

PEST DETERRENT SYSTEM AND METHOD

TECHNICAL FIELD

This invention relates generally to a pest deterrent system and a pest deterrent method.

5

Background

Birds and other pests are a persistent problem across environments, including urban environments. Their presence can result in contamination of exposed prepared food, scattering of food waste, and hazards to health and safety.

10

Conventional deterrent approaches have included nets, spikes, and visual scare elements. These solutions often suffer from limited effectiveness, high maintenance requirements, or reduced performance over time as pests adapt. Laser-based deterrent systems have been explored as alternatives, employing beams of light to disturb or frighten pests. While such systems show potential, many known configurations rely on fixed positions or manual operation, which restricts coverage and consistency. Conventional devices also generally operate with uniform beam characteristics such as fixed intensity or direction, making them predictable and less effective against habituated pests.

15

20

Another limitation of existing systems is the absence of integrated sensing and automated control. Without analysis of sound or video images to confirm pest presence, laser discharge may occur indiscriminately, reducing efficiency and raising safety concerns. In environments where humans are present, such systems may also pose risks to the eyes and skin if beams are directed without safeguards. Known devices often lack the ability to disable discharge in response to human proximity or recognition.

25

Accordingly, there remains a need for a pest deterrent system and method to address the foregoing issues, especially one that selectively activates laser discharge in response to confirmed pest activity, and that incorporates safety features to avoid human targeting.

Summary

In accordance with a first aspect of the invention, there is disclosed a pest deterrent system comprising a base plate, a support stem for coupling the base plate to a surface, the base plate being rotatably coupled with the support stem, at least one upper-level laser gun coupled to the support stem and being activatable for discharging a laser beam, a microphone for sound capture, at least one lower-level laser gun coupled to the base plate and activatable for discharging a laser beam, a camera for capturing video images, the camera being coupled to the base plate, and a controller wherewith the at least one upper-level laser gun, the microphone, the at least one lower-level laser gun and the camera are in signal communication. The controller analyses sounds sensed by the microphone for identifying presence of pest based on pitch and frequency characteristics, and for activating the at least one upper-level laser gun when the presence of pest has been identified sensed sounds. The camera analyses video images captured by the camera for identifying presence of pests within the video images, the controller for activating the at least one lower-level laser gun in response to the presence of pest being identified within the video images.

In accordance with a second aspect of the invention, there is disclosed a pest deterrent method comprising analysing sounds sensed by a microphone by a controller for identifying presence of pest based on pitch and frequency characteristics, and for activating at least one upper-level laser gun for discharging a laser beam therefrom when the presence of pest has been identified sensed sounds, the at least one upper-level laser gun being coupled to a support stem, the support stem for coupling a base plate to a surface, the base plate being rotatably coupled with the support stem. The method further comprising analysing video images captured by a camera by the controller for identifying presence of pests within the video images, the controller for activating at least one lower-level laser gun for discharging a laser beam therefrom in response to the presence of pest being identified within the video images, the at least one lower-level laser gun and the camera being coupled to the base plate. The at least one upper-level laser gun, the microphone, the at least one lower-level laser gun and the camera are in signal communication with the controller.

Brief Description of the Drawings

Figure 1 shows a front view of a AI based laser light pest repellent (L2PR) apparatus in a popsicle shape self-contained apparatus suspended from a building structure in accordance with a first embodiment of this invention based on an aspect of the invention;

5

Figure 2 shows a section across the front view (see through) of the L2PR apparatus as shown in Figure 1 with second embodiment of the steel support stem and the third embodiment of functional components inside the apparatus;

10

Figure 3 shows a side view of the L2PR apparatus as shown in Figure I & Figure 2;

Figure 4 shows a section across the front view (see through) of the L2PR apparatus as shown in Figure 3 with second embodiment of the steel support stem and the third embodiment of functional components inside the apparatus;

15

Figure 5 shows a plan view of the turret base with the demonstrative angle of view of the CCTV camera and projection angle of the high-level laser gun/s;

Figure 6 shows a plan view of the turret body with the demonstrative angle of view of the and projection angle of the low-level laser gun/s;

20

Figure 7 shows a section view of Area of Protection with single apparatus (Bounding Box illustrated);

25

Figure 8 shows a plan view of Area of Protection (Camera lined to center of Bounding Box illustrated);

Figure 9 shows a plan view of Area of Protection (Camera lined to edge of Bounding Box illustrated);

30

Figure 10 shows a section view of Area of Protection with two Apparatus (Bounding Box illustrated);

Figure 11 shows a plan view of Area of Protection with 2 apparatus (Bounding Box illustrated);

5 Figure 12 shows a section view of Area of Protection with Spot Target area (close distance illustrated);

Figure 13 shows a plan view of Area of Protection with Spot Target area (close distance target area illustrated);

10 Figure 14 shows a section view of Area of Protection with Spot Target area (intermediate distance illustrated);

Figure 15 shows a plan view of Area of Protection with Spot Target area (intermediate distance illustrated);

15 Figure 16 shows a section view of Area of Protection with Spot Target area (Yonder distance illustrated);

20 Figure 17 shows a plan view of Area of Protection with Spot Target area (Yonder distance illustrated); and

Figure 18 shows a high-level laser beam projection.

Detailed Description

An exemplary embodiment of the present invention, a pest deterrent system, is described hereinafter with reference to FIG. 1 and FIG. 18. The pest deterrent system may be utilized and implemented using a pest deterrent method.

