Live combat simulation

This present invention relates to live combat simulation games and, more particularly, a firearm-like device and unit for use in live combat simulation games.

Live combat simulation games using firearm-like devices emulating or simulating real-life firearms, such as laser tag or combat games, allow participants or players to participate in realistic combat simulations in a range of different indoor and outdoor environments without substantially endangering their own, and others', personal safety. Such games can be used for entertainment, sport, team building and morale building.

In a typical live combat simulation, players are divided into at least two teams. Each player is equipped with a firearm-like device arranged to generally simulate a firearm, such as a rifle or a machine-gun, for example. The devices when fired, such as by squeezing a trigger or pressing a button, emit a focused infra-red beam or pulse directed in the assumed trajectory of a projectile fired from the device. Each player also carries one or more sensors coupled to the device, which may be arranged about the head or on the body of the player, for example, for sensing "hits" (i.e. emitted infra-red beams) from another player.

Each player's device may be configured to fire a predetermined maximum number of times and also accept a predetermined number of hits, after either of which the

device may enter a "dead" state in which the device is effectively inactive and unable to fire. The player, or a referee supervising the game, may then be able to reactivate ("re-spawn") the "dead" player's device so that the device is again able to be fired and the player can re-enter the game or participate in a further game.

One problem with existing firearm-like devices is the lack of immediate feedback provided to players. When a player hits another player using the device, typically the device of the hit player will emit a sound and/or actuate one or more light emitting diodes (LEDs) indicating to surrounding players that they have been hit and their device is, at least temporarily, disabled. Since a combat simulation game may be played in a large outdoor space, where distances between players may be up to 100 metres or more, it can be difficult for the firing player to determine if they have made a hit. This can result in a player believing that they are being regularly hit by other players, without realising that they themselves are also effecting hits. This can detract from the player's enjoyment and experience, and/or the effectiveness of the game.

Further, while live combat simulation games using the devices described above have been found to be relatively popular, the appearance of the custom made firearm-like devices generally differs from real-life firearms. As such, the devices have often been found to detract considerably from the general realness and believability of live combat simulations and, in consequence, enjoyment and/or effectiveness as a training tool. The manufacturing costs associated with designing and producing a

range of the custom made firearm-like devices arranged to accurately simulate in both handling and appearance a range of different firearms and for use in live combat simulations, however, is considered prohibitive.

According to one aspect of the invention, there is provided an electric firearm-like device for use by a game player in a live combat simulation, the device including a transmitter for transmitting at least first and second signals, the first signal being transmitted towards a target receiver on another game player in response to firing the device, the second signal being transmitted in response to a target receiver on the first game player being hit by the said first signal from a like device of another game player, whereby the second signal indicates the hit to that other player.

The target receiver may include one or more sensors coupled to the device and arranged about and on the head or body of a player supporting the device, for example, the sensor(s) for sensing the said first signal transmitted from another player (i.e., a hit). Alternatively, sensor(s) may be mounted on the device, whereby the receiver is formed as an integral part of the device. Alternatively, the receiver may be defined by both a part of the device and one or more sensors coupled to the device and supported on the body of the player external of the device. Preferably, the sensor(s) are arranged to filter out infra-red light not associated with the transmitter.

The device according to the invention advantageously enables real-time hit-feedback in an indoor or outdoor environment when playing a live combat simulation game. For example, the first signal is able to effectively simulate the firing of the device, with the first signal when received by a like device being indicative of a hit on the like device by the first device. The second signal is able to be used to provide substantially instantaneous feedback if the first signal registers a hit, thereby enabling a player firing the device to be informed of whether the firing was successful. For example, the second signal may be used to provide feedback to the player that their hit has resulted in an opponent player being “hit” or “killed.” Alternatively, and/or additionally, the second signal may be used to provide feedback to the player as to whether the device of the hit opponent player was already in an inactive or “dead” state.

Advantageously, the device is arranged to selectively simulate or emulate the characteristics of one or more real-life firearms. Preferably the transmitted first signal is in the same direction as the assumed trajectory of an assumed missile fired from the device.

The transmitter may include an infrared emitter for transmitting the first signal and the first signal may be an infra-red beam or pulse, for example. Further, the transmitter may include a lens for focusing the infra-red beam or pulse. Preferably the effective range of the infra-red beam or pulse may be selectively varied.

The transmitter may include a radio transmitter for transmitting the second signal and the second signal maybe a radio signal, for example. Advantageously, the, preferably digital, radio transmitter is selectively operable on several different channels, whereby different firearm-like devices may effectively listen on different channels so as to facilitate the operation of two or more separate live simulations in relatively close proximity to one another, such as on adjacent or adjoining "battlefields" in an outdoor environment, for example.

Preferably, the device includes a protective case in which at least the transmitter is housed. The case may be formed from a relatively hard plastic, for example. Advantageously, when the case is formed from plastic, an aerial or antenna associated with transmitting and receiving radio signals is able to be located inside the case so that there is no requirement to locate the aerial externally, whereby it may be exposed during a combat simulation.

The case may also house circuitry, such as a circuit board, for controlling an operation of the unit and a power source for providing power for the operation of the unit, for example.

The device may also include a visual display, such as a liquid crystal display (LCD) for providing information to a player operating the device. The information may include real-time hit feedback to the player based on the second signal, such as feedback indicating the device of another player has been hit and/or or the hit

another player's device switches to an inactive state in response to the first player firing their device. The displayed information may also include details of operating characteristics of one or more firearms the device may be arranged to simulate.

Preferably the device also includes a speaker for emitting or playing a sound effect in response to one or more of a signal transmit by the firearm-like device and a signal received by the firearm-like device. For example a sound effect may be played to provide real-time feedback to a player in response to one or more of the firing of the device and the device effecting a hit on another player's device. Preferably, the speaker may also be used to provide a description of one or more firearms the device is arranged to simulate. Further, the device may be arranged to selectively play sound effects in several different languages, whereby the device may be readily adapted for use in different countries.

The device may include one or more LEDs for indicating the transmitting of the first signal. The LEDs may be used to simulate muzzle flash, for example. Preferably, the unit includes several differently coloured muzzle flash LEDs such that in a live combat simulation involving more than two teams of players, particularly at night, the units of opposed teams may be configured to use different coloured LEDs.

