electric current passes through the mosquito, plasma and vapors are generated in the compartment 106 due to the killing of the mosquito. Further, the generated plasma forms a plasma arc across the zapper wires 107 and emits light. Moreover, the vapors absorb a set of wavelengths of the UV light in the compartment 106, thereby generating modified UV light. When the mosquito includes a pathogen, the modified UV light includes a unique set of wavelengths. The biosensor
10 135 facilitates the determination of the presence of the pathogen based on this unique set of wavelengths. Further, when the mosquito does not include the pathogen, the modified UV light includes a set of wavelengths that is different from the unique set of wavelengths.

The biosensor 135 includes a focusing device (not shown), optical gratings (not shown), and
15 mirrors (not shown) that receives light emitted by the plasma arc and the UV light sources 130 of the compartment and generates a light spectrum. The biosensor 135 further includes an ultraviolet spectral complementary metal–oxide semiconductor (UV-CMOS) sensor that receives the light spectrum and generates light signal data corresponding to the light spectrum. In one embodiment, a wide angle lens is used as the focusing device, and the optical gratings, and the mirrors are used
20 to split the light from the plasma arc and the UV light sources 130 into various wavelengths to generate the light spectrum.

Moreover, the biosensor 135 includes a trigger and timing circuit (not shown) that is connected to the UV-CMOS sensor to receive the light signal data. The trigger and timing circuit processes the
25 light signal data to determine whether the light signal data corresponds to the light from the plasma arc. When the trigger and timing circuit determines that the light signal data corresponds to the light from the plasma arc, the trigger and timing circuit samples the light signal data at a predetermined sampling rate. Example of the predetermined sampling rate is 20 times per second. The biosensor 135 further includes a signal processing circuit (not shown) that receives all the
30 sampled light signal data and buffers the sampled light signal data for signal processing. Then, the signal processing circuit executes signal processing algorithms such as box and cox

transformation, sequential floating forward selection (SFFS), and linear discriminant analysis (LDA) on the sampled light signal data to generate a UV light absorption spectrum (also referred to as “third data”) corresponding to the modified UV light including the unique set of wavelengths. The signal processing circuit further transmits the UV absorption spectrum to the processor 140.

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Further, the UV light in the compartment 106 along with the oxidizing catalyst decomposes the body of the killed mosquito. The UV light in the presence of the oxidizing catalyst generates oxidizing radicals that dissociate the tissues of the killed insect. This is referred to as a photocatalytic process of the killed mosquito. This process results in the generation of heat and carbon dioxide. The carbon dioxide is then used as the second lure. Further, the UV light sources 130 generate heat, which is the first lure. The combination of heat and carbon dioxide is released into the environment by way of the wired screen 132 located at the bottom of the station 100. A combination of the carbon dioxide and the heat mimics the presence of humans. Further, the UV light intensity is controlled by the luring control system 142 to generate heat at a temperature that is enough to lure the mosquito. The carbon dioxide is released into the environment by way of the additional compartment 134 and the wired screen 132.

Further, the processor 140 receives particulate matter measurement, humidity values, temperature values, rainfall values, sunlight value intensity values, and wind speed values from the pollution sensor 110, the humidity sensor 112, the temperature sensor 114, the rain sensor 116, the solar intensity sensor 120, and the wind speed sensor 122, respectively, and generates sensor data. Further, the processor 140 generates and outputs the collective data corresponding to the sensor data and the UV absorption spectrum. The collective data also includes a count of the killed mosquitoes. The transmitter 136 receives and transmits the collective data. In an embodiment, the transmitter 136 transmits the collective data by means of wireless communication methods such as mobile network, wireless local area networks (WLAN), Low Power Wide Area Network (LPWAN) and the like. In another embodiment, the transmitter 136 transmits the collective data by means of wired communication methods such as Ethernet, local area network (LAN) and the like.

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The receiver 202 at the data processing center 148 receives the collective data and outputs the collective data. The information processor 204 receives the collective data and extracts the UV absorption spectrum, the sensor data, and the count of the killed mosquitoes therefrom. The information processor 204 determines the presence of the parasite plasmodium in the killed mosquito based on the UV absorbance spectrum. In an embodiment, the information processor 204 executes supervised learning algorithms such as support vector machines and neural networks to determine the presence of the plasmodium parasite in the mosquito based on the UV absorbance spectrum. Thus, the information processor 204 determines the onset of an epidemic based on the presence of parasites in the mosquito and the count of the killed mosquitoes. When the information processor 204 positively determines the onset of malaria epidemic, the information processor 204 generates and outputs the warning signal. The display 206 receives the warning signal and displays a warning message based on the warning signal. In an embodiment, the data processing center 148 alerts the medical authorities in the region by means of short message service (SMS), electronic mail (email), and the like. The information processor 204 transmits SMS to an external messaging server (not shown) and emails to an external email server connected to a public phone network to alert the medical authorities.