Pest Deterrent System

In accordance with a first aspect of this invention, there is provided an external frame comprising elements (A1, A02 and A03), constructed in a dust-free, non-metallic construction and configured to define a popsicle shape apparatus. The frame includes a first member (A03), which serves as a turret base; a second member (A02) which forms a turret composed of equal halves defining a capsule body and a third member (A1), which functions as a support stem connecting both halves of the turret to the structure from which the self-contained apparatus is suspended.

The first half capsule member (A03) shall have a projecting sill that extends outward beyond the cylindrical edge of the second half capsule member (A02), preventing dust from entering the apparatus. The support stem (A1) is constructed from a steel stem (A04) formed of a round hollow section.

One end of the steel stem is welded to a flat mounting plate (A05), while the opposite end threaded for a distance of 30-50mm to facilitate secure attachment. Preferably, apertures are formed on the steel stem (A04), one/ more apertures are located above the capsule and one or more within the turret above the same generatrix base (A18); these machined apertures allow cables from the components inside the capsule to exit and connected to an external control panel.

The flat plate (A05) enables the support stem to be securely fastened and anchored to the supporting structure without requiring on-site welding, thereby avoiding potential damage to

existing structural members. Additionally, the plate allows for adjustment of the apparatus to ensure proper levelling and plumb alignment during installation

5 A EPDM grommet (A30) is fitted over the oculus the top of the the dome allowing the support stem (A04) extending from the soffit of the structure to pass through the grommet and into the core of the capsule. The stem (A04) pass the annulus base plate for the turret base (A10), and is received by a sealed castor bearing (A32). This arrangement enables adjustment of the final height of the capsule and supports the entire weight of the capsule. The turret base is balanced on other sections of the annulus support plate via crossed roller
10 skewing bearing with inward facing gears attached to the perimeter of the plate (A10).

Additionally, the external body of the capsule body, comprising members (A02 and A03) includes a number of preformed apertures configured to accommodate the installation of devices with indicating, controlling or sensory function relating to the external parameters. A
15 clear acrylic cover (A12) is mounted over the front facing opening of the apparatus to protect the (A24) CCTV camera. The cover can be removed to allow access for maintenance enabling the camera to be extracted and replaced as needed.

A narrow, vertical embrasure (A14) is formed at the front of the capsule body (A03) in
20 combination with an opening sealed by a bottom dish shaped access cover (A15). The access cover is fabricated from the same material as the capsule body and is provided solely for functional checks of internal components and mechanism. This feature allow the entire apparatus to be placed on the ground maintenance or testing without obstruction.

25 Within the Capsule body, housed a metallic mechanism designed to set the azimuth orientation of the upper-level laser gun(s) (A20) enabling precise mapping of the upper space within the area of coverage. The angle of tilt about the y-axis is manually adjusted using a removable lug wrench inserted through one of the above-described apertures aligned along the directrix of the turret body.

A similar mechanical arrangement is provided for the IP based CCTV camera (A24) allowing adjustment the azimuth orientation within lower portion of the area of protection. A noise cancelling condensing microphone (A13) is mounted inside the front aperture of the Capsule body. Additional apertures of approximately same diameters are fitted with a high-intensity
5 strobe light for rapid indication, a “system normal” indicator light and an emergency stop (kill switch) button.

For replacement of the laser gun(s), the front protective cover over these gun(s) must first be removed. The laser gun(s) can be manually extracted and replaced by attaching afunctional
10 unit via a snap-fit connection utilizing a neodymium magnet type power adapter. To replace the CCTV camera (A24), the side access panel and front acrylic cover (A12) must first be removed, followed by disconnecting of the multiple pin adapter.

Within the rotary turret body is housed a metallic mechanism configured to provide pan- tilt
15 functionality. This mechanism allows for adjustment of the azimuth orientation of low- level laser gun(s) positioned within the embrasure as well as control of the tilt angle about the y-axis in coordination with the horizontal rotary motion.

The condensing microphone is configured to capture the audio sounds from bird/s within the
20 indoor structure. The captured sounds are analyzed based on the pitch and frequency characteristics which are then processed and compared against pre-trained convolutional neural network (CNN) model to determine the source is avian in nature. This audio-based detection function is particularly useful in high ceiling areas of the protected zone where visual detection may be limited or ineffective due to structural elements that may obscure the
25 line of sight, In such locations, the detected birds are typically either roosting or scouting rather than scavenging.

The function of the IP based fixed CCTV camera is to detect the presence of bird/s and human, particularly the latter within the area of protection. In particular, the camera monitors
30 individuals who may in close proximity with the apparatus when servicing it or facing the

apparatus where they could be potentially exposed to sudden discharge of laser beams. An optional attribute is to capture the presence of fire within the monitored area.

The CCTV camera operates primarily in the lower portion of the protected space, where visual recognition is based on the entire Bird and for human, the head and top torso of the body. The data for lower torso for AI analytic is discarded during AI processing to expedite the data processing in order to reduce computational load and expedite processing time. AI analytic for both human and bird/s is based on shape and size scalability.

For optional fire/ smoke detection, AL analysis is based on color, texture and size scalability features.

Upon matching the captured audio signal to a bird sound using a pre-trained convolutional neural network (CNN), the upper-level laser gun(s) is/are activated for a predetermined duration of approximately ten (10) seconds

Upon matching the video imagery of the area of protection against a pre-trained convolutional neural network (CNN) configured to recognize bird shapes, the lower-level laser gun(s) (A16) is/are activated for a predetermined duration of approximately seven (7) seconds.

