



A Target System and Method of Operation



Field & Background

5 The present invention relates to a target system and corresponding method of operation.

Proficiency in effective firearms handling requires a certain amount of practising at shooting simulated firing targets. This trains the precision, split-second decision making, and endurance abilities required for eliminating threats in real-life. Hence, to ensure that the relevant individuals are fully prepared for any and all types of shooting scenarios, it is important that training activities closely mimic real-life encounters.

15 For those reasons, it is a well-followed practice to train individuals using target systems, prior to deploying them on official duties. Although conventional target systems typically serve those needs, one drawback they suffer from is difficulty and inflexibility of deployment.

20 One object of the present invention is therefore to address at least one of the problems of the prior art and/or to provide a choice that is useful in the art.

Summary

According to a 1st aspect of the invention, there is provided a target system for a shooting range. The system comprises a plurality of target trolleys for carrying respective target objects, each target trolley being spaced from and connected to each other via linkage rods at a predetermined distance. The system also comprises a trolley support to which the plurality of target trolleys is mounted, and a controller for moving the plurality of target trolleys on the trolley support to enable the respective target objects to be used as firing targets.

30 The system is advantageous in that it supports a wide range of target commands in relation to movement/type of target objects/boards, including configurability for both 2D and 3D targets, associated movement of the target boards (e.g. moving left/right/slower/faster/stopping, flipping up of the target boards (to indicate a missed shot), flipping down of the target boards (to indicate a landed

shot), and the like). The system also supports high hit counts. Additionally, the system allows action events, including acceleration and exposure, of the target boards to individually be programmable, based on specific requirements of a firing practice to be conducted. Further, with the system, the number of firing
5 lanes (corresponding to the targets) may be adjusted easily.

Preferably, the predetermined distance may be fixed. Alternatively, the predetermined distance may be adjustable, and each linkage rod may be telescopic. Yet preferably, trolley support may have a linear arrangement or a
10 non-linear arrangement. The non-linear arrangement may include a curved lengthwise arrangement.

More preferably, the trolley support may have a generally I-shaped cross-section. In addition, the target system may further comprise a plurality of
15 secondary trolley supports coupled to the trolley support. Each secondary trolley support may have a linear arrangement or a non-linear arrangement.

Yet more preferably, each target trolley may further comprise an adapter configured to support a target object and to move the target object between a
20 target-up position for firing upon, and a target-down position which is not for firing upon. Specifically, the target objects may be movable between the target-up and target-down positions during the collective movement of the plurality of target trolleys.

25 Optionally, the target system may preferably further comprise a second plurality of target trolleys and a second trolley support, wherein the second plurality of target trolleys are configured to be collectively driven on the second trolley support.

30 Preferably, the controller is configured to move the plurality of target trolleys collectively.

According to a 2nd aspect of the invention, there is provided a method of operating a target system of the 1st aspect of the invention. The method

comprises moving the plurality of target trolleys collectively on the trolley support.

5 Preferably, the method may further comprise moving the target objects between target-up positions for firing upon, and target-down positions which are not for firing upon during the collective movement of the plurality of target trolleys. Additionally, the method may also further comprise adjusting the respective distances between each of the plurality of target trolleys.

10 It should be apparent that features relating to one aspect of the invention may also be applicable to the other aspects of the invention.

These and other aspects of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter.

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Brief Description of the Drawings

Embodiments of the invention are disclosed hereinafter with reference to the accompanying drawings, in which:

20 Figure 1 is a schematic diagram of a target system, according to an embodiment of the invention;

Figure 2 is a schematic diagram of a drive control box and a drive unit of the target system of Figure 1;

Figures 3a to 3c are different perspective views of a trolleys system of the target system of Figure 1;

25 Figures 4a to 4d are different perspective views of a target trolley used in the trolley system of Figure 3;

Figures 5a to 5d are magnified perspective views of the corresponding views of Figures 4a to 4d;

30 Figure 6 is a magnified top plan view of a section of the target trolley of Figure 5b;

Figure 7 is a schematic diagram of an IFPS box as depicted in the magnified section of Figure 6; and

35 Figures 8a and 8b show adjustment of the inter-distance between the target trolleys, each of Figure 4, based on a number of them to be deployed for different firing practice sessions.