Further, the information processor 204 performs data analytics on the collective data to understand the atmospheric conditions of the environment in which the station 100 is placed. In the preferred embodiment, the data processing center 148 determines the presence of heavy showers and low temperatures that are favorable for the spread of malaria. Further, the information processor 204 generates and outputs the analyzed data. The display 206 receives and displays the analyzed data. The analyzed data may include graphs indicating a growth rate of the mosquito population in the area over a period of time, a correlation of the rainfall and the count of the killed mosquitoes, a correlation between wind speed and the count of killed mosquitoes, a correlation between the temperature of the environment of the area and the count of mosquitoes and the like. Further, a heat map of the vector population can be generated using the collective data. The medical authorities can take corrective measures to eliminate hotspots of breeding areas of mosquitoes based on the heat map.

In an embodiment, the data processing center 148 receives the collective data at regular intervals of time. Further, the collective data may be analyzed for research to study the growth and mobilization of the target vector species.

- 5 Thus, the aforementioned integrated vector control and atmospheric monitoring station 100 monitors the presence of a pathogen in an insect of a target insect species and generates a warning signal, thereby detecting the onset of an epidemic. Further, the integrated vector control and atmospheric monitoring station 100 gathers environmental data that may be utilized for studying the population growth and movement of the target vector species in relation to changes in the
- 10 environment of the region. This helps medical authorities to determine the movement of target vector species and identify probable breeding areas of the target vector species. Moreover, it reduces the response time required by the medical authorities to counter the spread of infectious diseases by the target insect species. Further, air passing through the compartment 106 is purified as the oxidizing catalyst dissociates other organic materials present in the air using photocatalytic
- 15 process. The accelerometer 126 and gyroscope (not shown) of the station 100 can detect any tampering with the station 100 and, thus, protect the station 100.

What is claimed is:

1. A system for detecting at least one pathogen carried by an insect of a target insect species, the system comprising:

5 a memory for storing at least one predetermined physical parameter corresponding to at least one target insect species, wherein the at least one predetermined physical parameter corresponds to first data, and wherein an insect is attracted to the system using first and second lures;

10 at least one sensor for determining at least one physical parameter of the insect approaching the system and generating second data based on the at least one physical parameter of the insect;

15 a processor connected to the memory and the at least one sensor for receiving the first and second data, respectively, comparing the first data with the second data, and generating an identification signal based on the comparison of the first and second data, wherein the identification signal indicates whether a species of the insect matches the at least one target insect species;

 a fan connected to the processor for receiving the identification signal, wherein the fan switches on based on the identification signal; and

20 a compartment connected to the fan for facilitating killing of the insect, wherein the fan pulls the insect into the compartment, and wherein the compartment includes:

 a zapper circuit connected to a high-voltage supply for killing the insect, wherein plasma is generated inside the compartment when the insect is killed;

 a light source for emitting light and generating the second lure, wherein the light is incident on the killed insect;

25 an oxidizing catalyst for catalyzing a photocatalytic process, wherein the killed insect is decomposed using the light and the oxidizing catalyst during the photocatalytic process, and wherein the photocatalytic process generates the first lure; and

30 a biosensor for receiving light emitted by the plasma and the light emitted by the light source, and generating an absorption spectrum, wherein the at least one pathogen carried by the killed insect is identified based on the absorption

spectrum, and wherein the processor receives the absorption spectrum and generates collective data including at least one of the absorption spectrum and a count of insects of the at least one target species.

- 5 2. The system of claim 1, further comprising a transmitter connected to the processor for transmitting the collective data to a data processing center, wherein the data processing center generates a warning signal based on the collective data, and wherein the warning signal indicates an onset of an epidemic.
- 10 3. The system of claim 1, wherein the first lure is carbon dioxide and the second lure is heat.
4. The system of claim 1, wherein the at least one sensor is a microwave radar sensor.
- 15 5. The system of claim 1, wherein the at least one physical parameter is a wingbeat frequency of the insect.
6. The system of claim 1, wherein the fan is switched off when the first data does not match the second data, and wherein the fan is switched on when the first data matches the second data.
- 20 7. The system of claim 1, wherein the zapper circuit includes a grid of wires, and wherein when the insect comes in contact with the grid of wires, an electric current passes through the insect, thereby killing the insect.
- 25 8. The system of claim 1, wherein the oxidizing catalyst is titanium dioxide.
9. The system of claim 1, wherein the biosensor generates light signal data based on the light emitted by the plasma and the light source, wherein the biosensor samples the light signal data at a predetermined sampling rate to generate the absorption spectrum, and
- 30 wherein the light source is an ultraviolet (UV) light source.