When activated, the laser gun(s) applies varying operational attributes – such as time duration, intensity, and non- linear polarisation at the output plane – in a manner configured to create disruptive dissonance.

These variations are applied to ensure that each beam discharge lacks consistency, thereby preventing birds from adapting cognitive learning by confusing their ability to recognize or anticipate the stimulus.

The CCTV camera (A24) continue to monitor for the presence of bird/s following the first discharge.

If birds are still detected, a repeat second discharge is triggered after a time delay of approximately ten (10) seconds. Upon a further repeat until the fourth such detection event, an extended beam emission of approximately three (3) minutes with maximum intensity is activated.

5

A possible combination of the apparatus includes a combination of one or both laser gun/s operating in an active duty, while remaining laser gun stays in standby mode.

A photo beam sensor is positioned within to detect when an active laser gun is discharged. The sensor generates a signal corresponding to the discharge event, which may be used for monitoring, verification, or system coordination purposes.

10

In simplified form, the invention may still be configured as a self-contained apparatus but the mode of operation is selectively enabled by one of the following activation methods: 2.4GHz smartphone application, timer-based activation or localised control of momentary switch.

15

In a further simplified form, the self-contained apparatus may operate without requiring the CCTV camera and/ condensing microphone, enabling non-automatic functionality based on the attributes previously described

20 Pest Deterrent Method

AI-analytic software for processing the image/ audio into visual recognition of classifier as human or bird, further comprising of deterrent members of first low-level laser gun/s aimed at area below the device operable by visual recognition, and second high-level laser gun/s aimed at object above the device.

25

A fully automatic, self-contained, AI-based Laser Light Pest Deterrent System (L2PR) device for repelling birds from at least a portion of an object, said device comprising:

- a. an external capsule body;
- b. sensory members including:

- first element- visual sensor in the form of a Fixed IP CCTV camera (A27) configured to capture image data,
 - second element- audible sensor in the form of a condensing microphone (A13) configured to detect sound data,
- 5 c. an artificial intelligence (AI) analytics module operatively connected to said sensory members, said AI module for processing said image and data to classify detected classifier as either human or avian;
- d. further comprising of deterrent members comprising:
- a first element- low-level laser gun(s) (A16) aimed downward below the
- 10 device, activated by the AI module upon detection of a bird within a defined area; and
- a second element- high-level laser gun(s) (A20) aimed upward toward the
- object at / above the device, selectively activated based on positional analysis and classification by the AI module;
- 15 All components are integrated into a single, self-powered unit, and operation of the deterrent members is fully automatic based on real-time sensory input processed through the AI analytics module.

20 The preferred embodiments of the present invention provide numerous advantages. Nuisance posed by the birds and the associated health risk can be effectively mitigated by repelling the birds using low powered laser gun(s) in a humane way that does not injure or cull them. Both high-level (A20) and low-level (A16) laser gun(s) emits targeted beams that deter avian presence without causing harm.

25 The present invention actively prevents birds from developing adaptive learning through cognitive behaviour pattern. This is achieved by the apparatus simulating unpredictable movement and behavior via a robotic control system, thereby avoiding habituation to fixed or repetitive deterrent actions.

The area of protection by the present invention comprises a structure having an indoor space or semi-indoor space configured to shelter human from the environmental elements, such as rain or sun, while facilitating the preparation, serving, or sale of food. This type of environment is particularly attractive to pests, especially birds, due to the ready availability of food sources.

The structure may have one or more open or partially enclosed sides which allow for ventilation and accessibility but also render the space vulnerable to pest ingress. As a result, birds are able to enter the area freely for roosting or food scavenging. Due to the open nature of such structures, conventional pest deterrent systems—such as physical barriers or static visual repellents—are often inadequate or ineffective. The apparatus of the present invention addresses these limitations by providing an automated, humane, and adaptive bird repellent system.

Construction of Apparatus Constituting the Pest Deterrent System

Referring now to Figure 1 and Figure 3, described herein broadly the external feature of the apparatus, there is illustrated a first preferred embodiment of the apparatus generally designated (A01) which embodies the aesthetic aspect and functional aspects of the invention as well as illustrating the method for repelling birds from area of protection in accordance with the present disclosure.

The capsule body of the popsicle-shaped apparatus (A01), having approximate dimensions of 400mm in diameter and 750mm in height, is fabricated using non-metallic material, preferably in fibreglass or plastic polymer, and may be manufactured using 3D printing technology.

The capsule body comprises at least a first half capsule member (A02) and a second half capsule member (A03). The first half capsule member A02 includes a protruded sill (A10) that extends beyond the cylindrical edge of the second half capsule member (A03). This sill

A10 serves to shield the internal components housed within the enclosure from the ingress of dust, intrusion by pests and unauthorised access to the apparatus.

5 The construction of the support stem (A04) comprises a flat plate (A05) that is welded to one end of steel stem (A04) which is formed from round tube section. The opposite end of the steel stem (A04) is externally threaded over a length of approximately 30-50mm, facilitating secure attachment to a mounting structure.

10 The apparatus (A01) is configured for static mounting, wherein it is suspended at a minimum height of 3m above finished floor level, or higher depending on the spatial constraints. The installation location is predetermined based on the radial coverage limitations of the control software, ensuring optimal protection across the defined area of protection.

15 One or more apertures (A07, A08) are preferably formed in the steel stem (A04) above the capsule assembly and an additional aperture (A09) is located within the turret base, aligned along the same generatrix as apertures (A07 and A08).