Preferably, the device is arranged to receive at least a third signal for controlling its operation. In response to receiving the third signal, the firearm-like device may be arranged to switch between an active sate in which the device is able to transmit the

first signal when fired and an inactive state in which the device is disabled from transmitting the first signal and, in effect, cannot then be fired. Alternatively, the number of such first signals that are allowed to be transmitted by the transmitter and, in effect, the number of "shots" or "rounds" that can be fired may be controlled by the third signal; accordingly, the third signal can have the effect of "re-loading" the device with a predetermined number of "shots", for example.

In practice, the third signal may be used by a referee, or other supervisor, supervising a live combat simulation to efficiently and remotely control a live combat simulation, and more particularly a firearm-like device being used in the simulation. The third signal may be an infra-red beam or pulse that is able to be directed towards a target receiver associated with a single device, or it may be a radio signal that is able to be received by any devices within range, for example.

Advantageously, the firearm-like device is selectively arranged to transmit the third signal. As such, advantageously a referee may not require a separate device to transmit the third signal, and may instead use a spare device.

It will be understood, however the operation of the device may be manually controlled without a third signal, or other form of remote control, as described above. For example, it is contemplated that players will be able configure and operate their own devices without a referee or supervisor, and as such the devices advantageously are fully self-operable with inputs forming part of the devices, such

as manual controls including inputs, such as switches, dials and/or buttons, that may be disposed on the case of the device, for example.

In a preferred form of the device, either the transmitter can be built into the device to form an integral part of the device, or it can be formed as a separate unit attached to a firearm having a firing action generated by an electrical triggering signal, or a simulated firearm in which operation of the trigger generates an electrical triggering signal; an example of a firearm having the required type of firing action is an airsoft electric gun (AEG).

Preferably, the unit includes a (or the) protective case for housing the transmitter, the case having a bracket, such as clamping structure, for example, for attaching the case to pre-existing structure of the firearm. More preferably, the pre-existing structure of the firearm is a standard rail or base for the mounting of a sight to which the unit can be selectively mounted and dismounted. The standard rail or base may be a pre-existing Weaver scope rail or base, for example.

Preferably, the case also includes a mount to which a sight, such as a red-dot sight or telescopic scope, for example, can be clamped. More preferably, the mount forms a standard rail or base for the mounting of a sight. The standard rail or base may be a Weaver scope rail or base, for example.

Preferably, the unit is arranged to be mounted to an existing, mass-produced, realistic-looking AEG, such as a rifle or pistol, or other toy gun having an electronic trigger switch. Advantageously, operating characteristics of the unit are able to be selected to correspond to operating characteristics of the firearm to which the unit is mounted. The unit may store details of the operating characteristics of a plurality of existing firearms, with a player able to select one of these. The operating characteristics may include one or more of effective range of the transmitted signal (range), rate at which signals may be transmitted (rate of fire) and maximum number of signals able to per transmitted (magazine capacity), for example. As such, by the use of sound effects and applying operating characteristics preferably appropriate to the selected firearm, the unit may be used to effectively simulate a large selection of firearms, without the prohibitive manufacturing costs that would otherwise be incurred if a number of the previously proposed firearm-like devices for use in live combat simulation games were separately manufactured in order to effectively simulate, in both appearance and operation, a range of different real-life firearms.

A preferred form of the unit substantially has the visual appearance of an authentic night vision scope, while still containing the optoelectronics and associated firmware for the operation of the unit. Further, the speaker may be coupled to the case such that the speaker has the visual appearance of an authentic tactical torch attached to the night vision scope, for example. As such, a preferred form of the unit, when attached to a firearm, such as a small arm, for example, allows a player to feel immersed in a live combat simulation. Further, it is contemplated that a preferred

form of the unit could be used, in addition to traditional skirmish-type combat simulation games, in fairs, festivals and re-enactment societies, for example. Further still, it will be understood that the designs of the unit and firearm may not be limited to a military style, and may be other designs, such as a science-fiction style, for example.

Although the emitting of the second signal which provides feedback of a hit is particularly advantageous, in a simplified version just the first (firing) signal may be emitted and this can be achieved by constructing a unit with a signal transmitter for attachment to a firearm or simulated firearm of the type discussed previously so that it can be readily converted into a form for game play.

According to a further aspect of the present invention, there is provided a unit for use by a game player in a live combat simulation, the unit for attaching to a firearm having a firing action generated by an electrical triggering signal or to a simulated firearm in which operation of the trigger generates an electrical triggering signal; the unit including a transmitter for transmitting at least a first signal towards a target receiver on another game player in response to the triggering signal, wherein the said first signal from a like device of another game player received by a target receiver of the first player is indicative of a hit on the first player by that other player.

While the unit may be only be operable to transmit the first signal, it may additionally transmit the second signal and include a receiver for the first signal (from another unit), the second (feedback) signal and possibly a third (control) signal.

In its practical application, the unit is mounted externally to the firearm and has the effect of converting a firearm made for other purposes into a firearm for use in a live combat simulation.

According to a still further aspect of the present invention, there is provided a firearm having a firing action generated by an electrical triggering signal or to a simulated firearm in which operation of the trigger generates an electrical triggering signal and a unit retrofitted to the firearm or simulated firearm, the unit including a transmitter for transmitting at least a first signal towards a target receiver on another game player in response the to the triggering signal, wherein the said first signal from a like device of another game player received by a target receiver of the first player is indicative of a hit on the first player by the second player. For example, the firearm or simulated firearm may be an AEG or other toy firearm.

The present invention will now be described, by way of non-limiting example only, with reference to the accompanying drawings, in which:

Figure 1 is a plan view of a unit for mounting to a firearm or simulated firearm;

Figure 2 is a side view of the unit shown in Figure 1 as viewed in direction A;

Figure 3 is a side view of the unit shown in Figure 1 as viewed in direction B;

Figure 4 is a lens through which an infra-red beam emitted from the unit shown in Figure 1 is focused;

Figure 5 is a schematic diagram showing a system including the unit of Figure 1 for a live combat simulation;

Figure 6 is a schematic state diagram showing states of the unit of Figure 1 when playing a live combat simulation game;

Figure 7 is a perspective view of a previously proposed night scope;

Figure 8 is a perspective view of a previously proposed tactical torch for attachment to the night vision scope shown in Figure 7; and

Figure 9 is a perspective view of the night vision scope in Figure 7 mounted to an example AEG.

