

UAV System and Method

FIELD OF THE INVENTION

This invention relates to systems employing UAV's and corresponding methods of operating UAV's, in particular relating to deployment of UAV's.

BACKGROUND OF THE INVENTION

5 Unmanned Air Vehicles (UAV) are well known and have many uses, which may include active surveillance or over-the-hill data gathering.

For example, by way of general background interest, the following publications disclose various UAV configurations:

EP 1884463 discloses a Micro Air-Vehicle (MAV) starting system that provides
10 the combined functions of: packing protection of sensitive vehicle components, a mechanical starting assembly, and a launch pad. The disclosed preferred embodiment comprises a container and a container lid with the MAV clamped to the lid. Also disposed on the container lid is a starting assembly. The lid which doubles as a launching pad with the attached MAV is removed from the container, placed on the
15 ground, the MAV is started with the starting mechanism and launched.

US 7,089,843 discloses a launcher including a plurality of launch tubes for stowing and launching a plurality of air vehicles. A central air manifold is operatively connected to an air storage tank; a first launch tube air manifold is operatively connected to a first group of the launch tubes and operatively connected to the central
20 air manifold. The first launch tube air manifold has a separate port corresponding to each launch tube of the first group of launch tubes. A release valve mechanism is removably mounted in one of the ports of the first launch tube air manifold, the release valve mechanism controlling the passage of launch air between the first launch tube air manifold and the launch tube corresponding to the port in which the release valve
25 mechanism is mounted. A plug is removably mounted in each of the ports not occupied by the release valve mechanism.

US 6,119,976 discloses a shoulder launched unmanned reconnaissance system for providing overhead visual surveillance of remote targets is disclosed. The system includes a reconnaissance air vehicle which may be fired from a portable launcher,

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accelerated to flight speed, and remotely controlled using a ground control system. The vehicle is flown to the target area to enable an onboard wide angle video system to transmit video images of the target to the ground control system for processing and display. The ground control system enables the reconnaissance vehicle to be flown to a recovery area and to descend in a stall mode after the flight is completed for maintenance prior to reuse. The air vehicle includes collapsible wings which are deployable after launch by a spring actuated mechanism.

Other known UAV systems include, for example, the "MAV" system by Aerovironment, and the "Train Cable UAV" by Planum Vision.

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SUMMARY OF THE INVENTION

According to a first aspect of the invention there is provided a method for guarding a perimeter, comprising:

(a) providing infiltration information of an actual or suspected infiltration at a target zone associated with said perimeter by at least one infiltration agent;

(b) deploying at least one ready-to-launch UAV to said target zone responsive to receiving said infiltration information;

(c) operating said at least one UAV to home onto at least one said infiltration agent; and

(d) at least one of:
identifying nature of at least one said homed-onto infiltration agent or nature of said infiltration via said at least one UAV and providing data corresponding to said nature; and

tracking at least one said homed-onto infiltration agent via said at least one UAV and providing data corresponding to a location of said homed-onto infiltration agent to enable neutralization thereof.

Herein, "guarding" includes, *inter alia*, one or more of watching, sensing, detecting, data gathering, and so on relating to unwanted and/or unexpected and/or unauthorized and/or hostile and/or dangerous infiltration agents (human and/or non-human), as well as relating to such agents and/or one or more of defending, protecting

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against, preventing intrusion by, controlling a location with respect to, securing against, providing safety from, such agents.

For example, step (b) may comprise speed-launching at least one ready-to-launch UAV in a trajectory or along any suitable flight path to said target zone
5 responsive to receiving said infiltration information

The method according to the first aspect of the invention may include one or more of the following features (A) to (U), in any desired combination:

(A) Wherein step (b) comprises providing at least one UAV launcher, the or each said UAV launcher comprising at least one UAV in ready-to-launch mode, the or
10 each said UAV launcher configured for enabling each respective UAV to be speed launched responsive to receiving said infiltration information.

(B) Wherein step (b) comprises:
providing a plurality of said UAV launchers; and
strategically deploying said UAV launchers with respect to said perimeter in a
15 manner allowing each said UAV to reach a predetermined point on said perimeter within a predetermined time after launch.

(C) Wherein step (a) comprises obtaining infiltration information from at least one of the following sources: human intelligence; human surveillance of said perimeter; electronic intelligence; electronic surveillance of said perimeter;
20 overhead imagery of said perimeter; perimeter breach sensors; radar data; electro-optical and/or infrared surveillance of said perimeter.

(D) Wherein in step (b) suitable command signals are generated corresponding to said infiltration information and transmitted to at least one said UAV launcher whereby to activate thereby speed-launching of said at least one ready-to-launch
25 UAV.

(E) Wherein said UAV comprises a suitable sensor configured for providing image data or other sensor data within a field of view, and step (c) comprises remotely flying said UAV to said target zone, receiving said image data or said other sensor data generated by said UAV of the target zone, and identifying nature
30 of said infiltration agent in step (I) from said image data or said other sensor data.

(F) Wherein step (d) comprises maintaining said infiltration agent within said field of view of said sensor.

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- (G) Wherein the method further comprises step (e) of neutralization of said infiltration agent. For example, step (e) may comprise one or more of intercepting, apprehending and immobilizing said at least one infiltration agent by direct human intervention. For example, said direct human intervention may comprise dispatching
5 to said location one or more of: manned or unmanned ground forces, manned or unmanned airborne forces, and manned or unmanned seaborne forces. Optionally, said at least one UAV may be recovered concurrent with or after step (e).
- (H) Wherein said at least one supplemental UAV may be speed launched in step (d) for supplementing said identification in step (I), and/or said tracking in step (II),
10 or taking over said identification and/or said tracking, respectively, from said UAV previously launched in step (b).
- (J) Wherein step (b) comprises speed-launching a plurality of said ready-to-launch UAV, each to a different respective start location in said target zone, responsive to receiving said infiltration information, and searching a respective
15 portion of said target zone for said infiltration agent.
- (K) Regarding feature (J), wherein at least one of said plurality of said launched UAV's is homed on said infiltration agent in step (c), and at least a first portion of a remainder of said launched UAV's are recovered.
- (L) Regarding feature (J) and/or feature (K), wherein at least one of said
20 plurality of said launched UAV's may be homed on said infiltration agent in step (c), and at least a second portion of a remainder of said launched UAV's may be maintained airborne for providing supplemental tracking.
- (M) Wherein there are a plurality of infiltration agents, wherein step (b) comprises speed-launching a plurality of said ready-to-launch UAV, and in step (c)
25 operating each said UAV to home onto a different said infiltration agent.
- (N) Wherein step (II) may be performed after step (I), and wherein in step (I), said nature is identified as being unwanted, hostile and/or dangerous.
- (O) Wherein said data corresponding to said nature in step (I) includes incriminating evidence relating to said nature of said infiltration agent or of said
30 infiltration thereby.
- (P) Wherein said perimeter constitutes a border between a host country being guarded and a geopolitical entity comprising said infiltration agents prior to said infiltration.