20 These machined apertures allow for the passage of cables from internal components housed within the capsule to an external control panel, enabling connection and operational control of the apparatus. The flat mounting plate (A05) facilitates secure attachment of the support stem (A04) to the structure without requiring field welding which could otherwise damage the existing steel member. Furthermore, the flat plate A05 allows for adjustment during installation to ensure proper levelling and plumb alignment of the apparatus.

25 Referring now to Figure 1 to Figure 6, described herein the basic internal support elements of the capsule body upon which all devices are mounted onto. Included in the first preferred embodiment is an EPDM grommet (A30) having inner diameter of approximately 50mm, which is positioned over the oculus at the dome of the capsule body (A02).

30 This grommet allows the support stem (A04) to extend towards the soffit of the stem structure and into the core of the capsule body pass the annulus base plate (A31) for the turret

assembly. The stem (A04) is received at its lower end by a sealed castor bearing (A32) and an internally threaded steel plate (A33), which together allows for fine adjustment of the final height of the capsule and support the entire weight of the apparatus.

5 The capsule is rotationally supported by a crossed roller skewing bearing (A25) mounted beneath the annulus base plate (A31). This bearing includes inward-facing gears (A23) attached along the perimeter of the annulus base plate (A31) enabling controlled rotational movement of the turret base relative to the support stem structure.

10 Referring now to Figure 1 and Figure 3, described herein all the devices having indicating, control, or sensing functions associated with the external of the first half of the capsule body (A02). Also included in the first preferred embodiment are a number of apertures formed on the external body of the 1st half of capsule body (A02), where the capsule body are preferably used for mounting devices having indicating, control, or sensing functions related
15 to external parameters.

These devices include, but are not limited to,

- a. a rapid strobe indicating light (A19);
- b. emergency stop (kill switch) button (a18);
- c. condensing microphone A13 sensory function

20

Additionally, a clear acrylic cover (A13) approximately measuring size 200mm in width x 120mm in height, is mounted over a front-facing opening in the apparatus. This cover provides protective shield for the Fixed IP CCTV camera (A27) located inside, allowing for unobstructed operation while protecting the camera. from environmental elements.

25 The acrylic cover (A13) is removable, enabling access for maintenance, removal, or replacement of the CCTV camera (A27) as needed.

Referring now to Figure 1 and Figure 3, described herein all the devices associated with the external of the second half of the capsule body (A03). Included in the first preferred
30 embodiment and formed on the external body of the capsule body (A03), are

- a narrow, vertical embrasure (A14) approximately 25mm wide x 200mm high that is formed at the front of the capsule body (A03).
- an opening at the bottom of the capsule body (A03), of approximately 250mm in diameter, which is sealed off by a dish shaped access cover (A15).

5

- The access cover (A15) is fabricated from the same material as the capsule body and is provided for the purpose of conducting functional checks of both internal components and mechanism.

10 This design allows the apparatus to be placed flat on the ground for maintenance or inspection, facilitating easy access and operational testing without requiring disassembly of the entire unit.

15 Referring now to Figure 2, Figure 4, Figure 5 and Figure 6, there is illustrated a second preferred embodiment of the apparatus designated generally as A01 which illustrates the functional and operational aspects of the mechanical mounting assembly, apertures and fitments associated with the high and low-level laser gun(s) and the process to remove and replace them.

20 Within the capsule body is located an apparatus is

- a mechanical mounting assembly (A21) for setting the azimuth orientation of the upper level laser gun(s) (A20) to math upper space over the area of coverage, ensuring precise alignment over the upper portion of the defined area of protection. The mechanism further includes a holding bracket(A22) that controls the angle of tilt (pitch) of the camera relative to the y-axis with final setting by tightening the locknut on the bracket. This adjustment can be made using a removable lug wrench inserted through one of the above-described apertures formed along the same directrix of the capsule body, allowing for manual calibration in the field.

25

- to remove and replace either one of the high-level laser gun(s) (A20), the front clear acrylic cover (A11) needs to be removed first. Once access is provided, the laser gun (s)(A20) can be manually extracted and replaced with a functioning unit via a Snap-On magnetic connection, utilizing a neodymium magnet type power adapter (A34).
- 5 • Also included in this second preferred embodiment a similar mechanical mounting set up (A32) located on the turret base (A10) , configured to support and adjust the azimuth orientation of the IP fixed CCTV camera (A24).

This arrangement allows the camera (A24) to be directed toward the lower portion of the area of protection. the lower portion of the area of protection. To service or replace the camera (A24), the side access panel (A17) and front acrylic cover (A13) must first be removed. The camera (A24) is then disconnected from the A34 multiple pin and released from the mounting base (A32) for removal or replacement.

15 Referring now to Figure 1, Figure 2 and Figure 5, described herein functional and operational aspects of the audio detection system within the second half of the capsule body (A03). There is illustrated an audible detection system is incorporated with a noise-cancelling condensing microphone (A13) is placed inside the front-facing aperture located on the Capsule body. The microphone (A13) is configured to detect ambient sound within the area of protection, enabling audio-based monitoring or triggering of system responses as part of the apparatus' integrated deterrence functionality.

Referring now to Figure 1, Figure 2 and Figure 5, described herein functional and operational aspects of the video detection system incorporated within the capsule body and the process to remove and replace the camera. This system includes a IP based fixed CCTV camera (A24) that is capable of supporting AI-based analytics through integrated Random Access Modules (RAM) and Read Only Modules (ROM) modules used for coding and image processing.