The present invention will now be described with reference to the below non-limiting example of a unit for use by a game player in a live combat simulation in the form of a Small Arms Transmitter/Receiver (SATR) 20 unit, which is shown in Figures 1 to 3. While the invention will be described with reference to the unit 20 that is arranged for mounting to a firearm having a firing action generated by an electrical triggering signal or to a simulated firearm in which operation of the trigger generates an electrical triggering signal (hereinafter referred to as a firearm), such as an AEG originally arranged to fire plastic pellets, for example, it will be understood that the present invention may alternatively be embodied in a purpose built into a firearm-like device for use by a game player in a live combat simulation.

The SATR unit 20 is arranged to be attached to a firearm, the unit 20 including a transmitter for transmitting at a least first, or firing, signal and preferably a second, or feedback, signal. The first signal may be in the form of an infra-red beam or pulse in response to a player in a live combat simulation game firing the firearm, such as applying pulling a trigger of the firearm, that is able to be transmitted towards a target receiver on another game player. The second signal may be in the form of a radio signal, for example, that is transmitted in response to a target receiver on a first game player being hit by the first signal from a like device of another game player, whereby the second signal indicates the hit to that other player, and preferably whether the hit has resulted in a kill or the device of that other player is already in a dead state.

Accordingly, when used in the play of a live combat simulation game, an opposing player also equipped with a unit 20 may carry one or more sensors for sensing the transmitted infra-red beam or pulse, which when sensed by the sensor(s) constitutes a hit on the opposition player. Hits on a player may be used to determine functioning of the player's unit 20 and, in consequence, the player's continued participation in the game.

In the description of the example unit 20 below, it will be understood that the references to firing, ammunition, magazines and the like refer to firing of the firearm or unit 20 (the transmitting of an infra-red signal), ammunition (the number of times the unit 20 is allowed to transmit an infra-red signal), magazines (the amount of

ammunition in reserve that can effectively be loaded into the unit 20) and the like as simulated by the unit 20.

Glossary of terms used when describing the unit 20

Configuration: Refers generally to the settings for the difficulty level, weapon and hit points (all defined below) on an individual unit 20. Configurations are advantageously remembered between re-boots of the unit 20.

Difficulty Level: Determines the level of difficulty for a player participating in a live combat simulation using the unit 20. During an initial boot sequence of a unit 20, each player can set the difficulty level. Three difficulty levels, for example, may include:

Difficulty Level	Hit Delay	Default Hit Points
Easy	2 seconds	5
Standard	1 second	5
Hard	0.5 seconds	3

It will be understood that the number of difficulty levels, and associated hit delays and default hit points (both defined below), may be varied as desired.

Fire Mode: Determines the mode of firing of the unit 20 (see table below) and may be selectively adjusted by a player during a live combat simulation. The fire mode is determined by a combination of the weapon (defined below), the difficulty

level and the current position of a fire mode select slide. Example fire modes may include:

Fire Mode	**Description**
Fully Automatic (FA)	In this mode, when the player pulls the trigger, the unit 20 fires (i.e. transmits infra-red signals) until out of ammunition or the participant releases the trigger.
Semi-automatic (SA)	In this mode, the unit 20 fires one round per trigger pull. However, the simulated new round is assumed to be in the chamber of the firearm automatically and very quickly, so rapid fire is still possible by the quick release and pulling of the trigger.
Bolt Action (BA)	In this mode, the unit 20 fires only once per trigger pull and then there is a delay and preferably a sound effect simulating a bolt being manually used to load a new round into the chamber of the firearm.
Auto Loader (AL)	In this mode, the unit 20 simulates an automatic loading pistol, such as an M1911A1/Colt.45M IV, for example.
Burst Fire (BF)	In this mode, the unit 20 is allowed to operate in FA mode, but is limited to simulating fully automatic bursts of up to three rounds, for example. After three rounds, the trigger must be released and then pulled again to fire further from the unit 20.

Revolver (RV)	In this mode, the unit 20 simulates a firearm in which the supply of ammunition is carried in a rotating cylinder.

Gun Class: The general class of the weapon (defined below). Advantageously, the unit 20 will be configured to function in a way consistent with the firearm to which it is mounted, and further will be limited to simulating firearms consistent with the selected gun class. Example gun classes may include:

Gun Class#	**Typical Gun Case**
1	Pistol.
2	Sub-machine gun.
3	Rifle.
4	Machine gun.

Hit: An infra-red beam from a unit 20 that is sensed by the infra-red sensors associated with another unit 20 and causes a reduction, typically of one point, for example, in another player's “health”. The number of hits that can be taken by a unit 20 before it goes into a dead state in which the unit 20 is inactive is determined by the initial hit points, which may be set at the boot of the unit 20. In a dead state the unit 20 is effectively inactive or inoperable, being unable to fire or re-load ammunition, thereby preventing the player from participating in a live combat simulation.

Hit Delay: The time in seconds after experiencing a hit before a unit 20 will accept a further hit. During the hit delay, a unit 20 may effectively ignore infra-red signals, and more particularly hits, from other units 20.

Hit Points: A measure of “health”; the higher the number of hit points, the more times a player can be hit by another player before entering a dead state. Each time a player's sensors (described below) are hit by an infra-red beam, their current hit points tally (or health) is reduced by one. When the hit points reaches zero, the unit 20 enters a dead state and is disabled until re-booted or re-started (or "re-spawned" as defined below).

Magazine: The number of simulated rounds of ammunition that a unit 20 can “fire” before a re-load is required.

Range: The maximum distance a unit 20 is configured make a hit on another unit's sensors. A unit 20 at full power may have a range of greater than 100 meters in direct sunshine, for example. Typically, however, not all weapons will be configured for full range and the range is selectively adjusted to correspond to the weapon to which the unit 20 is mounted. Advantageously, when the unit 20 is used to simulate a shoulder fired automatic rifles and the unit 20 is fired rapidly, for example, it will reduce the range category after a predetermined number of fired shots or duration. This simulates the inherent inaccuracy of firing fully automatic versus slower, aimed fire. Example range categories are shown in the table below:

Range Category	% Of Maximum Range
Short	50.00%
Medium	75.00%
Long	100.00%

Re-loads: The number of times between re-spawns (defined below) of a unit 20 that a player can re-load his/her ammunition (i.e., re-load a further magazine of ammunition) to a unit 20.