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(Q) Wherein said perimeter constitutes a building or structure.

(R) Wherein said perimeter comprises fence, wall or line circumscribing an installation, a group of buildings, a complex, or a geographical zone.

(S) Wherein at least one said ready-to-launch UAV is configured structurally
5 and/or operatively to minimize detection thereof by said infiltration agents.

(T) Wherein said infiltration agent may be a human agent. For example, said human agent may be taken from the group including: terrorist, illegal alien, smuggler, thief, foreign troops.

(U) Wherein said infiltration agent may be a non-human agent. For example,
10 said non-human agent may be taken from the group of: non-authorized UAV, unmanned land vehicle, and unmanned sea vehicle. Alternatively, for example, said non-human agent is a contamination agent, and for example said contamination agent may be taken from the group including: toxic, chemical, biological, radiological or nuclear agents.

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According to a second aspect of the invention, there is provided a system for guarding a perimeter, comprising:

control center configured for generating a control signal responsive to receiving infiltration information of an actual or suspected infiltration at a
20 target zone associated with said perimeter by at least one infiltration agent;

launch system configured for deploying at least one ready-to-launch UAV to said target zone responsive to receiving said control signal;

at least one controller configured for operating said at least one UAV to home onto at least one said infiltration agent and for at least one of:

25 (i) identifying nature of said infiltration agent or nature of infiltration;
and

(ii) tracking said infiltration agent via said at least one UAV; and

communication system configured for providing at least one of: data corresponding to said nature in (i); and location data corresponding to a
30 location of said infiltration agent in (ii) to enable neutralization thereof.

For example, the launch system may be configured for speed-launching at least one ready-to-launch UAV in a trajectory or any suitable flight path to said target zone responsive to receiving said control signal.

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The system according to the first aspect of the invention may include one or more of the following features (a) to (f), in any desired combination:

- 5 (a) Said launch system may comprise at least one a UAV launcher remote from said control center, the or each said UAV launcher may comprise at least one said UAV, the or each said UAV launcher being in operation configured for automatically speed-launching at least one said UAV responsive to receiving said launch command signal from said control center.
- (b) The or each said launched UAV may be configured for being transported under its own power to a target zone within a predetermined response time.
- 10 (c) The or each said UAV may comprise a sensor system having a field of view, in operation said UAV being configured for providing sensor data associated with said infiltration agent responsive to said infiltration agent being in said field of view. For example, said sensor system may comprise an image acquisition system for providing images corresponding to said field of view. For example, said image acquisition system may comprise a pointing
15 mechanism for controllably changing a line of sight of said image acquisition system in at least one or azimuth and elevation.
- (d) The or each said UAV may comprise a GPS or other positioning system configured for providing geographical location data of the respective UAV
20 according to a pre-known coordinate system. For example, said location data may be derived from said geographical location data and from knowledge of the line of sight of the image acquisition system and from knowledge of an altitude of the respective said UAV.
- (e) Said communication system may comprise a communication module
25 comprised in the or each said UAV, each said communication module being configured, in operation, for receiving said command signal, for enabling operation of the respective UAV by said controller, and for transmitting sensor data provided by said sensor system.
- (f) Said UAV may further comprise any suitable payload, for example a
30 contamination sensor configured for detecting said infiltration agent when in the form of a contaminating agent. For example, said contamination agent may be taken from the group including: toxic, chemical, biological, radiological or

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nuclear agents. Additionally or alternatively, the UAV may be configured for carrying any other suitable payload.

(g) Said control center may be remote from said launch system.

5 (h) At least one said UAV launcher may be mobile, and configured for controllably changing its geographical position with respect to at least one of said control center and said perimeter

(j) The system may comprise a plurality of said UAV launchers, spaced from one another and at different locations with respect to said perimeter, wherein said control center is configured for providing said launch command
10 signal to a said launcher capable of launching a respective said at least one UAV to minimize said response time.

(k) Said controller may comprise a human UAV operator.

(l) The system may be configured for transmitting said sensor data to at least one of said control center and said controller.

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According to a third aspect of the invention there is provided a system for acquiring a target and/or for providing airborne tracking of a target, comprising:

a control center configured for selectively generating a launch command signal;

20 at least one a launcher remote from said control center and comprising at least one UAV, the or each said launcher being in operation configured for automatically speed-launching at least one said UAV responsive to receiving said launch command signal from said control center, and the or each said launched UAV being configured for being transported under its own power to a
25 target zone within a predetermined response time;

the or each said UAV comprising a sensor system having a field of view, in operation said UAV being configured for providing second target data associated with said target responsive to said target being in said field of view

30 the system being further configured for operating the or each said UAV, at least after being speed-launched from its respective said launcher, including:

- guiding the respective UAV to said target zone; and
- acquiring the target, including at least detecting and tracking said target by operating said sensor system.

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The system according to the third aspect of the invention may include one or more of the features (a) to (k) according to the second aspect of the invention, *mutatis mutandis*.

According to a fourth aspect of the invention, there is provided a system for
5 tracking an intruder in a restricted zone, comprising:

a control center configured for selectively generating a launch command signal responsive to receiving intruder initial location data representative of an initial location of the intruder in the restricted zone;

10 at least one a UAV launcher in or proximal to the restricted zone and remote from said control center, the or each said UAV launcher comprising at least one UAV, the or each said UAV launcher being in operation configured for automatically speed-launching at least one said UAV responsive to receiving said launch command signal from said control center, the or each said launched UAV configured for being transported under its own power to said initial
15 location after launch within a predetermined response time under guidance provided by said system or according to a pre-programmed route;

the or each said UAV comprising a sensor system having a field of view, in operation said UAV being configured for providing second intruder data associated with the intruder responsive to the intruder being in said field of view

20 the system being further configured in use for operating the or each said UAV to detect and track the intruder by operating said sensor system.

The system according to the fourth aspect of the invention may include one or more of the features (a) to (k) according to the second aspect of the invention, *mutatis mutandis*.

25 According to a fifth aspect of the invention, there is provided a system for acquiring a target and/or for providing airborne tracking of a target, comprising:

a control center configured for generating a launch command signal responsive to receiving data representative of presence of a target at a target zone;

30 at least one launcher comprising at least one UAV, the or each said launcher in operation configured for automatically speed-launching at least one said UAV responsive to receiving said launch command signal from said control center;

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the launched UAV configured for being guidable to a target zone associated with said target within a predetermined response time;

the launched UAV comprising a sensor and communication system for generating and transmitting sensor data for enabling the control center to
5 identify the target;

the system being further configured for operating the or each said UAV and for receiving sensing data therefrom at least after being speed-launched from its respective said launcher.