Included in the fourth preferred embodiment is an AI analytics module with primary function to detect human and avian, and secondary function to detect fire or smoke. This feature

enhances the apparatus' ability to provide multi-functional surveillance and hazard detection, expanding its utility beyond bird repellent and to include fire safety monitoring.

Referring now to Figure 1, Figure 2 and Figure 5, described herein control and system indication light each serving a distinct operational or safety function, and the process to service or replace them.

There is illustrated a fifth preferred embodiment of the present invention. On the first half of the capsule body (A02). Are a number of device, include

- a “error status” module in the form of rapid strobe indicator (A19),
- a “power normal” indicator (A33) and
- a emergency stop (kill switch) button (A18).

To facilitate maintenance or replacement of these components, the side access panel on first half capsule body (A02) is first removed, followed by the removal of the respective lock nut(s) securing the switch or indicator. The component can then be disconnected and replaced as needed. Once the new switch or indicator is in place, it is secured back into position using the original lock nut, ensuring a stable and safe installation.

Referring now to Figure 2, Figure 4 and Figure 6, described herein the mechanical pan-tilt assembly used for the operations of the low-level laser gun(s) within the second half of the turret base plate, capsule body(A03); here as illustrated the sixth preferred embodiment of the apparatus A01.

The mechanical pan-tilt assembly (A35) is located under the annulus base plate (A31), includes

- the sealed castor bearing (A32) mounted to the stem (A04) to allow for smooth horizontal movement,
- automatic horizontal movement - an inward-facing gears (A23) attached to the annulus base plate (A31) along the perimeter, together with a direct current stepper

motor (A38) operate along the horizontal azimuth orientation across the x-axis with maximum angle of tilt set according to site condition but not exceeding 180 degree.

- Automatic vertical movement - a sector gear (A27) with the maximum center angle of 90 degree, installed vertically onto the annulus base plate (A31) and fitted to a direct current stepper motor (A23) that controlled the vertical azimuth orientation in the y-axis with a maximum angle of tilt restricted by the embrasure (A14) on the capsule body (A03).
- The camera (A24) will facilitate the fine tuning of the vertical and horizontal azimuth orientation according to the detected avian location within the camera captured frame.

Referring now to Figure 17, described herein the local motor control panel used to power and activate the present invention.

There is illustrated a seventh preferred embodiment which includes a separate LMCP configured to operate one or more apparatus simultaneously. The LMCP shall be mounted out of reach of most human to prevent unauthorized access to the LMCP.

The LMCP comprises:

- a miniaturised circuit breaker for incoming power supplies protection and
- a step-down transformer cum trickle charger that converts the input voltage to a regulated 12 Volt direct current (12 VDC) ,
- sealed lead acid battery for backup power,
- indicator lights including Fault/Normal/ Charger fail/ Fire (optional) LED indicators,
- test switches for routine servicing,
- scrolling LCD display and
- a master controller card.

The master controller card includes:

- which comprise of A voltage modulator,
- An E²PROM module embedded with Convolutional Neural Network (CNN) coding for image processing and behavioural recognition,
- A RAM drive,
- 5 • A a removable solid-state hard disk for data storage,
- And a SIM-based wireless router for remote communication and control.

In addition to these components, the LMCP incorporates a incorporates a self-diagnostic function to perform routine system initialization checks and generate fault reports, ensuring
10 reliable operation of the apparatus.

Whereas the step-down transformer cum trickle charger, cabling, and related power delivery components may be required to serve more than one (1) apparatus (A01) at any one time, the CPU shall be coded such it is capable of establishing an address for each apparatus (A01)
15 served. This enables the CPU to carry out the abovementioned system diagnostic and fault reporting on an individual basis.

In configurations where multiple units of the apparatus A01 are connected to a single Local Motor Control Panel (LMCP), the step-down transformer, trickle charger, and associated
20 cabling are designed to support simultaneous operation across multiple apparatus (A01). The central processing unit (CPU) within the master controller card is programmed to assign a unique address and manage unique identifiers for to each connected apparatus (A01), thereby enabling individualized control, monitoring, and maintenance functions across the entire networked system.

25

Referring now to the foregoing figures, described herein the AI-based analytic software module in conjunction with the audio-visual detection system.

There is illustrated a eighth preferred embodiment of the apparatus (A01), an AI analytic software configured to work with the noise cancelling condensing microphone (A13) to detect and identify bird activity within the indoor structure.

- 5 The AI software processes audio signals captured by the microphone A13, analyzing the pitch and frequency of sounds emitted by birds. These acoustic characteristics are compared against pre-trained Convolutional Neural Network (CNN) database to determine whether the detected sound corresponds to bird vocalizations.
- 10 This function is particularly useful for high space of the area of protection where visual detection may be obstructed by structural elements such as beams, ducting, or overhead fixtures. In such areas, birds are typically observed roosting or scouting, rather than actively scavenging.
- 15 Included in the eighth preferred embodiment is the image-based detection functionality provided by the IP based fixed CCTV camera (A24) which capture video data for both bird/s and human presence.

- The CCTV camera (A27) operates primarily in the low space of the area of protection where
- 20 visual recognition of full-body Bird silhouettes and for human head and upper torso is feasible.

- The AI analytic for both human and bird rely on shape recognition and size scalability, allowing for accurate classification and contextual response generation. An optional feature
- 25 of the AI analytic software includes the capability to detect fire or smoke based on colour variation, texture pattern and size scalability of anomalies within the field of view.