Re-spawn: The process during a live simulation game of allowing or promoting players having a dead state back into the game in a “live” state by reactivating or "re-spawning" the player's unit 20 using the last configuration specified. Typically when in a dead state, a player returns to an allocated base or re-spawning area where a referee supervising the game re-starts (or re-boots) the player's unit 20 remotely or the referee or the player re-start the player's unit 20 by turning it off and on.

Rate of Fire: The number of times a unit 20 can be fired (or transmit a signal in the form of an infra-red beam or pulse) per minute. Typically the rate of fire will be selected or set to correspond to the simulated weapon or to selectively restrict the firing rates of players.

Weapon: The weapon that a unit 20 is simulating or emulating. This may be selected upon boot of the unit 20 and preferably corresponds to the firearm to which the unit 20 is mounted. Alternatively, the unit 20 may be used to simulate a firearm other than that to which it is mounted. Advantageously the unit 20 stores, or has access to, information on a plurality of real-life firearms that can be presented to a player and which the player can select the unit 20 to simulate.

For the play of a typical combat simulation game using the units 20, three physical components may be provided:

1. SATR units 20 for attachment to respective firearms.

2. Optionally, a controller in the form of a referee gun (not shown) for controlling the operation of SATR units 20 involved in the game. Alternatively, a spare SATR unit 20 may be configured to function as a referee-gun.

3. Optionally, a command module in the form of a central radio control system (not shown).

Each of these will be discussed below.

1. SATR unit 20

The unit 20 integrates a directional infra-red emitter, infra-red sensors system, and preferably a radio control system and is able to be mounted to a weaver rail of a firearm, such as an AEG, or suitable replica or toy gun, to allow the play of combat simulation games by simulating a real-life firearm using an infra-red system. An example SATR unit 20 is shown in Figures 1 to 3. Each unit 20 includes:

- Protective outer case 22 having a bracket in the form of clamping structure 24 by which the unit 20 is advantageously able to be mounted onto a standard weaver scope rail, such as those found on many rifles, including commonly available AEGs, other toy electric guns and firearm replicas. The case 22 houses optoelectronics and preferably a radio module (described below) associated with the operation of the unit 20.

Advantageously, the substantially enclosed case 22 may be formed from heavy duty injection moulded hard plastic and, as indicated in Figures 2 and 3, may have dimensions of around 105mm by 280mm and a width preferably appropriate to the firearm to which it is mounted, although it will be understood that these dimensions may be varied as desired. Preferably, the case 22 substantially looks like a typical night vision scope 26 with a tactical torch 28 attached, an example of which is shown mounted to a an example replica firearm or AEG 30 in Figures 7 to 9. Further, as each unit 20 will typically be required to function under often harsh conditions, the case 22 is preferably formed to be both highly water and dust resistant.

- Mount for a sight in the form of a standard weaver rail 32 to which standard sights, such as a red-dot sight, telescopic scope, or weaver scope ring mounts, for example, may be mounted. The weaver rail 32 may be integrally formed as part of the case 22 and/or formed from the same hard plastic, for example.

- Circuitry (not shown), in the form of a circuit board, for example, functioning as a central processing unit (CPU) for the unit 20 and which is located within the case 22. This circuit board is advantageously also configured to generate sound effects associated with the use of the firearm and unit 20. The circuit board may be about 50mm x 70mm, for example, with mounting points at each corner, although it will be understood the dimensions of the circuit board may be varied as required.

- Software associated with the circuit board for operating the unit 20. Advantageously, the software can be configured to determine and establish settings associated with the operation of the unit on boot-up, such as by using the fire mode slide (discussed below) to enter or select settings from a menu displayed on a liquid crystal display (discussed above), for example, Preferably, one of the settings includes a selection of whether the unit 20 is operating in outdoor mode (the default operating mode) or indoor mode; in indoor mode, significantly less power may be provided to the infra-red emitter (discussed below) to reduce the range of the infra-red emitter so as to reduce problems associated with infra-red bounce.

- Power source (not shown) housed within the case 22, preferably in the form of a re-chargeable battery. The battery is preferably sufficient to operate the unit 20 for at least 24 hours without requiring re-charging. The battery may be a 6 cell 7.2 volt rechargeable nickel metal hydride battery (NiMH) battery with a Tamiya connection, for example.

- Infrared emitter (not shown) housed in the casing, such as the TSAL6100, which transmits an infra-red signal in the form of a directed infra-red beam or pulse when the unit 20 is “fired” to trigger hits preferably to at least an 80-metre range in direct sunshine on a sensor (described below) of another player.

- Lens assembly including a 40mm glass lens 34 having a focal length of 100m, for example, which is located within the case 22, although it will be understood the properties of the lens 34 may be varied as desired. The lens assembly focuses the infra-red beam when the unit 20 is fired so as to transmit infra-red light in a relatively narrow beam out of the case 22 in a generally forward direction, as indicated by the arrow 36, such that players are able to obtain hits at a range of up to about 100 metres and players have to aim to achieve hits. The lens assembly and Weaver rail 32 are advantageously in close alignment after manufacture, and remain so during use, so that the unit 20 remains zeroed under combat simulation conditions. The lens assembly may be about 30mm longer than the focal length and about 4mm wider than the diameter of the lens 34, for example, although again it will be understood that the dimensions of the lens assembly may be varied as required.

- Muzzle LEDs (not shown), preferably at least one green and one yellow, for example, located on a forward external part of the case 22. One of the LEDs will flash each time the unit 20 is fired, preferably as determined by a firmware setting.

The different colours may be used to indicate players on opposed teams, which may be advantageous for identifying players on opposing teams at night, for example.

- Liquid crystal display (LCD) located towards the rear of the housing for a player using the unit 20 to view. The LCD (not shown) may have a black background and green text and be able to display four lines each having 20 characters, for example. A panel holding the LCD may be about 40mm wide x 8mm depth x 32mm height, for example, although it will again be understood that these dimensions may be varied as required. The LCD may be used to display information including real-time hit feedback for indicating to a first player if another player has been hit and/or or the hit another player's device switches to an inactive state in response to the first player firing action their device. The LCD may also be arranged to display details of operating characteristics of one or more firearms the device may be arranged to simulate.

- Rear, preferably rubber, protective cover or eye shield 38 secured to, or formed as part of, the case 22 and located about the LCD for a player's eye to rest against while viewing the LCD and also advantageously to provide shade for the LCD in sunny conditions.