10. The system of claim 1, wherein the oxidizing catalyst further purifies air passing through the system.

11. The system of claim 1, further comprising a pollution sensor for identifying particulate matter in an environment of the system, wherein the collective data further includes particulate matter measurement corresponding to the identified particulate matter.

12. The system of claim 1, further comprising a global positioning system (GPS) for determining a location of the system and an accelerometer for determining an acceleration of the system, wherein the GPS and the accelerometer detect tampering of the system, and wherein the collective data further includes at least one of the location and the acceleration of the system.

13. The system of claim 1, further comprising a humidity sensor, a temperature sensor, a wind speed sensor, a solar intensity sensor, and a rain sensor for determining humidity, temperature, wind speed, light intensity, and rainfall values, respectively, wherein the collective data further includes at least one of the humidity, temperature, wind speed, light intensity, and rainfall values.

14. The system of claim 13, wherein the zapper circuit and the light source are operated based on the rainfall values and a rainfall threshold value.

15. The system of claim 1, further comprising an energy harvesting system for utilizing renewable energy, wherein the energy harvesting system provides a power supply to the system.

16. A system for detecting at least one pathogen carried by an insect of a target insect species, the system comprising:

a memory for storing at least one predetermined physical parameter corresponding to at least one target insect species, wherein the at least one predetermined physical parameter corresponds to first data, and wherein an insect is attracted to the system using first and second lures;

at least one first sensor for determining at least one physical parameter of the insect approaching the system and generating second data based on the at least one physical parameter of the insect;

at least one second sensor for determining at least one environmental parameter of an environment of the system;

a processor connected to the memory, the at least one first sensor, and the at least one second sensor for receiving the first data, the second data, and the determined at least one environmental parameter of the environment of the system, respectively, comparing the first data with the second data, and generating an identification signal based on the comparison of the first and second data, wherein the identification signal indicates whether a species of the insect matches the target insect species;

a fan connected to the processor for receiving the identification signal, wherein the fan switches on based on the identification signal; and

a compartment connected to the fan for facilitating killing of the insect, wherein the fan pulls the insect into the compartment, and wherein the compartment includes:

a zapper circuit connected to a high-voltage supply for killing the insect, wherein plasma is generated inside the compartment when the insect is killed;

a light source for emitting light, wherein the light is incident on the killed insect;

an oxidizing catalyst for catalyzing a photocatalytic process, wherein the killed insect is decomposed using the light and the oxidizing catalyst during the photocatalytic process, and wherein the photocatalytic process generates the first and second lures; and

a biosensor for receiving light emitted by the plasma and the light emitted by the light source, and generating an absorption spectrum, wherein the at least one pathogen carried by the killed insect is identified based on the absorption spectrum, and wherein the processor receives the absorption spectrum and generates collective data including at least one of the absorption spectrum and a count of insects of the at least one target species.

17. The system of claim 16, further comprising a transmitter connected to the processor for transmitting the collective data to a data processing center, wherein the data processing center generates a warning signal based on the collective data, and wherein the warning signal indicates an onset of an epidemic.

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18. The system of claim 16, wherein the first lure is carbon dioxide and the second lure is heat.

19. The system of claim 16, wherein the zapper circuit includes a grid of wires, and wherein
10 when the insect comes in contact with the grid of wires, an electric current passes through the insect, thereby killing the insect.

20. The system of claim 16, wherein the biosensor generates light signal data based on the light emitted by the plasma and the light source, and wherein the biosensor samples the
15 light signal data at a predetermined sampling rate to generate the absorption spectrum.

ABSTRACT

20 An integrated vector control system for detecting pathogens carried by insects of a target insect species includes a memory for storing predetermined physical parameters of the target insect species, a luring control system for attracting an insect of the target insect species, one or more sensors for determining the physical parameters of the insect, a processor connected to the memory and sensors for generating an identification signal when the predetermined physical
25 parameters match the physical parameters of the insect, and a fan connected to the processor that switches on based on the identification signal for pulling the insect into a compartment. The compartment includes a zapper circuit for killing the insect, a light source for emitting light, and an oxidizing catalyst for catalyzing a photocatalytic process by which the killed insect is decomposed. A biosensor connected to the compartment and the processor facilitates identifying
30 pathogens carried by the killed insect.