- Upon confirmation of a match with the fire or smoke algorithm, the central processing unit (CPU) generates and transmits a signal output through an electrical connector, which may be
- 30 linked to an external visual and/ or audible alarm system, enabling prompt hazard response.

Referring now to the foregoing description, described herein how the pre-trained Convolutional Neural Network (CNN) is configured to process the data obtained from both audible and video recognition and generate the output for the apparatus (A01) to operate and
 5 repel the birds.

The first step is to define the area of protection from the captured image indoor structure i.e. without human, avian or pest using a simple monte carlo method by repeating the initial process on the pre-trained Convolutional Neural Network (CNN) to form the convulsion
 10 layer or backdrop for AI analysis.

In the context of video recognition, images frames in the bounding box are continuously processed through region of interest (ROI) pooling mechanism, wherein proposed regions from the established background are analyzed to generate object classification results.

15

The resulting classifier operates based on shape and size scalability, enabling accurate differentiation between human and birds. In the context of audible recognition, the system performs background analysis and compares against the stored frequency and pitch profiles corresponding to selected birds for classifier matching. This comparison facilitates audio-
 20 based classification and identification of avian presence.

As an optional feature, the system includes visual fire and smoke detection capabilities across successive frames, includes:

Fire detection is based on analysis of the colour spectrum and size scalability Smoke
 25 detection relies on evaluation of texture spectrum and size scalability.

When either condition is identified by the AI algorithm, the presence of fire or smoke is confirmed, and appropriate system responses may be initiated.

Referring to the foregoing description, the term "bounding box" as used herein defined as the
 30 virtual area representation of the lower space of area of protection that is digitally configured

captured camera imaging to form the convolution layer which is the background for the AI analysis.

The bounding box will be constantly processed with the convolution layer and eventually predict the presence of a classifier - such as human or birds - through visual detection methods.

In each image processing iteration, a regional proposal is generated within the bounding box and used to match against known classifiers.

The classifier in this present invention comprises an ensemble of programmed instructions that map and interpret image or audio features corresponding to humans, birds, fire or smoke, on the following basis.

Classifier	Visual recognition				Audible recognition
	Colour	Size scalability	Shape	Texture	
Human	Exclude	Yes	Head and Upper torso	Exclude	
Human	Exclude	No	Head and eyes only ¹		
Bird	Optional	No	Full body	Exclude	Bird's chirping
Alternative fire	Yes	Yes, minimum of 0.75m ²	No	Optional for smoke, minimum of 2m ²	

Referring now to Figure 8 to Figure 15, describe herein is the AI-event and mode of activating the laser gun(s) used for bird repellent. There is illustrated a ninth preferred embodiment of the present invention wherein activation:

- The lower-level laser gun(s) (A16) is triggered upon matching the video imaging of bird shape

- The upper-level laser gun(s) (A20) is triggered upon matching the vocalizations of birds.

- Once a bird is identified, the laser gun(s) (A16 r A20 respectively are activated, During activation, each laser gun applies variant operational attributes designed to create disruptive dissonance, including:

- variable time duration durations of laser beam discharge,
- Modulated intensity levels,
- Non-linear polarisation at plane

10 These variations ensure that no consistent pattern is detectable by the bird(s), thereby preventing adaptation through cognitive learning. Additionally, vibration chipsets (A35) attached to respective laser gun(s) (A16 or A20) activated simultaneously with the laser beam discharge. This generates an accompanying auditory and tactile disturbance, further enhancing the deterrent effect.

15

The following table summarizes the relationship between laser activation and associated disruptive attributes:

Pest repellent operation	Activation	Birds	Human not facing apparatus ²	Human facing apparatus ¹
Low level laser gun(s) ³ (A16) with diffraction grating len, inside turret	Visual recognition	Activate for 7±2 seconds maximum, paused for 10 s minimum. (adjustable)	Continue to operate if no human face detected (Optical safety protection)	Disable function immediately (Optical safety protection)
High level laser gun(s) (A0) with multiple lens, inside turret base	Audible recognition	Activate for 7±2 seconds (adjustable)	Not applicable	Disable function immediately (Optical safety protection)

20

The IP based CCTV (A17) will continue to monitor presence of bird(s) after the first laser beam discharge.

When the bird(s) are not repelled, the apparatus will emit a second discharge after a time lapse of ten (10) seconds for the same beam discharge duration. This is again repeated a third time if the situation remains status quo. On the fourth event, the laser beam discharge duration will be increased to approximately 3 minutes and the maximum laser intensity will be applied.

Included in the above attributes is a configuration wherein one or both laser gun(s) may be designated as on active duty and the additional laser gun is maintained in standby mode for deployment as needed. This dual-mode operation enhances system reliability and ensures continuous deterrence capability to reduce mean time between failure of the apparatus.

A photo beam sensor is positioned internally within the apparatus (A01) to detect the activation of a laser gun discharge. The sensor captures and records each triggering event, allowing the system to compare the actual laser firing activity against expected operational parameters. This enables real-time verification of performance, fault detection, and logging of system behaviour for maintenance and diagnostic purposes

Included in the above attributes is the key characteristics and attributes of the laser gun(s)

- Class: 2 or lower,
- Beam colour: green and/ or blue,
- Wave length: 380 Nm to 600 Nm,
- Power rating: ≤ 1 Watts) with diffraction grated lens.