- One or more sensors 40 associate with a target receiver on the player form sensing hits (transmitted infra-red beams or pulses) from other units 20. Each sensor 40 includes an infra-red receiving circuit and preferably two coloured LEDs,

such as yellow and green LEDs, for example. The LEDs may be activated to indicate to other players when a sensor 40 has been hit or when the unit 20, and therefore player, is in a dead or inactive state. The sensors 40 may be housed in hard plastic domes, for example, and preferably include a filtering system to minimise the impact of sunlight on the performance of the sensors. The difference in ranges between a sensor in direct sunlight compared to a sensor in darkness is preferably less than about 20%.

In one preferred arrangement, a sensor 40 is mounted on an upper, generally forward part of the case 22. Alternatively, and/or additionally, one or more sensors in the form of front and rear head sensors (not shown) that may be mounted to a hat or headband of player may be associated with the target receiver. A short electrical wire may be used to couple the front and rear sensors and a longer heavy duty cable may be used to couple preferably the rear sensor to the circuit board.

- Re-load button 42 mounted on the case 22 and able to be pressed to re-load further ammunition or rounds that can be subsequently fired from the unit 20.

- On/off switch 44 mounted to the case 22, by which the unit 20 may be turned off and on. Actuation of the switch 44 may be controlled by a key lock, for example.

- On/off LED 45 mounted on the case 22, preferably near the switch, for indicating whether the unit 20 is on.

- Two position slide 46 for controlling the fire mode; one position 48a for fully automatic (FA) fire mode and the other position 48b for semi-automatic (SA) fire mode. It will be understood the slide 46 may have more than two positions 48a, 48b and could be used to indicate other fire modes, for example. Moreover, the fire mode may be further limited by the selected firearm being simulated or emulated by the unit 20.

- Charging port 50 by which the rechargeable battery is able to be recharged while still inside the case.

- External power port 52 mounted on the case 22 for coupling of the unit 20 to the firearm to which unit 20 is attached. The port 52 incorporates an electric trigger input from the firearm for signalling to the unit 20 that the firearm has been fired, such as by pulling a trigger of the firearm or applying another firing-like action.

- Red-dot sight, such as a 30mm red-dot sight, or a telescopic scope, for example, mounted on the weaver rail 32. The sight or scope (not shown) may be zeroed during manufacture of the unit 20 and, in the instance of a 30mm red-dot sight, wired so that it is powered by the main re-chargeable battery and turns off when the unit 20 is turned off.

- Waterproof speaker 54, preferably having a diameter of about 25mm, for example, and located on one side of the case 22, the speaker 54 for making or

playing sound effects associated with the operation of the firearm and/or unit 20. If a second speaker is required for volume requirements, the second speaker may be located on the other side of the case 22. Preferably, the speaker 54 substantially resembles a tactical torch 28 (see Figure 8) mounted to a night vision scope 26 (see Figures 7 to 9).

The speaker 54 of the unit 20 is advantageously used be play sounds in response to the operation of the unit 20. For example, the speaker 54 may be used to play a commentary on the weapons the unit 20 is arranged to emulate, such as a commentary detailing characteristics of each weapon and its history. Further, the speaker 54 may be used to play sound effects corresponding to the simulated reloading of the weapon, the firing of the weapon and/or changes to the fire mode. Advantageously, the speaker 54 may also be used, when there is appropriate hit-feedback signal from another player's unit 20, to play a sound effect corresponding to the hit on the another unit 20, which preferably will be different for a hit that kills the another unit 20 (i.e. sends the another unit 20 into a dead or inactive state) and a hit that does not. Advantageously, the player may selectively turn audible feedback associated with the hit feedback-signal on and off during boot–up of the unit 20.

- Radio module (not shown) that attaches to the main circuit board to provide radio receiving and transmitting capability so that the unit 20 can receive and process radio feedback signals from other SATR units, or control signals from central radio control systems (discussed below), or from any SATR unit configured to function as a referee gun (discussed below) on boot of the unit 20, for example.

Advantageously the radio module is arranged to receive radio signals from up to up to at least 80 metres away, for example. Further, advantageously the preferably digital, radio module is selectively operable on several different channels, whereby different firearm-like devices may effectively listen on different channels so as to facilitate the operation of two or more separate live simulations in relatively close proximity to one another, such as on adjacent or adjoining "battlefields" in an outdoor environment, for example.

The hit-feedback signals advantageously may provide real-time hit-feedback to a first player's unit 20 of a hit on another player by the first player. The real-time hit feedback may be in the form of a display on the first players LCD and an audible sound effect played on the speaker 54 of the first player's unit in response to a hit-feedback signal, for example.

In practice, the control signals may be used by a referee, or other supervisor, supervising a live combat simulation to efficiently and remotely control a live combat simulation game, and more particularly units 20 being used in the game, without the need to manually key each device off and on each time to reset settings of the units 20.

- Radio antenna (not shown) associated with the radio module. Advantageously, the plastic case 22 allows the radio antenna to be located inside the case 22 so there is no requirement for the antenna (or aerial) to be positioned externally.

2. Referee Gun:

It will be understood that a purpose-built referee gun is described below. Alternatively, advantageously a SATR unit 20 may be selectively configured at boot of the unit 20 to function as a referee gun.

During play of a live combat simulation, as players are hit by other players' units 20, when a player or unit 20 is hit a predetermined number of times the unit 20 may go into a dead state in which the unit 20 is substantially inoperable. A referee gun advantageously may be provided to allow a referee, or other supervisor, supervising a game to remotely re-spawn a unit 20 that is in a dead or inactive state to a live or active state, to kill a unit 20 (i.e. remove all the unit's hit points and send the unit to a dead state) or to re-load a unit 20 with more “ammunition”. For example, when a sensor of a unit 20 in the dead state is hit by an infra-red signal from a referee firearm, a re-spawn of the unit 20 into a live state may be triggered. A referee is therefore able to use the referee gun to remotely and quickly re-spawn a player with the last configuration for their unit 20 by firing the referee gun to hit the sensors of the player's unit 20. Advantageously, the referee gun is arranged to store the number of re-loads and re-spawns using the radio system. Further, the referee gun may not make any sound when it “fires” and may not require a display or speaker. An example referee gun may include:

- Case. The case of the referee gun may be generally similar in shape to a pistol, or other small firearm, for example, so as to facilitate aiming. It will be understood however, that while the referee gun preferably has the shape of a

firearm, the referee gun need not be a firearm shape and may have other shapes while maintaining the same functionality.