10 The target zone may represent a zone containing the range probability of the target being located there, and optionally taking into account the range of the detection equipment of the UAV.

The system according to the fifth aspect of the invention may include one or more of the features (a) to (k) according to the second aspect of the invention, *mutatis*
15 *mutandis*.

According to a sixth aspect of the invention there is provided a fast-response system and method for three-stage pursuit of a suspected target such as infiltrators entering a restricted area or predefined perimeter:

The first stage includes detection of a suspected target by any means of detection
20 (human and/or automated).

The second stage includes speed-launching at least one UAV to track the target and maintain it under close observation so that at least its location is known.

The third stage includes taking over from the UAV by another system (manned system or unmanned system) and proceeding with further tracking or neutralization of
25 the target.

The system according to the sixth aspect of the invention may include one or more of the features (a) to (k) according to the second aspect of the invention, *mutatis mutandis*. The method according to the sixth aspect of the invention may include one or more of the features (A) to (U) according to the second aspect of the invention, *mutatis*
30 *mutandis*.

According to at least one of the above first to sixth aspects of the invention, the respective UAV launchers may be configured as stand-alone autonomous units, capable

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of providing launch-ready UAV in an automated manner without the need for human intervention.

According to at least one of the above first to sixth aspects of the invention, the respective UAV's may be configured as generally autonomous self-powered, untethered
5 vehicles. Additionally or alternatively, at least some said UAV's may comprise a payload compartment comprising a marker, such as a dye, and/or comprising any suitable device that may be dropped onto the target for marking or immobilizing the target.

According to at least one of the above first to sixth aspects of the invention, the
10 respective target (also referred to interchangeably herein as an infiltration agent) can be static/mobile/airborne/ground based/sea or water based.

According to at least one of the above first to sixth aspects of the invention, a system is provided for guarding a perimeter, including a control center, a launch system, a controller and a communication system. The control center is configured for
15 generating a control signal responsive to receiving infiltration information of an actual or suspected infiltration at a target zone associated with the perimeter by one or more infiltration agents. The launch system is configured for deploying one or more ready-to-launch UAV's to the target zone responsive to receiving the control signal from the control center. The controller is configured for operating the launched UAV(s) to home
20 onto at least one such infiltration agent. The controller is also configured for identifying the nature of the infiltration agent or the nature of infiltration; and/or for tracking the infiltration agent via the UAV(s). The communication system is configured for providing data corresponding to the nature of the infiltration agent or the nature of infiltration, and/or for providing location data corresponding to the location of the
25 infiltration agent being tracked by the UAV's to enable neutralization thereof. A corresponding method for guarding a perimeter is also provided.

A feature of at least some embodiments of the invention is providing a method and system for guarding a perimeter, which in at least one operating mode is essentially activated only in response to a threat posed to the perimeter. Until such a threat is
30 detected, the system may be operated in a passive manner, i.e., without the need to launch a UAV to look for new, as yet undetected, threats.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to understand the invention and to see how it may be carried out in practice, embodiments will now be described, by way of non-limiting example only, with reference to the accompanying drawings, in which:

5 **Fig. 1** schematically illustrates a system according to an embodiment of the invention.

Fig. 2 illustrates an embodiment of a UAV launcher.

Fig. 3 illustrates an embodiment of a UAV.

Fig. 4 illustrates another embodiment of a UAV launcher.

10 **Fig. 5** schematically illustrates an application of the embodiment of Fig. 1.

Fig. 6 schematically illustrates another application of the embodiment of Fig. 1.

Fig. 7 schematically illustrates another application of the embodiment of Fig. 1.

Fig. 8 schematically illustrates a method according to an embodiment of the invention; **Fig. 8(a)** schematically illustrates a variation of the embodiment of Fig. 8.

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DETAILED DESCRIPTION OF EMBODIMENTS

Referring to Figs. 1 to 3, a multi-purpose UAV deployment system according to a first embodiment of the invention, generally designated **100**, comprises a control center **200** and a plurality of UAV launchers **300**.

20 Referring to Fig. 2, each launcher **300** is configured for speed-launching at least one UAV **400** in an automated manner in response to receiving a control command signal to do so, and thus each launcher **300** is configured for operating unattended. In the embodiment illustrated in Fig. 2, the launcher **300** is configured for speed-launching one or a plurality of UAV's and comprises a plurality of launch housings **310**, each launch
25 housing **310** housing a UAV **400**, which in operation of the respective launch housing **400** is in a ready for launch mode (RFL mode). In alternative variations of this embodiment, at least one launcher is configured for speed-launching one UAV and comprises a respective launch housing. The launch housing **310** further comprises a suitable launching system (not shown) configured for imparting a forward momentum to the respective UAV **400**
30 sufficient to enable the UAV to become airborne and subsequently be capable of maintaining flight under its own power after exiting the respective launch housing **310**. For

example, the launching system may be configured for launching the respective UAV via any suitable pneumatic, hydraulic, pyrotechnic, elastic, mechanical or other arrangement.

In alternative variations of this embodiment, the launch housing **310** does not comprise any specific mechanism or arrangement to eject and push out the respective
5 UAV **400** therefrom for launching the same. Rather, the UAV **400** is itself configured for exiting the launch housing **310** under its own power – for example the UAV may have VTOL, STOL or V/STOL capabilities, and/or may comprise auxiliary power packs (e.g. rocket assisted take-off systems).

The launcher **300** further comprises a suitable communication system **350**,
10 comprising at least a receiver for receiving command signals transmitted by the control center **200**. In this embodiment, the communication system **350** also comprises a transmitter for transmitting signals at least to the control center **200**. Furthermore, the launcher **300** may comprise a control unit **390**, such as for example a microprocessor, for controlling operation thereof.

15 In this embodiment, the communication system **350** is wireless, for example operatively connected to the control center **200** wirelessly via a radio transmitter using any suitable radio band, either directly, or via a system of relay stations and/or via satellite connection. In alternative variations of this embodiment, communication system **350** may be cable-based, and is operatively connected to the control center **200** via a cable network,
20 or is based on laser communication or fiber optics, or comprises a combination of different communications media, for example.

The launcher **300** in this embodiment comprises a pointing mechanism **360**, which is configured for enabling the azimuth and/or elevation of the respective launch housings **310** to be selectively controlled, thereby providing any desired or optimal launch direction
25 LD for the launch housings **310**. Further, the launcher **300**, while in use is typically statically deployed at a fixed geographical location in this embodiment, is readily transportable to a different geographical location when desired, by means of trailer **370**, which can be pulled by any suitable vehicle, for example. In alternative variations of this embodiment, at least one launcher **300** is permanently deployed at one geographical
30 location in a fixed permanent installation, while in these or other alternative variations of this embodiment, at least one launcher **300** may be self-propelled, for example affixed on a carrier vehicle, which may be, for example, a land vehicle, a sea-faring vehicle, an amphibious vehicle, a hovercraft, etc. In alternative variations of this embodiment, at least

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one launcher **300** does not comprise a pointing mechanism, and is permanently pointing in one direction, at least relative to the launcher base.