An option al configuration of upper-level laser gun(s) (A20) equipped with multiple lenses configured to project laser from the top of the enclosure.

The laser beam output is arranged to provide minimum coverage of 180-degree radial distribution, enabling broad spatial deterrence and improved effectiveness in repelling birds across a wide area. This feature enhances the apparatus' ability to cover open or semi-

enclosed environments where birds may approach from multiple directions, ensuring comprehensive protection without requiring mechanical repositioning of the laser unit.

Referring now to the foregoing description, describe herein is laser beam characteristics of the low-level laser guns in this present invention which is configured to project onto a small beam spot in the location inside the area of protection where the bird is detected. Therein this laser beam will be discharged after the mechanism has automatically established the desired azimuth orientation in both x-axis and y-axis to align with the position of the bird detected by the camera (A24). The purpose of this narrow beam divergence approach is to prevent optical injury to humans who are within the area of protection and they may be exposed to laser beams when they are discharged.

There is illustrated is a rotary function mounting mechanism for the low level laser gun(s) (A16) that will pan and tilt the laser gun(s) to aim the target area where the bird(s) is detected as previously described. This feature enables controlled rotational movement of the laser unit, to operate the apparatus in large area or large density of human presence who may be suffer optical injury from the laser beams.

The proposed safety measure is to limit the beam spot that lands onto the target area by controlling the spatial distance between bulb and len or len diopter value ie not to apply a broad beam that extends to the entire or most of the area of protection. These adjustments allow for optimized deterrence performance while maintaining compliance with laser safety standards.

Whereas it is deemed configuring large beam spot over extended target area may have health risk concerns for humans, the target beam spot may be reduced to a portion of the area of protection of approximately 0.05m² to 0.1m², by changing the laser gun lens to reduce the beam projection area over the entire area of protection.

When the extent of beam spot is reduced, compensation for coverage is made by allowing the laser gun to be moved to target area where Bird/s was detected.

In such instance, ability of the laser light to cover the entire area of protection is managed by a pair of servo motors (A38 & A23) to direct the laser gun/s to the correct horizontal and vertical axis respectively. The movement of either servo motors shall be powered by direct current, intrinsically safe low voltage, reversible through polarity switching and controlled by contact type limit switch that prevent motor overrun.

Referring now to Figure 16, described herein the method for activating the high-level laser gun(s) (A20) using audio detection system. There is illustrated a tenth preferred embodiment of the apparatus A01, the audio detection system in form of noise-cancelling condensing microphone (A13) s sent to the pre-trained Convolutional Neural Network (CNN) module which process the data against the stored bird vocalization and upon matching the sound, activates the upper level laser gun(s) (A20) . This response is designed to deter birds located in elevated or less accessible areas of the structure, where audible cues may be more reliable than visual detection due to environmental or architectural constraints. The activation sequence follows predefined operational logic to ensure timely and targeted deterrence while minimizing unnecessary energy consumption and potential habituation by birds.

Referring now to Figure 2 and Figure 4, described herein is a self-contained, standalone apparatus that is not wired to external power source or control module i.e. apertures (A7, A8, A9 and A13) on the stem (A04) are no longer required.

There is illustrated a eleventh preferred embodiment of the present invention, which is a simplified form, the invention may still exist as a self-contained standalone apparatus (A01). The mode of operation in this embodiment may be initiated through various means including:

- 2.4GHz “Zigbee” wireless signal remote activation,
- Smartphone application-based control,
- Timer-based automatic activation or by Manual activation using momentary push-button switch.

This multi-mode control capability enhances the versatility and ease of use of the apparatus, making it suitable for a wide range of installation environments and user preferences.

5 Referring now to Figure 2 and Figure 4, described herein a simplified bird repellent system that is non automatic. There is illustrated a twelfth preferred embodiment of the present invention, which in further simplified form, the self-contained apparatus does not not require CCTV camera (A24) and/ or condensing microphone (A13) and the pre-trained Convolutional Neural Network (CNN) module to operate with the above-described attributes
10 for non-automatic function/s. This simplified design offers a cost-effective alternative suitable for environments where full sensory automation is not required, while still maintaining the deterrent functionality of the apparatus A01.

Aspects of particular embodiments of the present disclosure address at least one aspect,
15 problem, limitation, and/or disadvantage associated with existing pest deterrent systems and method. While features, aspects, and/or advantages associated with certain embodiments have been described in the disclosure, other embodiments may also exhibit such features, aspects, and/or advantages, and not all embodiments need necessarily exhibit such features, aspects, and/or advantages to fall within the scope of the disclosure. It will be appreciated by
20 a person of ordinary skill in the art that several of the above-disclosed structures, components, or alternatives thereof, can be desirably combined into alternative structures, components, and/or applications. In addition, various modifications, alterations, and/or improvements may be made to various embodiments that are disclosed by a person of ordinary skill in the art within the scope of the present disclosure, which is limited only by
25 the following claims.

