

TARGET LOCATING AND ENGAGING SYSTEM

FIELD OF THE INVENTION

[0001] The present invention generally relates to a method and system for locating and engaging targets using an aerial vehicle, an aerial vehicle tracking system, a target locating system and a target engagement system.

BACKGROUND TO THE INVENTION

[0002] One of the current techniques for locating, identifying and engaging hostile forces in an urban warfare involves the use of helicopter gunships flying in the sky with Line Of Sight (LOS) weapons or Non-Line-Of-Sight (NLOS) missiles to engage targets that are hiding in difficult to reach locations. However, the capability of helicopter gunship is limited in that they cannot be flown safely in narrow and cramped surroundings. This is especially true in urban environments where the hostile forces are in close proximity and could be waiting in ambush.

[0003] Unmanned Aerial Vehicle (UAV) with Global Positioning System (GPS) and other sensors can be used to locate hostile forces hiding in the aforementioned environments. However GPS signals can be jammed or could otherwise be unavailable at the time of the engagement with the hostile forces. GPS that is used to determine the absolute position of the UAV flying in an urban environment can also have poor satellite coverage and can suffer inaccuracy due to cloudy weather or the surrounding tall buildings especially when the GPS is used without DGPS (Differential GPS) or WAAS (Wide Area Augmentation System).

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2 [0004] The absolute location of an UAV can also be determined by a surveying
3 instrument or a laser distance sensor by placing the crosshair of the instrument or sensor onto
4 the flying UAV which can be at a distance away. However, in the time of tension, the
5 operator of the surveying instrument or the laser distance sensor may not be able to
6 accurately place the crosshair of the sensor onto the flying UAV within milli-seconds when
7 the ground operator of the UAV locates the target through a distance sensor, a digital
8 compass, an inclinometer; and identifies the target with a camera or electro-optics which are
9 mounted on the UAV. If this takes place, erroneous data would be obtained and a wrong
10 target position would be determined by a computer using triangulation algorithm.

11 12 SUMMARY OF THE INVENTION

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14 [0005] In accordance with the first aspect, a method and a system of locating and
15 engaging a target having an engagement zone and a target location comprises generating a
16 target location of the target using a target locating system, and using a target engagement
17 system to control a target destruction system. The target engagement system delivers a
18 projectile to the target based on the target location determined by computer through
19 triangulation. Further, the computer of the target engagement system checks an aerial vehicle
20 position of an aerial vehicle with the engagement zone of the target, and if the aerial vehicle
21 position is within the engagement zone of the target, then the target engagement system
22 disables the target destruction system to allow the aerial vehicle to be maneuvered safely
23 outside the engagement zone before the target is engaged.

24

1 **[0006]** From the foregoing disclosure and the following more detailed description of
2 various preferred embodiments, it will be apparent to those skilled in the art that the present
3 invention provides a significant advance in the technology of tracking and engaging targets
4 especially in an urban environment. Particularly significant in this regard is the potential that
5 the invention affords for providing a high quality target tracking and engaging system.
6 Additional features and advantages of various preferred embodiments will be better
7 understood in view of the detailed description provided below.

8 9 **BRIEF DESCRIPTION OF THE DRAWINGS**

10 **[0007]** Fig. 1 shows a target locating and engaging system in a preferred embodiment,
11 showing the use of triangulation to determine the locations of the target and the aerial vehicle.

12
13 **[0008]** Fig. 2 is a flowchart that shows generally the steps in the preferred
14 embodiment of the invention wherein the aerial vehicle tracking system has two or more 3
15 dimensional video cameras.

16
17 **[0009]** Fig. 3 is a flowchart that shows generally the steps in another preferred
18 embodiment of the invention wherein the aerial vehicle tracking system has a video tracking
19 camera and a laser distance sensor.

20
21 **[0010]** Fig. 4 is a flowchart that shows generally the steps in another preferred
22 embodiment of the invention wherein the aerial vehicle tracking system has a millimeter
23 wave radar with a 3D radar scanning mechanism.

[0011] It should be understood that the appended drawings are not necessarily to scale, presenting a somewhat simplified representation of various preferred features illustrative of the basic principles of the invention. The specific design features of the method and system for tracking and engaging targets as disclosed herein, including, by way of example, the specific dimensions of the method and system for tracking and engaging targets, will be determined in part by the particular intended application and use environment. Certain features of the illustrated embodiments have been enlarged or emphasized relative to others to help provide clear understanding. In particular, thin features may be thickened, for example, for clarity of illustration. All references to direction and position, unless otherwise indicated, refer to the orientation illustrated in the drawings.

DETAILED DESCRIPTION OF CERTAIN PREFERRED EMBODIMENTS

[0012] It will be apparent to those skilled in the art, that is, to those who have knowledge or experience in this area of technology, that many uses and design variations are possible for locating and engaging targets and are disclosed herein. The following detailed discussion of various alternatives and preferred features and embodiments will illustrate the general principles of the invention with reference to a method and system suitable for locating and engaging targets. Other embodiments suitable for other applications will be apparent to those skilled in the art given the benefit of this disclosure.

[0013] The invention disclosed herein is an improved method and system for target locating and engaging comprising an aerial vehicle 101, an aerial vehicle tracking system, a target locating system and a target engagement system. Fig. 1 shows various parts of the invention. Aerial vehicle 101 is equipped with a smart laser distance sensor 104, a video

camera or electro-optics 105 and a video transmitter 106. The aerial vehicle 101 or the smart laser distance sensor 104 can also have an inclinometer or a MEMS accelerometer, a digital compass and an encoder. The aerial vehicle 101 also has an aerial vehicle data up and down link 107 to allow the smart laser distance sensor 104 and the video camera or electro-optics 105 to be controlled from the ground, and to provide the vector indicating the coordinate of the target 103 with respect to the smart laser distance sensor 104, or an integral video and data link and a radar reflector. The radar reflector enhances the reflected radar signal from the aerial vehicle 101 especially to avoid confusion in locating the aerial vehicle 101 due to low signal to noise ratio especially in an urban environment. The video camera or electro-optics 105 on the aerial vehicle 101 preferably has infrared, night vision, image and/or thermal intensifying capabilities with or without the assistance of infrared illuminator to search and identify targets in poor light conditions or to work effectively in night operation.

[0014] Since the aerial vehicle 101, which is preferably a VTOL (Vertical Take Off and Landing) UAV (Unmanned Aerial Vehicle) has high maneuverability, the VTOL UAV is effectively the gimbals for the video camera or electro-optics 105 and the smart laser distance sensor 104. The aerial vehicle 101 can be manned by an external pilot on the ground or is programmed to operate autonomously. The aerial vehicle 101 can also have audio capturing and amplification capabilities.