- Circuitry, such as a circuit board, for example, for controlling the operation of the referee gun and generating an emitted infra-red pulse or beam when the trigger is pulled to trigger a re-spawn, kill or re-load of a unit 20.

- Power source housed within the referee gun case in the form of a re-chargeable battery.

- Transmitter in the form of an infra-red emitter for transmitting an infra-red beam or pulse towards a target sensor 40 of a unit 20 will have a range of 80 or more metres, for example.

- Trigger or button that when pulled or pressed causes the referee gun to emit an infra-red beam or pulse.

- On/off switch, preferably including a key lock for controlling access to the switch, similar to the unit 20.

- On/off LED indicating whether the referee gun is turned on, similar to the unit 20.

3. Central Radio Control System (CRCS)

A device herein referred to as a CRCS, which preferably includes the re-spawning functionality of the referee firearm, advantageously includes a central radio control for controlling the operation of all units 20 within range such as by selectively pausing, resuming, starting and powering down units 20 within range. An example CRCS, which may be used by a referee or other supervisor, supervising a live combat simulation may include:

- CRCS case which may be in the form of a hand held box-shaped case, for example.

- Circuitry, such as a circuit board, for controlling operation of the CRCS.

- Power source housed within the case in the form of a re-chargeable battery for powering the CRCS.

- On/off switch, preferably including a key lock for controlling access to the switch, similar to the unit 20.

- On/off LED indicating whether the CRCS is turned on, similar to the unit 20.

- Radio transmitter arranged to transmit radio signals, preferably at least 50 metres, to be received by a unit 20 within range. As outlined above, the signals may include a signal to all units 20 in range to go to a power down state (power-down), a

signal to all units 20 in range to go to power up state effectively rebooting to last settings so as to be ready for live game action (power-up), a signal to all units 20 in range to go to a pause state (pause) and a signal to all SATR units 20 in range to, if they are in pause state, return to normal operation (resume or un-pause). The roles of the signals are discussed below:

- Power down signal - causes units 20 within range to go to a power down state.

- Power up signal - causes units 20 within range, regardless of current state, to commence a two to three second countdown, for example, before booting to their last configuration.

- Pause signal – causes units 20 within range to enter into a pause mode. During the pause mode, all functions cease and the LCD displays the current health, ammunition and re-loads available.

- Resume signal - causes units 20 within range that are in the pause mode to go back to normal full operation having the same conditions (health, ammunition, re-loads) before receiving the pause signal.

- Channel select for selecting between four radio channels, for example. Similar to the unit 20, the channel select allows radio functions to only affect units 20 on the same radio channel as the CRCS transmitting the signal and, as such, is able to be used to determine which units 20 respond to radio signals.

Boot or Start-up of a SATR unit 20

Inputs to the unit, such as the re-load button 42, fire mode slide 46 and electric trigger input 52, for example, may all be used to set the configuration for each unit 20 on boot and by the players during a combat simulation game. During the boot sequence (or start-up) of a unit 20, a referee or the player preferably has a number of options so that the configuration of each unit 20 is able to be adapted in accordance with the skill level of the player and/or the mission being simulated. These options may include difficulty level, weapon and hit points, for example. The unit 20 advantageously remembers the last configuration between re-boots (re-starts).

As discussed above, at start-up or boot-up, the SATR unit 20 may advantageously be selectively configured to function as a referee gun.

The difficulty level, which may be changed by using the re-load button on boot, for example, may be used to determine one or more of:

- Hit Delay. For a harder difficulty levels the units 20 may be arranged to receive hits sooner than for an easier difficulty level, for example.

- How players are notified a unit 20 is out of ammunition. When an easier difficulty level is selected, a player may be notified by a sound effect when they are out of ammunition while for a harder difficulty level player may only be notified by the LCD, for example.

- Whether the unit 20 commences an automatic re-load upon running out of ammunition. For an easier difficulty level a re-load may commence automatically

while for a harder difficulty level a player may be required to use the re-load button to commence re-load, for example.

- Default hit points. For an easier difficulty level the default hit points (initial health) may be set higher than for a harder difficulty level, for example.

In game functioning of a SATR unit 20

A system for a live combat simulation, including a SATR unit 20, a referee firearm, a CRCS (referred to as a Referee Box in Figure 5), a player and another SATR unit 20 is schematically shown in Figure 5. With reference to Figure 5, during a live combat simulation, each unit 20, once booted and operational, may perform the following functions:

1. Take hits from other players' units 20 (a hit on any sensor 40 has the same effect).

Each hit (except the last one that effectively kills the unit 20 by causing it to enter a dead state) results in:

- The unit 20 being disabled for the predetermined hit delay, during which time the unit 20 is unable to be fired or hit.

- If the hit points after the hit is greater than three, then the LCD may display in response to a hit-feedback signal "Near Miss" on the LCD, otherwise the LCD may display “Hit”.

- LEDs associated with the sensors 40 flash while the unit 20 is disabled from the hit for the duration of the hit delay.

- The hit points counter is reduced by one.

- A sound effect appropriate for the remaining hit points is played.

When a unit 20 enters a dead state (hit points equal zero; i.e., the unit 20 has been hit as many times as the initial hit points), the following (dead sequence) occurs:

- The LCD displays "Dead".
- The unit 20 enters a dead state in which it is disabled (until turned on/off/key reset, hit by a referee gun or is re-started by the CRCS power down / power up sequence).
- The LED associated with the sensors 40 stay on.
- A sound effect appropriate for the unit 20 entering a dead state is played.

2. Shoot (i.e., transmit infra-red beam or pulse through unit 20 lens 34). When the trigger of the firearm to which the unit 20 is attached is pulled and the unit 20 is not in a dead state, out of ammunition, re-loading or disabled for the hit delay after being hit, the unit 20 fires whereby the following occurs:

- One or more directed beams or pulses of infra-red light are emitted through the lens 34 of the unit 20.
- A sound effect appropriate to the weapon and the selected fire mode is played.
- The muzzle LED flashes to indicate that the weapon is firing.