The launcher **300** further comprises a GPS or any other suitable global positioning system, and furthermore the control unit **390** is configured for operating the communication system **350** to send a signal to the control center **200** advising the same of the geographical position of the respective launcher **300** according to its GPS location. Alternatively, the position of the respective launcher **300** may be determined manually, and relayed to the control center **200** by personnel such as for example the ground crew responsible for deploying the launcher **300**.

After deployment, the launcher **300** is configured for operating in an automated manner, without the need for any ground crew. A ground crew may be provided from time to time for repair, maintenance and refurbishment, but operation of the launcher **300** for launching the respective UAV's is generally automated and responsive to receiving suitable control signals to this effect from the control center **200**.

In these or other alternative variations of this embodiment, one launch housing may be used to launch multiple UAV's, which may be stored one behind another serially in the launch housing, or may be stored one above another in the launch housing, or may be loaded one at a time to the launch housing using a suitable loading mechanism. For example, referring to Fig. 4, at least one launcher according to a different embodiment, and designated with the reference numeral **300'**, comprises one or more multiple launch housings **310'** mounted onto a pointing mechanism **360'**, and also comprises control unit **390'** configured for operating the communication system **350'**. Each such multiple launch housing **310'** comprises a launch tube **320'** configured for speed launching a UAV, and a UAV magazine **370'** comprising a plurality of UAV's **400** in stacked arrangement, and configured for loading each UAV from the magazine **350'** in turn to the launch tube **320'** after the previous UAV has been launched.

Referring again to Fig. 1, the control center **200** comprises a suitable command and control module **210** (CC Module), which in operation may be configured for processing intelligence data ID and deciding whether or not to launch one or more UAV's **400**, from one or more launchers **300**, and in which direction and towards which particular target zone. The CC Module **210** in operation is further configured for processing surveillance and other data provided by the launched one or more UAV's **400**, and for passing on such

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surveillance and other data and/or analysis thereof to another party. The control center **200** further comprises a suitable communication system **250**, comprising at least a transmitter for transmitting command signals to the launchers **300**. In this embodiment, the communication system **250** also comprises a receiver for receiving signals from at least the
5 launchers **300**. Furthermore, the control center **200** comprises a controller **290**, such as for example a microprocessor, for controlling operation thereof.

In this embodiment, the communication system **250** is wireless, for example operatively connected to the launchers **300** wirelessly via a radio transmitter using any suitable radio band, either directly, or via a system of relay stations and/or via satellite
10 connection. In alternative variations of this embodiment, communication system **250** may be cable-based, and is operatively connected to the launchers **300** via a cable network, or is based on laser communication, fiber optics or any other suitable means of communication, or comprises a combination of different communications media, for example.

The control center **200** is in operation further configured for receiving
15 intelligence data **ID**, and may do so in one or more forms. In particular, such data **ID** may include a suspected location of a target that it is desired to identify and/or track. Such data may include human intelligence, for example observers **490** in the field may spot a suspected target **T** and radio or otherwise advise the control center **200** of the fact and location of the suspected target **T**.

Where the system **100** is used for guarding a perimeter against infiltration,
20 wherein the target is an infiltrator, additionally or alternatively, breaches in the perimeter (e.g., a fence, wall, etc.) may be sensed optically and/or thermally and/or by sound and/or by touch/movement and/or electronically, and data indicative of the breach is suitably transmitted to the control center **200**. Additionally or alternatively,
25 human intelligence data may include data of a possible infiltration at a particular time and/or place, and this data is suitably transmitted to the control center **200**.

Additionally or alternatively, the control center **200** may comprise a receiver for receiving satellite intelligence data from a satellite network **492**, for example satellite image data (visible spectrum, infra red, etc) of a particular target zone at a particular
30 reference time, and this image data may be analyzed to provide such intelligence data to the control center **200**. Additionally or alternatively, the control center **200** comprises or is operatively connected to a suitable sensing module, for example any suitable SIGINT

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module for intercepting signals, optionally including at least one of an ELINT module and a COMINT module.

Additionally or alternatively, the control center **200** comprises a suitable detection system **270** (which may comprise, for example, a suitable radar system and/or a suitable
5 ground based electro optic system) operatively connected thereto for detecting a target T within a particular radius of operation, around the control center **200** and/or around one or more additional zones, wherein a number of linked radar systems and/or ground based electro-optic systems may be provided for radar coverage thereof.

In this embodiment, the CC Module **210** is in the form of one or more human
10 operators, skilled at receiving and analyzing the aforesaid intelligence data, and at deciding whether to launch one or more said UAV from one or more launchers. The controller **250** may assist the human controller by highlighting the closest launcher available and ready for launch with respect to a particular target.

In alternative variations of this embodiment, the CC Module **210** may be fully
15 automated and thus comprises a suitable computer system that is configured for initiating a launch of a UAV based on predetermined parameters.

In this embodiment, the control center **200** is at a geographically fixed, static location, at least during operation thereof. In alternative variations of this embodiment, the control center **200** may be comprised in a mobile platform – for example transported by
20 means of a vehicle (e.g., carried by the vehicle or towed as a trailer by the vehicle), and the vehicle may be, for example, a land vehicle, a sea-faring vehicle, an amphibious vehicle, a hovercraft, etc, or for example carried by personnel – and the center **200** may be operated also when mobile.

Referring to Fig. 3, each said UAV **400** is configured as a non-tethered vehicle in
25 the form of a steerable airborne platform comprising at least one sensor system configured at least for enabling a target within the sensor's field of view FOV to be identified. In this embodiment, the sensor system comprises a suitable imaging system **410** configured for providing in real time a video stream in the visible spectrum, and may be further configured for providing corresponding infrared images and/or comprises enhanced night
30 vision features. In alternative variations of this embodiment, the imaging system may additionally or alternatively comprise a Synthetic Aperture Radar (SAR) and/or any other suitable sensor system.

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The imaging system 410 may comprise a suitable camera, preferably an electronic camera, preferably mounted to the UAV 400 via a stabilizing platform such as to compensate for vibration etc, and thus provide stable images to the control center 200 via communications module 420. The UAV 400 comprises a suitable propulsion unit 430, 5 which may be electrically powered, or fuel powered, or a hybrid, for example, for providing powered flight and/or VTOL capability to the UAV. Preferably, the imaging system 410 comprises a pointing mechanism 412 which is configured for enabling the azimuth and elevation of the imaging system 410 to be selectively controlled, thereby providing any desired line of sight (LOS) for the imaging system within a defined field of 10 regard FOR. Further, the imaging system may be configured for providing a variety of magnifications, and/or fields of view (FOV). Such imaging systems are well known in the art.