[0015] The aerial vehicle tracking system can be installed on a vehicle 102 preferably an armored fighting vehicle. The aerial vehicle tracking system preferably can comprise:

(i)(a) two or more 3-dimensional aerial vehicle tracking video cameras or electro-optics

1 108. The 3-dimensional aerial vehicle tracking video cameras are separated by a large
2 baseline This is to improve the accuracy and to build up a precise three dimensional image of
3 the aerial vehicle for tracking.; and

4 (b) a pan-tilt device 109 and joystick control 112 for an operator on the ground to place the
5 crosshair of the cameras or electro-optics 108 onto the aerial vehicle 101 before the video
6 tracking software is initiated by the operator for aerial vehicle tracking; and

7 (c) a computer 111 with 3 dimensional video tracking algorithm installed; and

8 (d) an up and down data link 115 and video link 114 transferring data and video between the
9 aerial vehicle 101 and the vehicle 102; and

10 (e) a video display of the target 103 in the monitor 113 for target 103 searching and
11 identification purposes; and

12 (f) an external pilot 118 on the ground maneuvering the aerial vehicle 101 for searching and
13 identification of a target 103, and to maneuver the aerial vehicle 101 to a safe zone when
14 subjected to sniper fire; and

15 (g) an infrared illuminator 116 which is manually controlled by an operator to enhance the
16 visibility of the aerial vehicle 101 in poor light conditions and at night;

17 or

18 (ii)(a) a video tracking camera or electro-optics 105 installed in vehicle 102; and

19 (b) a smart laser distance sensor with an inclinometer, and a digital compass 110, and

20 (c) both (a) and (b) are mounted on a pan-tilt device 109 with joystick control 112 for an
21 operator on the ground to place the crosshair of the camera or electro-optics 105 onto the
22 aerial vehicle 101 before the video tracking software installed in the computer 111 is initiated
23 for aerial vehicle tracking; and

24 (d) an up and down data link 115 and video link 114 between the aerial vehicle 101 and the
25 vehicle 102; and

1 (e) a video display of the target 103 in the computer 111 monitor 113 for target 103 searching
2 and identification purposes; and

3 (f) an external pilot 118 on the ground maneuvering the aerial vehicle 101 for searching and
4 identification of a target 103, and to maneuver the aerial vehicle 101 to a safe zone when
5 subjected to sniper fire; and

6 (g) an infrared illuminator 116 which is manually controlled by an operator to enhance the
7 visibility of the aerial vehicle 101 in poor light conditions and at night;

8 or

9 (iii) (a) a Millimeter Wave Radar with a 3 Dimensional radar scanning mechanism;

10 and a 3D aerial vehicle tracking algorithm loaded in the computer 111; and

11 (b) the aerial vehicle 101 carries a radar reflector to enhance the signal; and

12 (c) the aerial vehicle tracking system also can have a digital compass 110 and an inclinometer;

13 and

14 (d) an up and down data link 115 and video link 114 between the aerial vehicle 101 and the
15 vehicle 102; and

16 (e) a video display of the target 103 in the computer 111 monitor 113 for target 103 searching
17 and identification purposes; and

18 (f) an external pilot 118 on the ground maneuvering the aerial vehicle 101 for searching and
19 identification of a target 103, and to maneuver the aerial vehicle 101 to a safe zone when
20 subjected to sniper fire; and

21 (g) an infrared illuminator 116 which is manually controlled by an operator to enhance the
22 visibility of the aerial vehicle 101 in poor light conditions and at night.

23

1 **[0016]** The target locating system is mounted in a vehicle 102 preferably in an
2 armored fighting vehicle. The purpose of the target locating system is to calculate the
3 position (i.e. the distance, elevation and azimuth) of the target 103 from the vehicle 102.
4

5 **[0017]** The target engaging system comprises of a computer system 111 and a target
6 destruction system 117 which is mounted on a pan-tilt device preferably with a feedback
7 control to improve the accuracy of the target engaging system. The computer system 111 can
8 be loaded with a target locating and engaging algorithm to direct the target destruction system
9 117 to aim at the target 103 through the pan-tilt device for the elimination of the target 103.
10

11 **[0018]** The target destruction system 117 is preferably an air burst grenade launcher
12 mounted on a pan-tilt device, or a missile mounted on a pan tilt device. The target destruction
13 system 117 has single or multiple projectiles. The projectiles can be an air burst grenades or
14 other form of airburst projectiles that can destroy the target 103 even when it is hiding behind
15 a parapet or behind a window or a structure on an upper floor of a building. The target
16 engagement system and the target destruction system 117 are preferably installed as part of
17 the vehicle 102 which is preferably an armored fighting vehicle.
18

19 **[0019]** Fig 2 is a flowchart that shows generally the steps in the preferred
20 embodiment of the invention. Referring to step 201 in Fig 2, an external pilot 118 flies the
21 aerial vehicle 101 to a desired site to seek out target 103. In this preferred embodiment, the
22 aerial vehicle tracking system comprises two or more 3-dimensional aerial vehicle tracking
23 cameras or electro-optics 108. The 3-dimensional aerial vehicle tracking cameras 108 or
24 electro-optics 108 are spaced at a predetermined distance called a baseline and are mounted
25 on a pan-tilt device 109 with pan and tilt sensors (i.e. an encoder for pan measurement and an

inclinometer for tilt measurement) and a digital compass 110 to measure the azimuth from a specific reference direction such as magnetic North or true North, and the inclination with respect to the horizontal plane of the aerial vehicle tracking system. Referring back to Fig 1, the distance L_1 between the aerial vehicle tracking system and the aerial vehicle 101 is measured using triangulation of the 3-dimensional aerial vehicle tracking cameras or electro-optics 108. If the aerial vehicle tracking system comprises 3-dimensional aerial vehicle tracking video cameras, to achieve a larger baseline, the electro-optics 108 can be mounted in more than one vehicle 102 and can have one or more computers.

[0020] Referring to step 202 in Fig 2, in order to initiate the tracking of the aerial vehicle 101, an operator in the vehicle 102, preferably an armored fighting vehicle, maneuvers the pan-tilt device 109 which carries the 3 dimensional aerial vehicle tracking cameras or electro-optics 108, so as to place the aerial vehicle 101 within the field of view of the three-dimensional aerial vehicle tracking cameras or electro-optics 108. The operator then places the image of the aerial vehicle 101 onto the cross hair of the three-dimensional aerial vehicle tracking cameras and displays the image on the monitor 113 of a computer system 111.

[0021] At step 203 of Fig 2, the operator then activates the tracking software in the computer system 111 of the aerial vehicle tracking system and the 3 dimensional aerial vehicle tracking cameras or electro-optics 108 on the pan-tilt device 109 track the aerial vehicle 101 automatically.

[0022] At step 204 in Fig 2, the three-dimensional aerial vehicle tracking cameras or electro-optics 108 on the aerial vehicle 101 is used to locate and identify the target 103. The

external pilot 118 can use a remote control to maneuver the aerial vehicle 101 and use the aerial vehicle 101 as the gimbals for the video camera 105 and the smart laser distance sensor 104. The aerial vehicle 101 could also be autonomous and may be maneuvered to follow the preset commands for specific way points to cover a predetermined search area. Optionally, in poor light conditions or at night, the aerial vehicle tracking system may use an infrared illuminator 116 on the ground to illuminate the search area around target 103 and/or the aerial vehicle 101 to assist in searching of the target. The video image of the target 103 is down linked to the operator in the vehicle 102 and displayed on the monitor 113 of a computer 111.

[0023] Referring to step 205 in Fig 2, when the target 103 is located and identified via the video camera 105 in the aerial vehicle 101, the position of the target 103 with respect to the aerial vehicle 101 (L_2 , β_2 θ_2) is determined and transmitted through the downlink to the vehicle 102.

[0024] Now referring back to Fig 1, the position of the target 103 with respect to a position in space of the aerial vehicle 101 comprises the distance or line L_2 that extends from the target 103 to the aerial vehicle 101; a elevation angle β_2 which is the angle between L_2 and a horizontal plane of the aerial vehicle 101; and an azimuth θ_2 , an angle that is measured in the horizontal plane of the aerial vehicle 101 and is the angle between a reference direction such as the magnetic north or the true north and the direction of R_2 of the target 103. The reference direction of the azimuth of the aerial vehicle 101 can extend in a northward direction or in any other direction. θ_2 is the angle from the reference direction of the aerial vehicle 101, and the intersection of the vertical plane containing the target 103 and the horizontal plane of the aerial vehicle 101.