Claims

1. A pest deterrent system comprising:
 - a base plate;
 - a support stem for coupling the base plate to a surface, the base plate being
 - 5 rotatably coupled with the support stem;
 - at least one upper-level laser gun coupled to the support stem and being
 - activatable for discharging a laser beam;
 - a microphone for sound capture;
 - at least one lower-level laser gun coupled to the base plate and activatable for
 - 10 discharging a laser beam;
 - a camera for capturing video images, the camera being coupled to the base
 - plate;
 - a controller wherewith the at least one upper-level laser gun, the microphone,
 - the at least one lower-level laser gun and the camera are in signal communication,
 - 15 wherein the controller analyses sounds sensed by the microphone for
 - identifying presence of pest based on pitch and frequency characteristics, and for
 - activating the at least one upper-level laser gun when the presence of pest has been
 - identified sensed sounds, and
 - wherein the camera analyses video images captured by the camera for
 - 20 identifying presence of pests within the video images, the controller for activating
 - the at least one lower-level laser gun in response to the presence of pest being
 - identified within the video images.
2. The system as in claim 1, each of the at least one upper-level laser gun being
- 25 movably coupled to the stem and the at least one lower-level laser gun being
- movably coupled to the base plate to enable angular pitch adjustments along a plane
- that is substantially parallel the length of the stem.
3. The system as in claim 1, the controller further for disabling the lower-level laser
- 30 gun to terminate discharge of laser beam therefrom in response to a human being

identified as at least one of being in close proximity to and looking substantially in the direction of the camera based on the video images captured by the camera.

4. The system as in claim 3, wherein a human is identified by presence of one of a head portion and an upper torso thereof in the video images captured by the camera.
5. The system as in claim 1, the controller utilises pre-trained Convolution Neural Network (CNN) for identifying at least one of birds, pest and human from video images captured by the camera and from sounds captured by the microphone.
6. The system as in claim 1, further comprising:
 - a gear assembly further intercoupling the stem and the base plate; and
 - an electric motor engaged with the gear assembly for actuation thereof, the electric motor being in signal communication with the controller and actuable for angularly displacing and positioning the lower-level laser gun about an axis that is substantially parallel the length of the stem.
7. The system as in claim 6, the controller further for identifying location of the pest and actuating the electric motor for angularly positioning the lower-level laser gun to direct the laser beam discharged thereby substantially in the direction of the pest.
8. The system further comprises:
 - at least one photo beam sensor for detecting presence of laser beam being discharged from at least one of the at least one upper-level laser gun and the at least one lower-level laser gun when being activated by the controller.
9. The system as in claim 1, further comprising:
 - a strobe lighting module in signal communication with the controller for emitting light flashes at pre-defined frequency, duration and interval for indicating a corresponding error code.

10. The system as in claim 1, the laser beam of each of the at least one upper-level laser gun and the at least one lower-level laser gun being activatable based on a plurality of tactics set, each of the plurality of attribute set determining duration, intensity, strobe frequency and polarization linearity of the laser beam to be discharged with one differing from the other of the plurality of attribute set,

wherein successive more than one of the plurality of attribute set are adoptable by the controller for the discharge of the laser beam for each of the at least one upper-level laser gun and the at least one lower-level laser gun.

11. A pest deterrent method comprising:

analysing sounds sensed by a microphone by a controller for identifying presence of pest based on pitch and frequency characteristics, and for activating at least one upper-level laser gun for discharging a laser beam therefrom when the presence of pest has been identified sensed sounds, the at least one upper-level laser gun being coupled to a support stem, the support stem for coupling a base plate to a surface, the base plate being rotatably coupled with the support stem; and

analysing video images captured by a camera by the controller for identifying presence of pests within the video images, the controller for activating at least one lower-level laser gun for discharging a laser beam therefrom in response to the presence of pest being identified within the video images, the at least one lower-level laser gun and the camera being coupled to the base plate,

wherein the at least one upper-level laser gun, the microphone, the at least one lower-level laser gun and the camera are in signal communication with the controller.

12. The method as in claim 11, further comprising:

disabling the lower-level laser gun by the controller to terminate discharge of laser beam therefrom in response to a human being identified as at least one of being in close proximity to and looking substantially in the direction of the camera based on the video images captured by the camera,

wherein a human is identified by presence of one of a head portion and an upper torso thereof in the video images captured by the camera, and

wherein the controller utilises pre-trained Convolution Neural Network (CNN) for identifying at least one of birds, pest and human from video images captured by the camera and from sounds captured by the microphone.

13. The method as in claim 11, the controller further for identifying location of the pest and actuating an electric motor for angularly positioning the lower-level laser gun to direct the laser beam discharged thereby substantially in the direction of the pest,

wherein electric motor is engaged with a gear assembly intercoupling the stem and the base plate for actuation thereof, the electric motor being in signal communication with the controller and actuable for angularly displacing and positioning the lower-level laser gun about an axis that is substantially parallel the length of the stem, and

wherein each of the at least one upper-level laser gun being movably coupled to the stem and the at least one lower-level laser gun being movably coupled to the base plate to enable angular pitch adjustments along a plane that is substantially parallel the length of the stem.

14. The method as in claim 11, further comprising:

activating the laser beam of each of the at least one upper-level laser gun and the at least one lower-level laser gun based on a plurality of tactics set, each of the plurality of attribute set determining duration, intensity, strobe frequency and polarization linearity of the laser beam to be discharged with one differing from the other of the plurality of attribute set,

wherein successive more than one of the plurality of attribute set are adoptable by the controller for the discharge of the laser beam for each of the at least one upper-level laser gun and the at least one lower-level laser gun.

15. The method as in claim 11, further comprising:

activating a strobe lighting module for emitting light flashes at pre-defined frequency, duration and interval for indicating a corresponding error code associated with the absence of laser beam from the corresponding one of the at least one upper-level laser gun and the at least one lower-level laser gun being activated by the controller,

5

Wherein the strobe lighting module is in signal communication with the controller.