According to one aspect of the invention, the UAV 400 may be based on any suitable micro-UAV's, for example the "Mosquito" UAV, produced by Israel Aerospace 15 Industries Ltd, Israel. According to another aspect of the invention, the UAV 400 may be based on any suitable mini-UAV's, for example the Birdeye family of UAV's, produced by Israel Aerospace Industries Ltd, Israel. According to another aspect of the invention, the UAV 400 may be based on any suitable larger UAV's, for example the I-View UAV's, produced by Israel Aerospace Industries Ltd, Israel.

20 The UAV 400 is configured for being automatically launched from its respective housing 310 when in the aforesaid RFL mode, in which the respective UAV 400 is fuelled and/or has sufficient electrical power to enable operation of the propulsion system and for powering the additional on-board systems, for example the imaging system 410 and communications module 420. At least in this embodiment, each operative said launcher 25 comprises at least one said UAV in RFL mode, and may have additional said UAV's in RFL mode, and/or is configured for placing more said UAV's in RFL mode in an automated manner.

Once launched, the UAV may be steered to the desired location in any number of ways. For example, the UAV may receive a particular flight plan to the target zone while 30 still in the launcher housing prior to launch via a suitable communication, or may up-load the flight plan after launch via suitable data-link. Additionally or alternatively, the UAV may be pre-programmed with a plurality of flight plans, for example one each to particular

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predetermined target zones, and the desired flight plan is brought on-line in the UAV. Alternatively, the UAV is steered manually to the target zone via a UAV operator **205**.

In variations of this embodiment where the launched UAV **400** comprised a payload, for example the imaging system or other payload, the payload may be operated
5 by means of a payload operator **206**, who optionally may also be the UAV operator **205**.

In this embodiment, the payload operator **206** and the UAV operator **205** are comprised in the control center **200**, and are located in the same location. In alternative variations of the embodiment, the payload operator **206**, and/or the UAV operator **205**, may be independent of the control center **200** and may be located at different geographical
10 locations.

In this embodiment, the UAV **400** further comprises a suitable GPS or the like, and the communication module **420** is configured for transmitting the geographical location of the UAV **400** to the control center **200**. Furthermore, the communication module **420** may further transmit the direction of the LOS of imaging system **410** with
15 respect to datum coordinate system UCS of the UAV, the UAV's direction and altitude, and the attitude of coordinate system UCS with respect to an Earth-based coordinate system ECS such as used by the GPS system, and may also further transmit data regarding the magnification of image and other optical parameters. With this data it is possible to then calculate the position and thus the geographical location (with respect
20 to the aforesaid Earth-based coordinate system) of whatever object is in the field of view FOV of the imaging system **410**.

Furthermore, the communication module **420** is also configured for providing identification data for the respective UAV **400**, for example an IFF or IP code, so that data received from each UAV by the control center **200** can be associated with its
25 respective UAV **400**.

In one application of the first embodiment, and referring to Fig. 1, the system **100** is configured for facilitating guarding of a particular perimeter, for example defending the perimeter against infiltration, and the plurality of launchers **300** (individually designated as **300a**, **300b**, **300c**, etc.) are deployed along the perimeter. For example such a perimeter
30 may be a political border **900** between the host nation **910** on which the launchers are deployed and a neighboring nation or other geographical/geopolitical entity **930** which may be hostile or harbor hostile or undesirable elements with respect to the host nation **910**. Each launcher **300** has an associated radius of operation R , which can be understood

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to refer to a characteristic range of the respective UAV **400**, attained after a predetermined elapsed time t from launch from the respective launcher **300**. The elapsed time t may thus be regarded as a desired response time for the UAV to reach a particular location. In this embodiment, the various launchers **300** are spaced from one another and from the border
5 such that each radius of operation R (individually designated as R_a , R_b , R_c , etc. respectively corresponding to the respective launchers **300a**, **300b**, **300c**, etc.) overlap with the border **900**, and also with respect to one another at least close to the border **900**, as illustrated in Fig. 5.

The control center **200** is also located in the host nation **910** (although in variations
10 of this embodiment it may be elsewhere, for example airborne or at sea in neutral or international areas), but may be further distanced from the border **900**, for example for site security considerations, particularly if the border zone in the vicinity of the border **900** is hostile.

The border **900** may comprise a fence or wall **920**, comprising sensors **925**
15 including proximity sensors and/or breaching sensors, respectively configured for sensing proximity of a foreign object (for example a body or vehicle) to the wall and for sensing breaches in the wall, and a communication module **930** for transmitting to the control center **200** sensor data indicative of such proximity or breach when such an event happens.

In this embodiment, all the launchers **300** are substantially similar to one
20 another, at least in terms of the type of launching systems provided, and the type of UAV launched by each housing **310**, and may also be similar to one another in having the same number of launch housings **310** per launcher, though in alternative variations of this embodiment, each launcher may have a number of launch housings that may be the same or different with respect to the other launchers **300**. In yet other variations of this
25 embodiment, each launcher may be different from the other launchers, in terms of type of launching systems provided, and/or in terms of the type of UAV launched by each housing **310** of the launcher, and/or in terms of the number of launch housings **310** per launcher **300**, and so on. Accordingly, the radius of operation R associated with each launcher **300** may be different from one another between the different launchers **300**.

30 In this application of the first embodiment, a number of launchers **300** are in communication with the control center **200** via wireless transmitters **292**, while other launchers **300** are in communication with the control center **200** via cables **295**.

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In one method of operation of the system **100**, designated with reference numeral **800** and referring also to Fig. 8, in step **810** the control center **200** receives intelligence data of a possible incursion or infiltration of the border **900** at a particular target zone at location **A**, for example via sensors **925**. Alternatively, such data may
5 originate from one or a combination of the following sources: human intelligence, electronic intelligence, satellite surveillance, etc. The CC Module **210** makes a command decision at **805** whether or not to investigate further, and in the affirmative, a command signal CS is sent out in step **820** to one or more launchers **300** for one or more UAV's to be launched. In the simplest implementation of step **820**, the command
10 signal CS is for launching a single UAV from the launcher closest to the location **A**, or if the launchers **300** have different UAV capabilities to one another, the launcher having the shortest response time **T** to the location **A**. The particular UAV **400** is automatically launched by the respective launcher **300** responsive to receiving the command signal CS and the UAV is automatically flown (by computer control) or manually flown (by UAV
15 operator **205**) to location **A**, with the respective imaging system **410** aboard the UAV **400** scanning the target area around the location **A** for signs of a candidate target such as an intruder.