The following equations are applied in the computation of the position of the target 103 with respect to the position of the aerial vehicle:

$$R_2 = L_2 \cos \theta_2; \text{ and} \quad \text{Equation 1}$$

$$H_2 = L_2 \sin \theta_2 \quad \text{Equation 2}$$

Where R_2 is the horizontal component of distance L_2 ; and H_2 is the vertical component of distance L_2 . The distance L_2 can be measured using the smart laser distance sensor 104 on the aerial vehicle 101. The tilt angle β_2 can be measured using an inclinometer or a MEMS accelerometer. The azimuth θ_2 can be measured using a digital compass 110.

[0025] At step 206 in Fig 2, if hostile forces engage the aerial vehicle 101 while the aerial vehicle 101 is searching and locating the hostile forces, the aerial vehicle 101 can evade their attack by flying out of the line of fire, and still be able to determine the position of the target 103 from its new position even when the new position of the aerial vehicle 101 is behind a tree. The smart laser distance sensor 104 in the aerial vehicle 101 does this by a three point height routine, by measuring the horizontal distance R_2 from the smart laser distance sensor 104, even through a gap in the tree to a point in the vertical surface on the building or structure where target 103 or the hostile forces are located at.

[0026] The smart laser distance sensor 104 is able to do this because it has two modes. In mode 1, which is when the aerial vehicle 101 has line of sight with the target 103, the smart laser distance sensor 104 would provide the hypotenuse L_2 and θ_2 to the computer 111 in the target locating system. In this case, when the aerial vehicle 101 is behind an object such as a tree to avoid fire, a signal is sent by the operator in the vehicle 102 to the smart laser distance sensor 104, activating mode 2 of the laser measurement which measures the horizontal distance R_2 from the smart laser distance sensor 104 to a point on the vertical

surface of the building or structure where target 103 or the hostile forces are located at. After measuring the horizontal distance R_2 , the aerial vehicle 101 is then maneuvered so that the smart laser distance sensor 104 is pointed towards the target 103. The angle β_2 between the target 103 with respect to the horizontal plane of aerial vehicle 101 is then measured with the smart laser distance sensor 104. The distance L_2 of the target 103 from the aerial vehicle 101 can then be calculated using COSINE equation. The digital compass on the aerial vehicle 101 or in the smart laser distance sensor 104 will then provide the azimuth θ_2 .

[0027] At step 207 in Fig 2, measurements of L_2 , θ_2 and β_2 are sent wirelessly via the aerial vehicle data up and down links 107 to a data link 115 of the target locating system mounted in a vehicle 102 on the ground. At the same time, the video captured by the video camera 105 or electro-optics on the aerial vehicle 101 is transmitted wirelessly via a video transmitter 106 to the target image receiver 114 of the aerial vehicle tracking system and displays the image in the monitor 113 of the computer system 111.

[0028] Again referring to Fig 1, the following equations are applied in the process of triangulation to determine the position of the aerial vehicle 101 with respect to the position of the aerial vehicle tracking system (L_1 , θ_1 and β_1).

$$R_1 = L_1 \cos \beta_1; \text{ and} \quad \text{Equation 3}$$

$$H_1 = L_1 \sin \beta_1 \quad \text{Equation 4}$$

Where R_1 is the horizontal component of distance L_1 ; and H_1 is the vertical component of distance L_1 . At step 208 in Fig 2, the distance L_1 is measured using the 3-dimensional aerial vehicle tracking cameras or electro-optics 108. The angle of elevation β_1 can be measured using an encoder installed at the tilt motor of the pan-tilt device or a MEMS inclinometer mounted on the pan-tilt device, and the azimuth θ_1 can be measured using a digital compass.

[0029] At step 209 in Fig 2, the position of the aerial vehicle 101 with respect to the position of the aerial vehicle tracking system (L_1 , θ_1 and β_1) are captured by the data link and fed real time to the computer 111 of the target locating system.

[0030] Referring to step 210 in Fig. 2, the target locating system uses L_2 , β_2 , θ_2 and L_1 , β_1 , θ_1 to compute the location (H_3 , R_3 , L_3 , β_3 , θ_3) of the target 103 with respect to the aerial vehicle tracking system. The location of the target 103 with respect to the aerial vehicle tracking system is known as the target location. Referring to Fig 1, the computation of the location of the target 103 with respect to the aerial vehicle locating system is based on the following equations.

$$H_3 = H_1 + H_2 \quad \text{Equation 5}$$

$$R_3 = \sqrt{[(R_1)^2 + (R_2)^2 - 2(R_1)(R_2)\cos(180^\circ - \theta_1 - \theta_2)]} \quad \text{Equation 6}$$

$$L_3 = \sqrt{[(H_3)^2 + (R_3)^2]} \quad \text{Equation 7}$$

$$\theta_3 = \cos^{-1} [(R_1 \cos \theta_1 + R_2 \cos \theta_2) / R_3] \quad \text{Equation 8}$$

$$\beta_3 = \tan^{-1} (H_3 / R_3) \quad \text{Equation 9}$$

[0031] Referring to step 211 in Fig. 2, after the target locating system has computed the location (H_3 , R_3 , L_3 , β_3 , θ_3) of the target 103 with respect to the aerial vehicle tracking system, this data is fed real time to preferably a feed back control target engaging system which then directs a target destruction system 117 in the direction of the target 103. The target engagement system and the target destruction system 117 are preferably installed as part of the vehicle 102.

[0032] Referring to step 212 in Fig. 2, if the aerial vehicle 101 is within the engagement zone of the target 103, the software of the target engaging system would disable

1 the target destruction system 117 preventing it from firing any rounds as long as the aerial
2 vehicle 101 is within the engagement zone of the target 103. The engagement zone of the
3 target 103 corresponds to the volume defined by the burst radius of a projectile at the target,
4 optionally enlarged by a safety factor. In such case, the external pilot 118 will be notified by
5 the computer 111 and he shall maneuver the aerial vehicle 101 out of the engagement zone.
6 When the aerial vehicle 101 is safely outside the engagement zone, the computer 111 shall
7 enable the destruction system 117 waiting for the operator to activate the destruction system
8 117 and to fire at the target 103.

9
10 **[0033]** Referring to step 213 in Fig. 2, an operator activates the target destruction
11 system to destroy the target 103.

12
13 **[0034]** Fig 3 is a flowchart that shows generally the steps in another preferred
14 embodiment of the invention. In this embodiment, the aerial vehicle tracking system has a
15 single video camera and a smart laser distance sensor. In this embodiment, a smart laser
16 distance sensor 104 is mounted with the single video camera on a pan-tilt device 109 to track
17 the aerial vehicle 101 instead of a pair of three-dimensional area vehicle tracking cameras as
18 discussed in Fig. 2. The laser distance sensor measures the distance L_1 between the aerial
19 vehicle 101 and the aerial vehicle tracking system. The pan-tilt device 109 has pan and tilt
20 sensors and a digital compass for the measurement of tilt angle β_1 and azimuth θ_1 respectively.