3. Perform re-load sequence when re-load button is pushed. Because there is a limited amount of ammunition per simulated magazine, players need to re-load during games. When not waiting for the hit delay after being hit and when not in a

dead state, a player can attempt to re-load at any time, even if the current magazine is not empty. To re-load, the player may push the re-load button, and then wait the predetermined time for the selected weapon and other unit 20 settings to load. A sound effect appropriate to the selected weapon indicates when the re-load has started and another sound effect indicates when the unit 20 is re-loaded. Re-loading may not be instant; the re-load time may be governed by the weapon selected. If a player hits the re-load button, any ammunition in the current magazine may be lost. If the unit 20 is hit while re-loading then the re-load time starts again.

4. Allows re-spawning. A re-spawn effectively restarts the unit 20, and may be effected by use of a key to turn the unit 20 off and on or by the unit 20 being hit by a referee gun, and allows a player to re-enter the game with full hit points and ammunition, for example. Re-spawning may be used in a game to simulate a new soldier entering a battle, for example.

5. Regularly updates the information displayed on the LCD. On the square shaped LCD, the top or first line indicates health generally including remaining hit points (Health) and ammunition in the current magazine (Mag), the second line indicates the number of re-loads left (Rel), and the number of Hits (H) and number of Kills (K), the third line indicates the status and the bottom or fourth line left indicates the weapon name. For example:

“Health". XX/XX "Mag." XXX/xxx

“Rel." XX/XX H.00 K.00

"Status:" XXXXX

"Current weapon Name"

Values before the '/' indicate the current values and values after the '/" indicate the starting values. For example, if the unit 20 was initially set with five hit points and had been hit two times during the mission or game so far, the displayed values for the health would be "H: 03/05". The status may be varied to show any of "Dead", "Near Miss", "Hit", "Firing", "Ready" (unit 20 ready to operate), "X" (seconds to re boot) and "Re-loading".

Advantageously, the LCD of the unit may be further configured to display the number of hits and additionally hits that result in kills by a player, for example.

In game states of a SATR unit 20

The unit 20 may be configured to go through several sates when used in a live combat simulation game. Example states the unit 20 may be configured to move through, and the transition between, each of the various states during a live simulation are shown in Figure 6 and will be described with reference to the below pseudo-code. While it will be understood that the unit 20 will go to an off state regardless of it current state if it is turned off by the key switch 44 (complete power down), for clarity it is only shown on the state diagram as going to an off state from the dead state.

1. Initial Boot State

After the unit 20 is turned on, the unit 20 enters an initial boot state. In this state a referee, or a player, can manually select either the last configuration specified for unit 20, which the unit 20 advantageously remembers when turned off and on and re-booted, or specify a new configuration, such as by using the re-load button 42, the fire-mode slide 46 and/or the trigger of the firearm, for example.

IF the trigger of the firearm is actuated:

Start unit 20 with the last configuration the unit 20 was set to and then commence a countdown (state 2).

ELSE IF the re-load button 42 is actuated:

In order, the unit 20 will display on the LCD the following screens from which a number of configuration selections may be made. These screens may include, for example:

- SCREEN 1: Easy/Standard/Hard (difficulty level; stage 3);
- SCREEN 2: Weapon Name (stage 4);
- SCREEEN 3: Number of Reloads (stage 4.1);
- SCREEN 4: Number of Hit Points (stage 5); and
- SCREEN 5: Language in which audible sound effects are made or played (stage 13).

Commence countdown (state 2).

ELSE IF the fire-mode slide 46 is actuated:

In order, the unit 20 will display on the LCD the following screens from which a number of operating mode selections may be made. These screens may include, for example:

- SCREEN 1: Set gun class (stage 14);
- SCREEN 2: Set colour of muzzle LEDs (stage 15);
- SCREEEN 3: Set radio frequency (stage 16);
- SCREEN 4: Set indoor/outdoor operating mode (stage 17); and
- SCREEN 5: Set enable/disable audible feedback (stage 18).

Commence countdown (state 2).

2. Countdown

The countdown, which may be around three seconds for example, is designed to let players start or re-enter the game without being shot the instant they re-start by giving them a period in which they are able to move away from a starting or re-spawning area without being hit. During the countdown, the unit 20 cannot be fired or settings changed, although the unit 20 can enter a pause mode and also go to power-down state upon receiving an appropriate radio signal from the CRCS. Following the countdown, the unit 20 progresses to a live standby state (state 6).

3. Set Difficulty Level

On boot the player can select the difficulty level, such as manually by use of the re-load button 42, fire mode slide 46 and trigger of the firearm.

4 Select Weapon

The player can select a weapon from the available weapons, data for which may be stored by the unit 20. Software settings may be used to determine the general gun class. The choice of weapon advantageously determines characteristics such as one or more of sound effects associated with the operation of the unit 20, rate of fire, ammunition in each magazine, available number magazines (of re-loads) and available fire modes.

As a cursor of the LCD is moved over a possible weapon selection displayed on the LCD, the unit 20 advantageously may commence playing a narrative through the speaker 54 associated with the weapon and the LCD will display the weapon name.

12. Set Reloads

Select the maximum number of reloads from 0 to 99, for example.

5. Set Hit Points

Select the initial hit points from a range of between 0 and 99. In the instance the initial hit points is set to 0, unlimited hits can be received by the unit 20. The default values for hit points are determined by the difficulty level.

Once the settings are selected (states 3 to 5), they may be locked in by pulling the trigger of the firearm, for example, at which time the unit 20 progresses to the countdown (state 2).

13. Set Language

Select the language in which audible sound effects are made or played.

6. Live Standby State

This is the state of the unit 20 in a live game. The unit 20 effectively polls input lines, giving priority to receiving hits. The LCD displays the current hit points and the rounds left in the current magazine during the live standby state.

IF hit signal received:

Go to hit state (state 7).

ELSE IF re-load button 42 pushed:

Go to re-loading State (state 8).

ELSE IF trigger pulled:

Go to gun firing state (state 9).

ELSE IF fire mode slide 46 changes to a new position:

Look-up fire mode table for current weapon.

IF fire mode table allows SA and (FA or BF):

BEGIN:

IF fire mode slide 46 = FA:

Make or play sound effect for FA mode change (the sound effect for changing from FA to SA and from SA to FA are preferably different)

ELSE:

Make sound effect for SA mode change.

END

END

The LCD is then updated with the current values.

7. Hit State

This state is reached if the unit 20 is not currently in the dead state (state 10, hit points have been reduced to zero) and the unit 20 has taken a hit. It is effectively an interrupt process that will pause processing in other states.

IF (current hit points <= 1) and (starting hit points > 0):

BEGIN:

Set current hit point value to 0.