When a candidate target has been acquired, e.g. detected digitally or in any other suitable manner and homed onto, the next step **830** is to identify the target, and this is
20 followed by decision node **840** - whether this identified target warrants further tracking or not. For example if the target is a human infiltration agent, for example an intruder such as a potential terrorist, illegal alien, smuggler, thief, foreign troops, etc., for example, tracking of the target is continued, while if it turns out that the target is a border guard, a tourist, an animal etc., for example, or it may be decided that the target
25 does not warrant further tracking. On the other hand, the target may be a non-human infiltration target, for example a dangerous animal (e.g., an animal suspected of carrying rabies or an infectious disease), or the target may be a non-human agent such as for example a non-authorized UAV or unmanned land or sea vehicle. In any case, if further tracking is required, then in step **850** the UAV maintains aerial surveillance of the
30 target, in general by maintaining the target within the field of view FOV of the imaging system **410**.

Further tracking can be manually performed, for example by the UAV operator **205** controlling the UAV in cooperation with the payload (imaging system) operator

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206 (which in at least some embodiment may be the same operator), typically at the control center 200 though the operator 206 may be stationed at a different location and communicates with the UAV to control operation thereof via suitable communication means.

5 Alternatively, the tracking may be automated, for example by means of a suitable computerized system and/or an electro-optical auto tracking system.

 The fact, details and other data of the target, including its location in real time, may be relayed by the control center to any desired party, for example ground forces such as border patrol, police etc. that are responsible for confronting and dealing with
10 the target.

 In step 860, tracking may be terminated, for example when suitable ground forces such as border patrol, police etc. arrive at the location of the target, which has been continuously tracked and relayed to the ground forces via control center 200 by the UAV, and the ground forces may then deal with the target, for example by neutralizing
15 or apprehending any potential threat. The ground forces may include one or more of personnel and vehicles (manned or unmanned), and/or air vehicles and/or sea vehicles as appropriate.

 In step 870 the UAV is recovered. For example the UAV may be flown to a recovery site, where it is landed and refurbished, to be subsequently re-used in the
20 original or a different launcher 300 when needed.

 In a further optional step 855 prior to step 860, another UAV 400 may be automatically launched from the same or a different launcher 300 in response to receiving a suitable command signal to take over or to assist tracking of the target. This may occur, for example, when the original UAV is damaged, or when the original UAV
25 lacks sufficient fuel or electrical power to maintain tracking operation. In such cases, the operational status of the original UAV is monitored, and the next UAV is launched such that its response time T is less than the estimated time to failure of the original UAV. Thus, location data of the original UAV is used to guide the second UAV to the target and take over tracking, such that tracking and surveillance of the target is
30 effectively continuous and uninterrupted.

 In a variation of this method of operation, a number of UAV's may be launched sequentially or substantially concurrently in step 820. This may provide multiple redundancy in tracking – for example if one UAV suddenly fails the other UAV's can

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still provide tracking data. Alternatively, it may turn out that what was initially considered to be a single target is in fact a group of targets that may potentially scatter in different directions, and thus the multiple UAV's may provide tracking of each separate target if there are sufficient targets launched (of course, once the target is identified in step **830** as comprising multiple targets, additional UAV's may be automatically launched and homed in to their location via the data provided by the first UAV. Alternatively, and depending on the terrain on which the target is located, it may be possible for the target to enter a structure having multiple exits, and the strategic solution for ensuring continuation of surveillance is to cover all the exits by providing a UAV to survey each such exit.

In another variation of step **820**, designated as step **820'** in Fig. 8(a), three UAV's (designated with reference numerals **400a**, **400b**, **400c**) are launched in response to the command signal **CS**, and is particularly useful where the exact location of the suspected target **T** is not known with certainty and/or where it is suspected or known that the suspected target **T** may move quickly from the last known location within the time taken for the nearest UAV to arrive at this location. In alternative variations of this embodiment, two UAV's or alternatively more than three UAV's may be launched in step **420'** instead of three. In such cases, a probability zone **PZ** may be defined around the last known location of the suspected target **T**, or centered around the area where the suspected target is general located. Thus, perimeter **P** is displaced by a dimension **S** from the center **C** of the probability zone **PZ** such that the perimeter **P** defines a threshold beyond which it is considered unlikely (within a predefined probability which may differ from case to case) that the suspected target will have traveled, even if traveling at a known, predicted or estimated maximum speed, irrespective of direction, in the time period between detection of the target and the arrival of at least one of the UAV's. While the shape of the probability zone **PZ** is illustrated as circular, it is not necessarily so, and the probability zone may take on any suitable shape, which may generally depend on the nature of the suspected target, its means of mobility, and the nature of the terrain.

In step **820'** the three UAV's are launched, each one to a different part of the probability zone **PZ**. For example: UAV **400a** and UAV **400b** are each directed to generally opposed extremities, target points **La** and **Lb** respectively, of the probability zone **PZ** at the perimeter **P**, while the third UAV **400c** is directed to a target point **Lc** at

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or near the center **C** of the zone. The three UAV's may be launched from the same launcher **300** or from different launchers **300**, optimally according to availability of UAV's in each launcher and according to satisfying the criteria of minimizing the response time of each UAV to its designated target point.

5 For example, **La** and **Lb** may lie along the generally direction that the target was observed to be traveling when detected. Alternatively, **La** and/or **Lb** and/or **Lc** may be locations in the probability zone **PZ** having relative high probability of finding the suspected target there. If the suspected target is located by one of the UAV's, steps **830** to **870** may be implemented with respect to this UAV, and the other two UAV's may be
10 recovered as per step **870**, or at least one of these two UAV's may be used to provide multiple redundancy in tracking, as disclosed above, *mutatis mutandis*.

On the other hand, if by the time the three UAV's reach their target points **La**, **Lb**, **Lc** the suspected target is not located by any of the UAV's, step **825'** is then implemented, in which the probability zone **PZ** is split into three search zones **Za**, **Zb**,
15 **Zc**, one zone for each UAV, and which each UAV **400a**, **400b**, **400c** implements a search-and-locate mission **M** in its respective zone **Za**, **Zb**, **Zc** (Fig. 7). For example, each mission **M** may follow a zigzag path that eventually covers the full respective zone such that the zone comes under observation by the respective imaging system 410 of the respective UAV.