21
22 **[0035]** Referring to step 302 in Fig. 3, in order to initiate the tracking of the aerial
23 vehicle 101 in this embodiment, an operator in the vehicle 102 maneuvers the single video
24 tracking camera or electro-optics and the laser distance sensor; using the joystick 112 to
25 capture the image of the flying aerial vehicle 101 into the designated field view of the video

1 tracking camera(s). An infrared illuminator 116 on the ground may also be used to illuminate
2 the area around the aerial vehicle 101 to help the single video camera and the smart laser
3 distance sensor of the aerial vehicle tracking system to track the aerial vehicle 101. In this
4 embodiment, the distance L_1 is measured using the laser distance sensor of the single video
5 camera or electro-optics system.

6
7 **[0036]** Since the aerial vehicle 101 is a relatively small target when it is at a distance
8 from the aerial vehicle tracking system, it would be difficult to maintain the laser distance
9 sensor mounted on the pan-tilt device 109 on the moving aerial vehicle 101 manually without
10 the video tracking camera and the video tracking software. The video tracking camera is
11 programmed to zoom in on the aerial vehicle 101 and the cross hair of the laser distance
12 sensor is programmed to be placed inside the zoomed image of the aerial vehicle 101. The
13 use of the single video tracking camera with the tracking software mitigates the probability of
14 tracking error as image tracking algorithms are used to autonomously maintain the aerial
15 vehicle 101 within the view of the video tracking camera.

16
17 **[0037]** Fig 4 is a flowchart that shows generally the steps in another preferred
18 embodiment of the invention. In this embodiment, the aerial vehicle tracking system has a
19 Millimeter Wave Radar with a 3D radar scanning mechanism which is very effective when
20 the aerial vehicle tracking system is used in rain or inclement weather, where there is smoke
21 and fire and when the sun is behind the aerial vehicle 101; to measure the position (L_1, β_1, θ_1)
22 of the aerial vehicle 101 with respect to the aerial vehicle tracking system on the ground.
23 wherein the radar aerial vehicle tracking is advantageous when the video tracking system is
24 ineffective in certain circumstances. This embodiment with the use of radar technology is

1 advantageous when the aerial vehicle tracking system is used in rain or inclement weather,
2 where there is smoke and fire and when the sun is behind the aerial vehicle 101.

3
4 **[0038]** Referring to step 402 in Fig. 4, in order to initiate the tracking of the aerial
5 vehicle 101, an operator in the vehicle 102 starts the radar scanning for the aerial vehicle 101,
6 to display the location of the radar reflector mounted in the aerial vehicle 101, in the monitor
7 113 of the computer system 111. L_1 is measured by the radar.

8
9 **[0039]** The aforementioned invention is not restricted to military applications but can
10 also be applied to other applications such as fire fighting and rescue operations. In addition to
11 the aerial vehicle tracking system embodiments described above, it will also be readily
12 apparent to the person skilled in the art, given the benefit of this disclosure that the aerial
13 vehicle tracking system can comprise combinations of the 3 embodiments discussed above.
14 This is to cater for deployment of the system in different circumstances and environment such
15 as the need to operate the system when raining, when there is smoke and/or fire, or when the
16 sun is behind the aerial vehicle 101 or there is space constraints which does not allow 3
17 dimensional video cameras because it requires a large baseline. The target locating and
18 engaging system also has the advantage when the GPS (Global Position System) cannot be
19 used because the GPS signal could be jammed in time of tension.

20
21 **[0040]** From the foregoing disclosure and detailed description of certain preferred
22 embodiments, it will be apparent that various modifications, additions and other alternative
23 embodiments are possible without departing from the true scope and spirit of the invention.
24 The embodiments discussed were chosen and described to provide the best illustration of the
25 principles of the invention and its practical application to thereby enable one of ordinary skill

1 in the art to use the invention in various embodiments and with various modifications as are
2 suited to the particular use contemplated. All such modifications and variations are within the
3 scope of the invention as determined by the appended claims when interpreted in accordance
4 with the breadth to which they are fairly, legally, and equitably entitled.
5

CLAIMS

1. A method of locating and engaging targets in buildings, or structures or platform with an aerial vehicle and a ground system comprising:
 - maneuvering the aerial vehicle into a position where a target can be spotted and identified, and measuring or otherwise determining the first data indicating the location of the target with respect to the location of the aerial vehicle,
 - maneuvering an aerial vehicle tracking system on the ground to track the aerial vehicle, measuring or otherwise determining the second data indicating the location of the aerial the aerial vehicle with respect to the location of the ground platform tracking the aerial vehicle,
 - computing or otherwise determining the third data indicating the position of the target with respect to the aerial vehicle tracking system in the ground platform so that a control system may direct equipment, tools, weapons or agents to engage the targets in the locations established.
2. The method according to claim 1 further comprising a remote control system for an unmanned aerial vehicle (UAV) preferably with vertical take off and landing (VTOL) capability and is operated by an external pilot or an autonomous aerial vehicle controlled by a software with predetermined waypoints or using computer programme or man-in-the-loop to maneuvering the aerial vehicle.
3. The method according to claim 1 wherein the aerial vehicle aligns a target seeking sensor with video and/or audio capturing capability, in the direction of a search area to seek out or otherwise identify targets.
4. The method according to claim 3 further comprising a targets seeking sensor in the aerial vehicle comprises a seeker such as an infrared video camera with thermal intensifying (TI) or image intensifying (II) capability and/or audio capturing device to assist in seeking and identifying targets in broad day light or in poor light conditions or when a target is behind glass windows, and at night.

5. The method according to claim 1 wherein a sensor in the aerial vehicle measures or otherwise determines the location of the targets in terms of distance with respect to the aerial vehicle; and inclination with reference to the horizontal plane of the aerial vehicle; and azimuth with reference to an axis on the horizontal plane of the aerial vehicle, when the targets are found and/or identified.

6. The method according to claim 1 further comprising radio transmitters relaying images of the search area and/or the targets and the location of the targets as the first data to a ground system to facilitate the external pilot to seek out and identify the targets and to input the first data to the computer for the determination of the third data in the ground system.

7. The method according to claim 1 further comprising a vehicle tracking system on the ground such as an electro-optics system with capability to pan and tilt a cooled or un-cooled infrared video camera so as to place the image of the aerial vehicle in a designated field of view in the display of the ground system initially with a system including but not limited to a joystick or a touch screen monitor and subsequently tracking the aerial vehicle automatically when a computerized aerial vehicle tracking application is executed.

8. The method according to claims 6 and 7 wherein the aerial vehicle tracking system measures or otherwise determines the distance between the aerial vehicle and the tracking system, the inclination of the aerial vehicle with referenced to the horizontal plane of the tracking system, and the azimuth of the aerial vehicle with respect to a reference axis on the horizontal plane of the tracking system, using a method of triangulation with sensors such as an electro-optics including but not limited to infrared video cameras, Micro-Electro-Mechanical-System (MEMS) inclinometer and 3 axis digital compass for obtaining second data.

9. The method according to claim 1 further comprising a ground system with a computer system to determine the third data based on the first data obtained by the aerial vehicle and transmitted to the ground platform comprises a wireless receiver and

the second data measured or other determined by the aerial vehicle tracking system in the ground platform.

10. The method according to claim 3 wherein a control system based on the third data computed by the computer in the ground system which may comprise an illuminating device pointing in the direction of the search area to assist in seeking and identification of the targets by the aerial vehicle in poor light condition and at night.

11. The method according to claim 1 further comprising a control system wherein a device, a weapon or an agent can be directed, based on the third data determined by the computer in the ground platform, to the targets identified so as to engage the targets.