Go to dead state (state 10).

Radio module transmits a hit-feed back signal indicating a hit, and more particularly a kill, has been made (hit-feedback system).

END

ELSE:

BEGIN:

IF (starting hit points > 0):

Decrement current hit points by 1.

Radio module transmits a hit-feed back signal indicating a hit has been made (hit-feedback system).

IF (current hit points < 3):

BEGIN:

Display “Hit” on LCD.

Make appropriate non-fatal hit noise.

Radio module transmits a hit-feed back signal indicating a hit, has been made (hit-feedback system).

END

Else

BEGIN

Display “Near Miss” on LCD.

Make appropriate near miss noise sound effect.

Radio module transmits a hit-feed back signal indicating a hit, and more particularly a near miss, has been made (hit-feedback system).

END

END

IF difficulty level = 1:

Set hit state timer to 2 seconds.

ELSE IF difficulty level = 2

Set hit state timer to 1 second

ELSE:

Set hit state timer to 0.5 seconds.

LOOP (until time specified in hit state timer has elapsed) DO

Flash LEDs associated with sensors 40 for duration of hit delay.

IF previous state NOT re-loading state (state 8):

Go to live standby state (state 6).

ELSE:

Return to re-loading state (state 8).

8 Re-loading State

The default number of re-loads allowed by the unit 20 preferably depends on the weapon selected. A hit interrupt during the re-loading process will delay the re-loading process while the unit 20 is in the hit state (state 7).

IF re-loads remaining = 0:

BEGIN:

Make appropriate “ammunition depleted sound effect.

END

ELSE:

BEGIN

Decrement re-loads remaining by 1.

Display number of re-loads left on LCD.

Set the ammunition in the current magazine to the rounds per magazine based on the selected weapon.

Set the re-load timer to the re-load time based on the weapon.

Loop (until time specified in re-load timer is completed) Do:

IF difficulty level = 1:

Make sound effect for re-loaded.

ELSE:

Make sound effect of appropriate magazine being inserted into weapon selected:

END

END

Go to Live Standby State (state 6)

9. Gun Firing State

This state may be entered from the live standby state (state 6) when a trigger of a firearm to which the unit 20 is mounted is pulled, for example.

FIRED_THIS_BURST = 0;

IF ammunition in current magazine = 0:

BEGIN

Make empty chamber sound effect.

```
        END
ELSE:
        BEGIN
        END_FIRE = False.
        WHILE (trigger held down AND Not END_FIRE):
                BEGIN:
                IF Ammunition in current magazine = 10 AND difficulty level =1:
                        Make ammunition low sound effect.
                ELSE IF Ammunition in current magazine <= 0:
                        BEGIN:
                        Make empty chamber sound effect.
                        Set ammunition in current magazine = 0.
                        END_FIRE:= True.
                        END
                ELSE:
                        BEGIN:
                        ROF_TIMER = 0 (automatic timer re-start).
                        SHOT_DELAY = 60/rate of fire (seconds).
                        Fire Round (procedure below).
                        Decrement ammunition in current magazine by 1.
                        Increment FIRED_THIS_BURST by 1.
                        IF current weapon fire mode = BA:
```

Delay while ROF_TIMER < (SHOT_DELAY – Time required for bolt returning sound effect).

Make bolt returning sound effect.

ELSE:

IF current weapon fire mode = AL:

BEGIN:

Delay while ROF_TIMER < (SHOT_DELAY – Time required for pistol load round into chamber sound effect).

Make round loaded sound effect.

END

ELSE:

Delay while ROF_TIMER < SHOT_DELAY.

END

IF fire mode slide 46 = SA OR weapon fire mode = AL OR weapon fire mode = BA OR (weapon fire mode = BF AND FIRED_THIS_BURST = 3):

END_FIRE:= True.

END

END

END

Go to live standby state (state 6).

```
PROCEDURE Fire Round:
    BEGIN
    Look up range for the current weapon:
    IF weapon last fired within 1 second AND not a gun class not machine gun
    AND difficulty level not easy:
        Reduce range by one category.

    IF weapon range is short then:
        IR_POWER= 0.05.
    ELSE IF weapon range is medium
        IR_POWER= 0.75.
    Else
        IR_POWER = 1.00

    IF (indoor mode):
        IR_POWER = IR_POWER /2.

    Trigger an infra-red pulse in the lens assembly with full Infrared power *
    IR_POWER.
    Trigger operation muzzle flash LED(s).
    Look up sound effect based on selected weapon and current weapon fire
    mode and make sound effect.
```

END

Upon firing, if the unit 20 subsequently, and substantially immediately, receives a hit-feedback signal from another unit 20 indicative of a hit on the target receiver associated with the another unit, advantageously the first unit 20 unit will also provide feedback to the player using the first unit indicating the nature of the hit (for example, a hit, a kill or already dead). The feed-back may be provided by way of the LCD or by appropriate sound effects played by the speaker 54, for example.

10. Dead State

The dead state occurs when a player in a live combat simulation game, for example, has effectively been at least temporarily eliminated from the game by being hit by other players' units 20 (i.e. the unit 20 is in an inactive state at least until re-started by the player or a referee, for example). The unit 20 can subsequently be re-spawned back into a live state, such as to the countdown state (state 2), as discussed above.

Make Dead Sound.

Display “Dead” on the display.

Turn LED(s) associated with the Sensor 40 on (not flashing).

Radio to the unit 20 that effected the hit that a kill has been effected (i.e. the hit unit 20 has gone to a dead state).

11. Power Down State

The purpose of this state is to allow all units 20 within range of the CRCS to be effectively power-downed or turned off all at once from a central radio system. In this state, all functions of the electronics are preferably shut down, except the LCD. A powered down unit 20 listens for a power-up or “on” signal from the radio system of the CRCS. Upon receiving an “on” signal, the unit 20 reboots to the last set configuration thereby effectively commencing a re-spawn.

It will be understood that the example states discussed above and example operation of the unit 20, such as when used by players participating in a live combat simulation game, such as a infrared combat simulation game, are provided by way of non-limiting example and that the operation of the unit 20 may be selectively varied to suit requirements. As such, it will be understood that the units 20 have been described by way of example only and modifications and variations may be made without departing from the spirit and scope of the invention described.

The reference to any prior art in this specification is not, and should not be taken as, an acknowledgment or any form of suggestion that that prior art forms part of the common general knowledge in Australia.