20 It is to be noted that the probability zone **PZ** is not necessarily of a static and fixed form. For example, if further intelligence data regarding the suspect target is received while the UAV's are on their way to the probability zone **PZ** or while they are carrying out their missions **M**, the shape and extent of each respective zone **Za**, **Zb**, **Zc** may be changed, as well as the number of zones searched and/or the form of the mission
25 **M** changed. Additionally or alternatively, if the suspected target is not detected within a particular time, it may be necessary to expand and/or displace the probability zone **PZ** to account for the possibility that the suspected target may have traveled further and out of the probability zone **PZ**. One possible way to address the expanded probability zone **PZ** is by extending each mission **M** accordingly. Another way is to define a new search
30 zone **Zx** between the original perimeter **P** of the probability zone **PZ** and the expanded perimeter **P'** of the expanded probability zone **PZ**, and to launch one or more additional UAV's to search this zone **Zx**. Of course, this process may be repeated as often as necessary, each time expanding the probability zone **PZ** as required.

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In some cases, it is possible to concurrently have a number of groups of UAV's, each group operating with respect to a respective different probability zone. In such cases, it is also possible to transfer UAV's from one group to another according to specific needs or requirements. For example, it may be that a UAV of one group
5 happens to be closer to a target zone of one particular probability zone than the original UAV that was dispatched to that zone. In another example, rather than launching a new UAV to a particular target zone it may be possible to divert a UAV, that was originally deployed for a different probability zone, to the aforesaid target zone.

In these or other applications of the system **100**, the respective UAV's **400** may
10 at least in some cases be tactical, mini- or micro- UAV's and/or operated from high altitudes such as to minimize the probability of being detected in flight by the suspected target, and thus reduces the probability of the suspected target from taking evasive action to avoid detection or being tracked. Furthermore, such small-sized UAV's may be maneuvered through confined spaces, for example wooded areas and urban areas in a
15 fast, slow or hovering flight, and in a controllable manner, at least in some cases with greater effectiveness, more safety and lower probability of detection than would be the case with manned air vehicles.

Additionally or alternatively, at least in some cases larger UAV's may be used where endurance may be required – for example where it is expected that the ground
20 forces cannot arrive and take over for long periods.

In another application of the system **100**, one or a plurality of launchers **300** may be provided atop masts or rooftops in an urban zone. For example, a launcher **300** may be installed on a rooftop of a building housing a bank and/or of a nearby building or at any other strategic locations. In case of a robbery or attempted robbery, the launcher
25 **300** automatically launches one or more UAV's which can then follow the getaway vehicle used by the criminals until a helicopter can take over surveillance and/or until the vehicle is apprehended. The command signal for activating the system **100** and launching the UAVs may be generated and transmitted, for example automatically on activation of the bank alarm system, or via a coded signal sent directly by law-
30 enforcement agents in the area.

In another application of the system **100**, one or a plurality of launchers **300** may be additionally or alternatively provided atop vehicles, for example law enforcement vehicles or military vehicles, which may be moving such as on patrol. When required, a

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UAV from such a vehicle is launched responsive to receiving the command signal CS from the control center 200.

In another application of the system 100, one or a plurality of launchers 300 may optionally be provided atop vehicles, for example emergency and rescue forces vehicles (e.g., fire fighters, environmental agencies etc), which may be deployed to answer an emergency situation. When required, a UAV 400 from such a vehicle (and/or from static locations such as illustrated in Fig. 1, for example) may be launched responsive to receiving the command signal CS from the control center 200. The launcher 300 may stay on the vehicle or may be removed and re-positioned for later usage. The UAV may include as payload, in addition to or instead of the image sensor, a contamination sensor configured for detecting and/or identifying toxic or otherwise dangerous chemical, biological, radiological or nuclear agents, and the UAV is operated to fly into a target zone that is suspected to include such agents. Such a target zone may be associated with a perimeter defining the site of an attack, or may be a building or complex that stores or processes such agents, and the target zone may include a body of such agents, for example smoke or a cloud of particulate matter, or precipitation or a mist, for example. The UAV then uses the contamination sensor to collect and identify any possible contaminants at the target zone, and to enable associated risks to be evaluated. Furthermore, the UAV may stay airborne and track the movement of the body of agents, until they are sufficiently dispersed as to be rendered harmless, or until other resources may be brought into play to deal with the contamination. Optionally, a plurality of UAV's may be launched to monitor and track the body of agents if this expands or moves in multiple directions at the same time.

Thus, in this application of system 100, the suspected contamination agents operate as infiltration agents at the target zone.

In the method claims that follow, alphanumeric characters and Roman numerals used to designate claim steps are provided for convenience only and do not imply any particular order of performing the steps.

Finally, it should be noted that the word "comprising" as used throughout the appended claims is to be interpreted to mean "including but not limited to".

While there has been shown and disclosed example embodiments in accordance with the invention, it will be appreciated that many changes may be made therein without departing from the spirit of the invention.

CLAIMS:

1. A method for guarding a perimeter, comprising:
 - (a) providing infiltration information of an actual or suspected infiltration by at least one infiltration agent at a target zone associated with said perimeter;
 - 5 (b) deploying at least one ready-to-launch UAV to said target zone responsive to receiving said infiltration information;
 - (c) operating said at least one UAV to home onto at least one said infiltration agent; and
 - (d) at least one of:
 - 10 (I) identifying nature of at least one said homed-onto infiltration agent or nature of said infiltration via said at least one UAV and providing data corresponding to said nature; and
 - (II) tracking at least one said homed-onto infiltration agent via said at least one UAV and providing data corresponding to a location of said homed-onto infiltration agent to enable neutralization thereof.
- 15 2. Method according to claim 1, wherein step (b) comprises one of:
 - (b1) providing at least one UAV launcher, the or each said UAV launcher comprising at least one UAV in ready-to-launch mode, the or each said UAV launcher configured for enabling each respective UAV to be speed launched responsive to receiving said infiltration information; or
 - 20 (b2) providing a plurality of said UAV launchers, and, strategically deploying said UAV launchers with respect to said perimeter in a manner allowing each said UAV to reach a predetermined point on said perimeter within a predetermined time after launch.
- 25 3. Method according to any one of claims 1 to 2, wherein step (a) comprises obtaining infiltration information from at least one of the following sources: human intelligence; human surveillance of said perimeter; electronic intelligence; electronic surveillance of said perimeter; overhead imagery of said perimeter; perimeter breach sensors; radar data; electro-optical and/or infrared surveillance of said perimeter.
- 30 4. Method according to any one of claims 1 to 3, wherein in step (b) suitable command signals are generated corresponding to said infiltration information and

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transmitted to at least one said UAV launcher whereby to activate thereby speed-launching of said at least one ready-to-launch UAV.

5 5. Method according to any one of claims 1 to 4, wherein said UAV comprises a suitable sensor configured for providing image data or other sensor data within a field of view, and step (c) comprises remotely flying said UAV to said target zone, receiving said image data or said other sensor data generated by said UAV of the target zone, and identifying nature of said infiltration agent in step (I) from said image data or said other sensor data.