12. The method according to any one claims 1 to 11 wherein the distance L_1 between the aerial vehicle and the target can be measured or otherwise determined by a laser distance sensor and the inclination β_1 of the target with respect to the horizontal plane of the aerial vehicle measured or otherwise determined by an inclinometer; and an azimuth θ_1 of the target with respect to a reference axis on the horizontal plan of the aerial vehicle measured or otherwise determined by a 3 axis digital compass.

13. A system for locating and engaging targets for rescuing lives or to eliminate or to alleviate hazards, or to remove hostile elements or to suppress fire from the hostile or dangerous targets in buildings, structures or platforms comprises:

- an aerial vehicle maneuver in the air near the building, structure or platform;
- a target seeking sensor in the aerial vehicle capturing images and other signals of the search area and the targets;
- a targets locating device wherein the distance between the targets and the aerial vehicle, inclination of the targets with reference to horizontal plane or the aerial vehicle and the azimuth of the targets with respect to the predetermined reference direction on the horizontal plane of the aerial vehicle can be measured or otherwise determined;
- a wireless transmitter in the aerial vehicle relaying the images or other signals of the search area and targets and the location of the targets with respect to the aerial vehicle as the first data to the ground system;

a ground system comprising: an aerial vehicle tracking system which can be precisely panned and tilted and controlled by a joystick or a touch screen manually and by a tracking programme automatically to measure or otherwise determine the location of the aerial vehicle in relation to the tracking system, namely the second data real time;

a computer system determining the location of the targets with respect to the tracking system as the third data;

a control system using third data to direct a device, a weapon or an agent to engage the targets;

wherein the external pilot maneuvers the aerial vehicle in the air and points the video/audio capturing device to capture the video image and/or audio signal of the target in the direction of the search area of the buildings, structures or platform, an operator maneuvers the aerial vehicle tracking system through pan and tilt operation to bring the images of the targets into the field of view and activate the automatic tracking software; and

a ground system comprising: a computer determines the third data, namely the location of the identified targets with respect to the ground system using first and second data.

14. The system according to claim 13 further comprising an infrared or visible light target illumination system to facilitate establishment of the third data by assisting the aerial vehicle in target searching and identification operation and in particular, in poor light condition and night operation.

15. The system according to one of claims 13 and 14 further comprising a control system operating a device, weapon or agent using computed third data to engage the targets identified.

16. The system according to any one of claims 13 and 14 wherein before the engagement of the targets, if the aerial vehicle is in line of fire or within the burst radius of the weapon; or in the delivery path of the agent to alleviate hazard of the targets, the software will automatically disable the engagement process and raise an alarm to alert the operator and the external pilot until the aerial vehicle is maneuvered to a safe location; and

the target destruction system can be manually overwritten by the commander if he chooses sacrificing the aerial vehicle while engaging the target even when the aerial vehicle is within the burst radius or near the line of fire of the weapon.

17. The system according to any one of claims 12 to 15 wherein the weapon operated by the control system can be a missile or airburst grenade launcher used to eliminate or suppress fire of the hostile elements.

18. The system according to any one of claims 12 to 16 wherein the device associate with the target engaging system can be a ladder of a fire engine or device to rescue victim in need of help.

19. The system according to any one of claims 12 to 17 wherein the agent can be chemicals, foam or any substance for delivery to the targets and guided by the control system to reduce the hazard or danger posed by the targets identified.

20. A method of locating and engaging a target having an engagement zone comprising, in combination, the steps of:

generating a target location of the target using a target locating system; and

using a target engagement system to control a target destruction system, wherein the target engagement system may deliver at least one projectile to the target to the established target location based on the third data if the commander chooses to engage the target and if the aerial vehicle is not in the line of fire or within the burst radius of the weapon, or if the commander chooses to engage the target and sacrifices the aerial vehicle in a specific circumstance;

wherein the target engagement system checks an aerial vehicle position of an aerial vehicle against the burst radius or the line of fire of the weapon, and if the aerial vehicle position is within the burst radius or in the line of fire of the weapon, then the target engagement system disables the target destruction system until the aerial vehicle is maneuvered to a safe location outside the burst radius or the line of fire of the weapon and the target can then be subsequently destroyed or eliminated;

the target destruction system can be manually overwritten by the commander if he chooses sacrificing the aerial vehicle while engaging the target even when the aerial

vehicle is within the burst radius or near the line of fire of the weapon;

the method further comprising an aerial vehicle tracking system, wherein the aerial vehicle tracking system comprises tracking software and the aerial vehicle tracking system is mounted on the ground vehicle or platform;

wherein the aerial vehicle comprises of an infrared video camera, which may be having image and thermal intensifying (TI and/or II) capabilities, and a laser distance sensor, an inclinometer and a 3 axis digital compass; and

the ground vehicle or platform comprises an electro-optic tracker to help tracking of aerial vehicle which is deployed for searching and identifying targets day or night or in poor light conditions.

21. The method of claim 20 wherein the aerial vehicle tracking system comprises in one instance two three-dimensional aerial vehicle tracking cameras having a field of view and each three-dimensional aerial vehicle tracking camera having a crosshair; wherein after the aerial vehicle is placed within the field of view and the image of the aerial vehicle is placed onto the crosshairs of the three-dimensional aerial vehicle tracking cameras, the tracking software is activated.

22. The method of claim 20 wherein in another instance the aerial vehicle tracking system comprises an electro-optics including but not limited to a cooled or un-cooled infrared video camera having a field of view and a crosshair, a digital compass, an inclinometer and a laser distance sensor;

wherein after the aerial vehicle is within the field of view of the video camera and the image of the aerial vehicle is on the crosshair of the video camera, the tracking software is activated.

23. The method of claim 20 wherein in further another instance the aerial vehicle tracking system comprises a radar having the aerial vehicle in the field of view and the aerial vehicle comprises a radar reflector enhancing a reflected radar signal from the aerial vehicle to the ground system to avoid confusion in locating the aerial vehicle due to low signal to noise ratio especially in an urban environment;

wherein after the aerial vehicle is placed within the field of view of the radar, and the signal from the radar reflector is received by the aerial vehicle tracking system when the tracking software is activated.

24. A method of locating and engaging a target having an engagement zone comprising, in combination, the steps of:

generating a target location of the target using a target locating system;

using a target engagement system to control a target destruction system, wherein the target engagement system may deliver at least one projectile to the target based on the computer established target location if the commander chooses to engage the target; or to ignore the engagement of the target due to reason; including but not limited to the aerial vehicle is within the burst radius or is in the line of fire of the weapon;

wherein the target engagement system checks the location of the aerial vehicle against the burst radius of the weapon and if the aerial vehicle position is within the burst radius or is in the line of fire of the weapon then the target engagement system disables the target destruction system until the aerial vehicle is maneuvered to a safe location outside the engagement zone and the target can then be subsequently destroyed or eliminated;

the target destruction system can be manually overwritten by the commander if he chooses sacrificing the aerial vehicle while engaging the target even when the aerial vehicle is within the burst radius or near the line of fire of the weapon; and

in one instance the aerial vehicle tracking system on the ground comprises

of: two three-dimensional aerial vehicle tracking cameras separated at a predetermine distance and having a field of view with and each three-dimensional aerial vehicle tracking camera having a crosshair; wherein after the aerial vehicle is placed within the field of view and the image of the aerial vehicle is placed onto the crosshairs of the three-dimensional aerial vehicle tracking cameras, the tracking software is activated; and,

in another instance, an electro-optic system including but not limited to a cooled or un-cooled infrared video camera having a field of view and a crosshair, a digital compass, an inclinometer and a laser distance sensor, and after the aerial vehicle is within the field of view of the video camera and the image of the aerial vehicle is on the crosshair of the video camera, the tracking software is activated, and

in further other instance, a radar having a field of view and the aerial vehicle comprises a radar reflector enhancing a reflected radar signal from the aerial vehicle to the ground system to avoid confusion in locating the aerial vehicle due

to low signal to noise ratio especially in an urban environment, wherein after the aerial vehicle is placed within the field of view of the radar, and the signal from the radar reflector is received by the aerial vehicle tracking system on the ground and after the tracking software is activated.

25. A target locating and engaging system comprising, in combination:
 - a target having an engagement zone;
 - a target location of a target generated using a target locating system;
 - a target engagement system which controls a target destruction system, wherein the target engagement system delivers at least one projectile to the target based on the target location if the commander chooses to engage the target and if the aerial vehicle is not within the burst radius or is not in the line of fire of the weapon;
 - wherein the target engagement system checks an aerial vehicle position of an aerial vehicle against the burst radius or in the line of fire of the weapon, and if the location of the aerial vehicle position is within the burst radius or in the line of fire of the weapon then the target engagement system disables the target destruction system until the aerial vehicle is maneuvered to a safe location before the target destruction system is enabled automatically by a computer to allow the operator to activate the destruction system to destroy or eliminate the hostile targets;
 - the target destruction system can be manually overwritten by the commander if he chooses sacrificing the aerial vehicle while engaging the target even when the aerial vehicle is within the burst radius or near the line of fire of the weapon;
 - an aerial vehicle tracking system in a ground vehicle, wherein a computer of the aerial vehicle tracking system comprises tracking software is mounted in the vehicle;
 - wherein the aerial vehicle comprises an infrared video camera which may have image intensifying (II) capability, or thermal intensifying (TI) capability or both, an inclinometer, a digital compass and a laser distance sensor; and
 - the ground vehicle comprises a computer, an aerial vehicle tracking system and a controller to guide an engaging system to point to the target based on the third data computed by the computer. If necessary, an infrared or visible light illuminator can be used to shine on the target to assist the aerial vehicle searching and identifying targets in poor light conditions and at night.

26. The target locating and engaging system of claim 25 wherein the aerial vehicle tracking system comprises in one instance two three-dimensional aerial vehicle tracking cameras which are separated at a predetermined distance to enhance accuracy and having a field of view and each three-dimensional aerial vehicle tracking camera having a crosshair; wherein after the aerial vehicle is placed within the field of view and the image of the aerial vehicle is placed onto the crosshairs of the three-dimensional aerial vehicle tracking cameras, the tracking software is activated.

27. The target locating and engaging system of claim 25 wherein the aerial vehicle tracking system comprises in another instance of an electro-optics including but not limited to a cooled or un-cooled infrared video camera having a field of view and a crosshair, an inclinometer, a digital compass and a laser distance sensor, and after the aerial vehicle is within the field of view of the video camera and the image of the aerial vehicle is on the crosshair of the video camera, the tracking software is activated.

28. The target locating and engaging system of claim 25 wherein the aerial vehicle tracking system comprises in further another instance a radar having a field of view and the aerial vehicle comprises a radar reflector enhancing a radar signal to noise ratio;
wherein after the aerial vehicle is placed within the field of view of the radar, and the signal from the radar reflector is received by the aerial vehicle tracking system when, the tracking software is activated.

29. A target locating and engaging system comprising, in combination:
a target having an engagement zone;
a target location of a target generated using a target locating system;
a target engagement system which controls a target destruction system, wherein the target engagement system delivers at least one projectile to the target based on the target location determined by the third data if the commander chooses to engage the target and if the aerial vehicle is not within the burst radius or the line of fire of the weapon;

wherein the target engagement system checks an aerial vehicle position of an aerial vehicle against the burst radius and/or the line of fire of the weapon, and if the location of the aerial vehicle position is within the burst radius or in the line of fire of the

weapon then the target engagement system disables the target destruction system until the aerial vehicle is maneuvered to a safe location before the target destruction system is enabled automatically by a computer to allow the operator to activate the destruction system to destroy or eliminate the hostile targets;

the target destruction system can be manually over written by the commander if he chooses sacrificing the aerial vehicle while engaging the target even when the aerial vehicle is within the burst radius or near the line of fire of the weapon; and

an aerial vehicle tracking system and a ground vehicle, wherein a computer of the aerial vehicle tracking system comprises tracking software and is mounted in the vehicle, wherein the aerial vehicle tracking system comprises

in one instance, two three-dimensional aerial vehicle tracking cameras which are separated at a predetermined distance to enhance accuracy and having a field of view and each three-dimensional aerial vehicle tracking camera having a crosshair; and after the aerial vehicle is placed within the field of view and the image of the aerial vehicle is placed onto the crosshairs of the three-dimensional aerial vehicle tracking cameras, the tracking software is activated,
 in another instance, an electro-optics including but not limited to a cooled or un-cooled infrared video camera having a field of view and a crosshair, an inclinometer, a digital compass and a laser distance sensor, and after the aerial vehicle is within the field of view of the video camera and the image of the aerial vehicle is on the crosshair of the video camera, the tracking software is activated,
 or

in a further other instance, a radar having a field of view and the aerial vehicle comprises a radar reflector enhancing a radar signal to noise ratio, wherein after the aerial vehicle is placed within the field of view of the radar, and the signal from the radar reflector is received by the aerial vehicle tracking system after the tracking software is activated.

30. A method of locating and engaging a target having an engagement zone comprising, in combination, the steps of:

generating a target location of the target using a target locating system; and
 using a target engagement system to control a target destruction system, wherein the target engagement system delivers at least one projectile to the target based on the

target location using the third data if the commander chooses to engage the target and if the aerial vehicle is not within the burst radius or is not in the line of fire of the weapon;

wherein the target engagement system checks an aerial vehicle position of an aerial vehicle against the burst radius and/or the line of fire of the weapon, and if the aerial vehicle's position is within the burst radius and/or the line of fire of the weapon, then the target engagement system disables the target destruction system until the aerial vehicle is maneuvered to a safe location outside the engagement zone and the target can then be subsequently destroyed or eliminated. The target destruction system can be manually over written by the commander if he chooses sacrificing the aerial vehicle while engaging the target even when the aerial vehicle is within the burst radius or near the line of fire of the weapon;

an aerial vehicle tracking system and a vehicle, wherein the aerial vehicle tracking system comprises tracking software and the aerial vehicle tracking system is mounted on the vehicle;

wherein the aerial vehicle comprises of an infrared video camera, having image and thermal intensifying (II and TI) capabilities, and a laser distance sensor; and

the ground vehicle may comprises of an infrared or visible light illuminator aiming at the target to help the aerial vehicle in searching and identifying targets in poor light conditions and at night .

31. The method of claim 30 wherein the aerial vehicle tracking system in one instance comprises two three-dimensional aerial vehicle tracking cameras having a field of view with each three-dimensional aerial vehicle tracking camera having a crosshair; wherein after the aerial vehicle is placed within the field of view and the image of the aerial vehicle is placed onto the crosshairs of the three-dimensional aerial vehicle tracking cameras, the tracking software is activated.