10 6. Method according to claim 5, wherein step (d) comprises maintaining said infiltration agent within said field of view of said sensor.

7. Method according to any one of claims 1 to 6, further comprising step (e) of neutralization of said infiltration agent.

15 8. Method according to claim 7, wherein step (e) comprises intercepting, apprehending or immobilizing said at least one infiltration agent by direct human intervention.

9. Method according to claim 8, wherein said direct human intervention comprises dispatching to said location one or more of: manned or unmanned ground forces, manned or unmanned airborne forces, and manned or unmanned seaborne forces.

20 10. Method according to any one of claims 7 to 9, wherein said at least one UAV is recovered concurrent with or after step (e).

11. Method according to any one of claims 1 to 9, wherein said at least one supplemental UAV is speed launched in step (d) for supplementing said identification in step (I), and/or said tracking in step (II), or taking over said identification and/or said tracking, respectively, from said UAV previously launched in step (b).

25 12. Method according to any one of claims 1 to 11, wherein step (b) comprises speed-launching a plurality of said ready-to-launch UAV, each to a different respective start location in said target zone, responsive to receiving said infiltration information, and searching a respective portion of said target zone for said infiltration agent.

30 13. Method according to claim 12, wherein at least one of said plurality of said launched UAV's is homed on said infiltration agent in step (c), and at least a first portion of a remainder of said launched UAV's are recovered.

14. Method according to claim 12 or claim 13, wherein at least one of said plurality of said launched UAV's is homed on said infiltration agent in step (c), and at least a

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second portion of a remainder of said launched UAV's are maintained airborne for providing supplemental tracking.

15 **15.** Method according to any one of claims 1 to 14, wherein there are a plurality of infiltration agents, wherein step (b) comprises speed-launching a plurality of said ready-
to-launch UAV, and in step (c) operating each said UAV to home onto a different said
infiltration agent.

16. Method according to any one of claims 1 to 15, wherein step (II) is performed after step (I), and wherein in step (I), said nature is identified as being hostile or dangerous.

10 **17.** Method according to any one of claims 1 to 16, wherein said data corresponding to said nature in step (I) includes incriminating evidence relating to said nature of said infiltration agent or of said infiltration thereby.

18. Method according to any one of claims 1 to 17, wherein said perimeter constitutes a border between a host country being guarded and a geopolitical entity
15 comprising said infiltration agents prior to said infiltration.

19. Method according to any one of claims 1 to 17, wherein said perimeter constitutes a building or structure.

20. Method according to any one of claims 1 to 17, wherein said perimeter comprises fence, wall or line circumscribing an installation, a group of buildings, a
20 complex, or a geographical zone.

21. Method according to any one of claims 1 to 20, wherein at least one said ready-to-launch UAV's is configured structurally and/or operatively to minimize detection thereof by said infiltration agents.

22. Method according to any one of claims 1 to 21, wherein said infiltration agent is
25 a human agent.

23. Method according to claim 22, wherein said human agent is taken from the group including: terrorist, illegal alien, smuggler, thief, foreign troops.

24. Method according to any one of claims 1 to 21, wherein said infiltration agent is a non-human agent.

30 **25.** Method according to claim 24, wherein said non-human agent is taken from the group of: non-authorized UAV, unmanned land vehicle, and unmanned sea vehicle.

26. Method according to claim 24, wherein said non-human agent is a contamination agent.

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27. Method according to claim 26, wherein said contamination agent is taken from the group including: toxic, chemical, biological, radiological or nuclear agents.

28. System for guarding a perimeter, comprising:

5 (a) control center configured for generating a control signal responsive to receiving infiltration information of an actual or suspected infiltration at a target zone associated with said perimeter by at least one infiltration agent;

(b) launch system configured for deploying at least one ready-to-launch UAV to said target zone responsive to receiving said control signal;

10 (c) at least one controller configured for operating said at least one UAV to home onto at least one said infiltration agent and for at least one of:

(i) identifying nature of said infiltration agent or nature of infiltration;

and

(ii) tracking said infiltration agent via said at least one UAV; and

(d) communication system configured for providing at least one of:

15 - data corresponding to said nature in (i); and

- location data corresponding to a location of said infiltration agent in (ii) to enable neutralization thereof.

29. System according to claim 28, wherein said launch system comprises at least one a UAV launcher remote from said control center and comprising at least one said
20 UAV, the or each said UAV launcher being in operation configured for automatically speed-launching at least one said UAV responsive to receiving said launch command signal from said control center.

30. System according to claim 28 or claim 29, wherein the or each said launched UAV being configured for being transported under its own power to a target zone
25 within a predetermined response time.

31. System according to any one of claims 28 to 30, wherein the or each said UAV comprises a sensor system having a field of view, in operation said UAV being configured for providing sensor data associated with said infiltration agent responsive to said infiltration agent being in said field of view.

30 32. System according to claim 31, wherein said sensor system comprises an image acquisition system for providing images corresponding to said field of view.

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33. System according to claim 32, wherein said image acquisition system comprises a pointing mechanism for controllably changing a line of sight of said image acquisition system in at least one or azimuth and elevation.
34. System according to any one of claims 28 to 33, wherein the or each said UAV
5 comprises a GPS or other positioning system configured for providing geographical location data of the respective UAV according to a pre-known coordinate system.
35. System according to claim 34, wherein said location data is derived from said geographical location data and from knowledge of the line of sight of the image acquisition system and from knowledge of an altitude of the respective said UAV.
- 10 36. System according to any one of claims 28 to 35, wherein said communication system comprises a communication module comprised in the or each said UAV each said communication module being configured, in operation, for receiving said command signal, for enabling operation of the respective UAV by said controller, and for transmitting sensor data provided by said sensor system.
- 15 37. System according to any one of claims 28 to 36, wherein said UAV further comprise a contamination sensor configured for detecting said infiltration agent when in the form of a contaminating agent.
38. System according to claim 37, wherein said contamination agent is taken from the group including: toxic, chemical, biological, radiological or nuclear agents.
- 20 39. System according to any one of claims 28 to 38, wherein said control center is remote from said launch system.
40. System according to any one of claims 29 to 39, wherein at least one said UAV launcher is mobile configured for controllably changing its geographical position with respect to at least one of said control center and said perimeter
- 25 41. System according to any one of claims 29 to 40, comprising a plurality of said UAV launchers, spaced from one another and at different locations with respect to said perimeter, wherein said control center is configured for providing said launch command signal to a said launcher capable of launching a respective said at least one UAV to minimize said response time.
- 30 42. System according to any one of claims 28 to 41, wherein said controller comprises a human UAV operator.
43. System according to any one of claims 31 to 42, wherein said sensor data is transmitted to at least one of said control center and said controller.