32. The method of claim 30 wherein the aerial vehicle tracking system in another instance comprises an electro-optics including but not limited to an cooled or un-cooled infrared video camera having a field of view and a crosshair, a digital compass, an inclinometer and a laser distance sensor;

wherein after the aerial vehicle is within the field of view of the electro-optics including but not limited to a cooled or un-cooled infrared video camera and the image of

the aerial vehicle is on the crosshair of the video camera, the tracking software is activated.

33. The method of claim 30 wherein the aerial vehicle tracking system comprises in further another instance a radar having a field of view and the aerial vehicle comprises a radar reflector enhancing a reflected radar signal from the aerial vehicle to avoid confusion in locating the aerial vehicle due to low signal to noise ratio especially in an urban environment;

wherein after the aerial vehicle is placed within the field of view of the radar, and the signal from the radar reflector is received by the aerial vehicle tracking system, the tracking software is activated.

34. A method of locating and engaging a target having an engagement zone comprising, in combination, the steps of:

generating a target location of the target using a target locating system;

using a target engagement system to control a target destruction system, wherein the target engagement system delivers at least one projectile to the target based on the target location determined by the third data and if the commander decides to engage the target and if the aerial vehicle is not in the line of fire or within the burst radius of the weapon;

wherein the target engagement system checks an aerial vehicle position of an aerial vehicle against the burst radius and/or the line of fire of the weapon, and if the aerial vehicle position is within the burst radius or the line of fire of the weapon, then the target engagement system disables the target destruction system until the aerial vehicle is maneuvered to a safe location outside the burst radius or the line of fire of the weapon and the target can then be subsequently destroyed or eliminated;

the target destruction system can be manually over written by the commander if he chooses sacrificing the aerial vehicle while engaging the target even when the aerial vehicle is within the burst radius or near the line of fire of the weapon; and

the aerial vehicle tracking system comprises one of the following systems or a combination of the systems;

(1) two three-dimensional aerial vehicle tracking cameras having a field of view with each three-dimensional aerial vehicle tracking camera having a

crosshair; wherein after the aerial vehicle is placed within the field of view and the image of the aerial vehicle is placed onto the crosshairs of the three-dimensional aerial vehicle tracking cameras, the tracking software is activated,

(2) an electro-optics including but not limited to a cooled or un-cooled infrared video camera having a field of view and a crosshair, a digital compass, an inclinometer and a laser distance sensor, and after the aerial vehicle is within the field of view of the video camera and the image of the aerial vehicle is on the crosshair of the video camera, the tracking software is activated, or

(3) a radar having a field of view and the aerial vehicle comprises a radar reflector enhancing a reflected radar signal from the aerial vehicle to avoid confusion in locating the aerial vehicle due to low signal to noise ratio especially in an urban environment, wherein after the aerial vehicle is placed within the field of view of the radar, and the signal from the radar reflector is received by the aerial vehicle tracking system, the tracking software is activated.

35. A target locating and engaging system comprising, in combination:
- a target having an engagement zone;
 - a target location of a target generated using a target locating system;
 - a target engagement system which controls a target destruction system, wherein the target engagement system delivers at least one projectile to the target based on the target location using on the third data computed and if the commander chooses to engage the target and if the aerial vehicle is not in the line of fire or is not within the burst radius of the weapon;

wherein the target engagement system checks an aerial vehicle position of an aerial vehicle against the burst radius or the line of fire of the weapon, and if the location of the aerial vehicle position is within the burst radius or the line of fire of the weapon, then the target engagement system disables the target destruction system until the aerial vehicle is maneuvered to a safe location before the target destruction system is enabled automatically by a computer to allow the operator to activate the destruction system to destroy or eliminate the hostile targets;

the target destruction system can be manually over written by the commander if he chooses sacrificing the aerial vehicle while engaging the target even when the aerial vehicle is within the burst radius or near the line of fire of the weapon;

an aerial vehicle tracking system and a vehicle, wherein a computer of the aerial vehicle tracking system comprises tracking software is mounted in the vehicle;

wherein the aerial vehicle comprises an infrared video camera may have an image intensifying (II) capability, thermal intensifying (TI) capability or both, and a laser distance sensor; and

the vehicle may comprises of an infrared or a visible light illuminator aiming at the target to assist aerial vehicle in searching and identifying targets in poor light conditions and at night.

36. The target locating and engaging system of claim 35 wherein the aerial vehicle tracking system comprises in one instance two three-dimensional aerial vehicle tracking cameras which are separated at a predetermined distance to enhance accuracy and having a field of view with each three-dimensional aerial vehicle tracking camera having a crosshair; wherein after the aerial vehicle is placed within the field of view and the image of the aerial vehicle is placed onto the crosshairs of the three-dimensional aerial vehicle tracking cameras, the tracking software is activated.

37. The target locating and engaging system of claim 35 wherein the aerial vehicle tracking system comprises in another instance an electro-optics including but not limited to a cooled or un-cooled infrared video camera having a field of view and a crosshair, an inclinometer, a digital compass and a laser distance sensor, and after the aerial vehicle is within the field of view of the video camera and the image of the aerial vehicle is on the crosshair of the video camera, the tracking software is activated.

38. The target locating and engaging system of claim 35 wherein the aerial vehicle tracking system comprises in further another instance a radar having a field of view and the aerial vehicle comprises a radar reflector enhancing a radar signal to noise ratio;

wherein after the aerial vehicle is placed within the field of view of the radar, and the signal from the radar reflector is received by the aerial vehicle tracking system, the tracking software is activated.

39. A target locating and engaging system comprising, in combination:
a target having an engagement zone;

a target location of a target generated using a target locating system;

a target engagement system which controls a target destruction system, wherein the target engagement system delivers at least one projectile to the target based on the target location determined by the third data and if the commander chooses to engage the target and if the aerial vehicle is not within the burst radius or not in the line of fire of the weapon;

wherein the target engagement system checks an aerial vehicle position of an aerial vehicle against the burst radius or the line of fire or the weapon, and if the location of the aerial vehicle position is within the burst radius or in the line of fire of the weapon, then the target engagement system disables the target destruction system until the aerial vehicle is maneuvered to a safe location before the target destruction system is enabled automatically by a computer to allow the operator to activate the destruction system to destroy or eliminate the hostile targets;

the target destruction system can be manually over written by the commander if he chooses sacrificing the aerial vehicle while engaging the target even when the aerial vehicle is within the burst radius or near the line of fire of the weapon; and

an aerial vehicle tracking system and a vehicle, wherein a computer of the aerial vehicle tracking system comprises tracking software and is mounted in the vehicle, wherein the aerial vehicle tracking system comprises one of the following systems or a combination of the systems:

two three-dimensional aerial vehicle tracking cameras which are separated at a predetermined distance apart to enhance accuracy and having a field of view with each three-dimensional aerial vehicle tracking camera having a crosshair; and after the aerial vehicle is placed within the field of view and the image of the aerial vehicle is placed onto the crosshairs of the three-dimensional aerial vehicle tracking cameras, the tracking software is activated,

an electro-optics including but not limited to a cooled or un-cooled infrared video camera having a field of view and a crosshair, an inclinometer, a digital compass and a laser distance sensor, and after the aerial vehicle is within the field of view of the video camera and the image of the aerial vehicle is on the crosshair of the video camera, the tracking software is activated, or

a radar having a field of view and the aerial vehicle comprises a radar reflector enhancing a radar signal to noise ratio, wherein after the aerial vehicle is

placed within the field of view of the radar, and the signal from the radar reflector is received by the aerial vehicle tracking system, the tracking software is activated.

40. A method of locating and engaging a target having an engagement zone comprising, in combination, the steps of:
- generating a target location of the target using a target locating system; and
 - using a target engagement system to control a target destruction system, wherein the target engagement system delivers at least one projectile to the target based on the target location;
 - wherein the target engagement system checks an aerial vehicle position of an aerial vehicle against the engagement zone of the target, and if the aerial vehicle position is within the engagement zone of the target, then the target engagement system disables the target destruction system until the aerial vehicle is maneuvered to a safe location outside the engagement zone and the target can then be subsequently destroyed or eliminated;
 - an aerial vehicle tracking system and a vehicle, wherein the aerial vehicle tracking system comprises tracking software and the aerial vehicle tracking system is mounted on the vehicle;
 - wherein the aerial vehicle comprises one of an infrared video camera, electro-optics, and a 3D video tracking camera having image and thermal intensifying capabilities, and a smart laser distance sensor; and
 - the vehicle comprises at least one infrared illuminator to help tracking of aerial vehicle and searching and identifying targets in poor light conditions and at night .

41. The method of claim 40 wherein the aerial vehicle tracking system comprises two three-dimensional aerial vehicle tracking cameras having a field of view with each three-dimensional aerial vehicle tracking camera having a crosshair; wherein after the aerial vehicle is placed within the field of view and the image of the aerial vehicle is placed onto the crosshairs of the three-dimensional aerial vehicle tracking cameras, the tracking software is activated.

42. The method of claim 40 wherein the aerial vehicle tracking system comprises a video camera having a field of view and a crosshair, a digital compass, an inclinometer and a laser distance sensor;

wherein after the aerial vehicle is within the field of view of the video camera and the image of the aerial vehicle is on the crosshair of the video camera, the tracking software is activated.

43. The method of claim 30 wherein the aerial vehicle tracking system comprises a radar having a field of view and the aerial vehicle comprises a radar reflector enhancing a reflected radar signal from the aerial vehicle to avoid confusion in locating the aerial vehicle due to low signal to noise ratio especially in an urban environment;

wherein after the aerial vehicle is placed within the field of view of the radar, and the signal from the radar reflector is received by the radar, the tracking software is activated.

44. A method of locating and engaging a target having an engagement zone comprising, in combination, the steps of:

generating a target location of the target using a target locating system;

using a target engagement system to control a target destruction system, wherein the target engagement system delivers at least one projectile to the target based on the target location;

wherein the target engagement system checks an aerial vehicle position of an aerial vehicle against the engagement zone of the target, and if the aerial vehicle position is within the engagement zone of the target, then the target engagement system disables the target destruction system until the aerial vehicle is maneuvered to a safe location outside the engagement zone and the target can then be subsequently destroyed or eliminated; and

the aerial vehicle tracking system comprises one of:

two three-dimensional aerial vehicle tracking cameras having a field of view with each three-dimensional aerial vehicle tracking camera having a crosshair; wherein after the aerial vehicle is placed within the field of view and the image of the aerial vehicle is placed onto the crosshairs of the three-dimensional aerial vehicle tracking cameras, the tracking software is activated,

a video camera having a field of view and a crosshair, a digital compass, an inclinometer and a laser distance sensor, and after the aerial vehicle is within the field of view of the video camera and the image of the aerial vehicle is on the crosshair of the video camera, the tracking software is activated, or

a radar having a field of view and the aerial vehicle comprises a radar reflector enhancing a reflected radar signal from the aerial vehicle to avoid confusion in locating the aerial vehicle due to low signal to noise ratio especially in an urban environment, wherein after the aerial vehicle is placed within the field of view of the radar, and the signal from the radar reflector is received by the radar, the tracking software is activated.

45. A target locating and engaging system comprising, in combination:

a target having an engagement zone;

a target location of a target generated using a target locating system;

a target engagement system which controls a target destruction system, wherein the target engagement system delivers at least one projectile to the target based on the target location;

wherein the target engagement system checks an aerial vehicle position of an aerial vehicle against the engagement zone of the target, and if the location of the aerial vehicle position is within the engagement zone of the target, then the target engagement system disables the target destruction system until the aerial vehicle is maneuvered to a safe location before the target destruction system is enabled automatically by a computer to allow the operator to activate the destruction system to destroy or eliminate the hostile targets;

an aerial vehicle tracking system and a vehicle, wherein a computer of the aerial vehicle tracking system comprises tracking software is mounted in the vehicle;

wherein the aerial vehicle comprises an infrared video camera having one of an image intensifying capability, thermal intensifying capability and both, and a smart laser distance sensor; and

the vehicle comprises at least one infrared illuminator to assist tracking of aerial vehicle and to assist searching and identifying targets in poor light conditions and at night.

46. The target locating and engaging system of claim 45 wherein the aerial vehicle tracking system comprises two three-dimensional aerial vehicle tracking cameras which are separated to enhance accuracy and having a field of view with each three-dimensional aerial vehicle tracking camera having a crosshair; wherein after the aerial vehicle is placed within the field of view and the image of the aerial vehicle is placed onto the crosshairs of the three-dimensional aerial vehicle tracking cameras, the tracking software is activated.

47. The target locating and engaging system of claim 45 wherein the aerial vehicle tracking system comprises a video camera having a field of view and a crosshair, an inclinometer, a digital compass and a laser distance sensor, and after the aerial vehicle is within the field of view of the video camera and the image of the aerial vehicle is on the crosshair of the video camera, the tracking software is activated.

48. The target locating and engaging system of claim 45 wherein the aerial vehicle tracking system comprises a radar having a field of view and the aerial vehicle comprises a radar reflector enhancing a radar signal to noise ratio;
wherein after the aerial vehicle is placed within the field of view of the radar, and the signal from the radar reflector is received by the radar, the tracking software is activated.

49. A target locating and engaging system comprising, in combination:
a target having an engagement zone;
a target location of a target generated using a target locating system;
a target engagement system which controls a target destruction system, wherein the target engagement system delivers at least one projectile to the target based on the target location;
wherein the target engagement system checks an aerial vehicle position of an aerial vehicle against the engagement zone of the target, and if the location of the aerial vehicle position is within the engagement zone of the target, then the target engagement system disables the target destruction system until the aerial vehicle is maneuvered to a safe location before the target destruction system is enabled automatically by a computer to allow the operator to activate the destruction system to destroy or eliminate

the hostile targets; and

an aerial vehicle tracking system and a vehicle, wherein a computer of the aerial vehicle tracking system comprises tracking software and is mounted in the vehicle, wherein the aerial vehicle tracking system comprises one of:

two three-dimensional aerial vehicle tracking cameras which are separated to enhance accuracy and having a field of view with each three-dimensional aerial vehicle tracking camera having a crosshair; and after the aerial vehicle is placed within the field of view and the image of the aerial vehicle is placed onto the crosshairs of the three-dimensional aerial vehicle tracking cameras, the tracking software is activated,

a video camera having a field of view and a crosshair, an inclinometer, a digital compass and a laser distance sensor, and after the aerial vehicle is within the field of view of the video camera and the image of the aerial vehicle is on the crosshair of the video camera, the tracking software is activated, or

a radar having a field of view and the aerial vehicle comprises a radar reflector enhancing a radar signal to noise ratio, wherein after the aerial vehicle is placed within the field of view of the radar, and the signal from the radar reflector is received by the radar, the tracking software is activated.