Detailed Description of Preferred Embodiments

Figure 1 shows a schematic diagram of a target system 100, according to an embodiment of the invention. It is to be appreciated that the target system 100 may also be termed as the moving electronic target system (METS). In particular, the target system 100 includes a trolleys system 102, a drive unit 104 to drive the trolleys system 102, a main control box 106 which controls a drive control unit 108 to generate appropriate control signals to the drive unit 104. The trolleys system 102 comprises four sets of slave target trolleys 1022 and one master target trolley 1024 that are adapted to move along a single rail support 105 (i.e. a trolley support), which is linearly arranged (i.e. straight configuration in relation to lengthwise) and has a cross-sectional shape resembling the letter "I". Thus the rail support is also known as an "I-Beam", and is made of aluminium. In this embodiment, the rail support 105 has a profile of 150 mm by 150 mm (i.e. height versus width), with a length of approximately 32000 mm (i.e. 32 metres), and weighs approximately 11 kg. Each target trolley 1022, 1024 is connected to a next subsequent neighbouring trolley in the trolleys system 102 via a linkage rod 1026. In particular, each linkage rod 1026 is telescopic (i.e. thus extendable or retractable in length), and is generally rectangular in terms of cross-sectional shape. Further, the target system 100 also includes a range control computer (RCC) 110, which is used by a system administrator of the target system 100 to control all operational aspects of the target system 100. The RCC 110 is also known as the instructor control station (ICS).

Functionalities provided through the RCC 110 to facilitate control of the target system 100 by the system administrator include a maintenance mode (for configuration and fault diagnostics), an action mode (for operation of targets and running training programs), an exchange/review mode (for after-action training reviews), a setups mode (for managing setup configurations of training programs), a program mode (for managing training programs), and a trainfire (TF) builder mode (for managing a TF database). In addition, the RCC 110 is communicably (directly) linked to the main control box 106 using wired Ethernet technology. It is also to be appreciated that the entire operation of the target

system 100 is controlled from the RCC 110 via wireless LAN technologies, such as the WiFi 802.11 standards.

5 The main control box 106 is configured with a multiport switchbox (not shown) and associated control components (such as an onboard basic processor circuit). Through the switchbox, physical communication links are also established from the main control box 106, using Ethernet technology, to the drive control box 108 and the trolleys system 102. Importantly, the main control box 106 relays instructions transmitted from the RCC 110 to control the entire
10 target system 100, and is also adapted for use in both outdoors and indoors conditions.

The drive control box 108 (also known as the Emerson control box, which is manufactured by Emerson Electric Co. of St Louis, United States) is configured
15 with two servo drive control units 1082a, 1082b as shown in the schematic diagram of Figure 2. The two servo drive control units 1082b, 1082a (in which one unit provides redundancy) receive signal inputs from the main control box 106 through the Ethernet connections, and in turn generate and transmit respective control and power signals to a main and a backup servomotor 1042,
20 1044 of the drive unit 104, also depicted in Figure 2. It is apparent that the backup servomotor 1044 is used to provide redundancy and is thus connected to the associated servo drive control unit 1082a that is configured for the same purpose.

25 The servomotors 1042, 1044 are coupled via a first toothbelt 1046, which is used to drive a gear 1048. During operation, the (clockwise/anticlockwise) rotational movement of the gear 1048 is imparted to a second toothbelt 202 that is configured to drive the master target trolley 1024 to translationally move either left or right along the rail support 105. Since all the target trolleys 1022, 1024 of
30 the trolleys system 102 are interconnected via the linkage rods 1026, moving the master target trolley 1024 has a consequential effect of moving the entire trolleys system 102 along the rail support 105 in whichever effected direction. In other words, the entire trolleys system 102 is configured to be winch-driven, as a result of the coupling arrangement of the master target trolley 1024 to the drive
35 unit 104. Emergency overrun switches (not shown) are provided on each end of

the rail support 105 to allow anyone to immediately stop the movement of the entire trolleys system 102 in operation, in an event that the target trolleys 1022, 1024 are driven too far towards the left or right side of the rail support 105, deviating from their intended positions which might result in malfunctioning dangers.

In this embodiment, the trolleys system 102 is configured to be able to move with a speed of approximately 3 metres/second, with an acceleration of 4.5 metres/second². It is also to be appreciated that each servomotor 1042, 1044 is internally configured with an absolute encoder (not shown) that generates precise drive control signals for accurate inter-positioning of the target trolleys 1022, 1024 along the rail support 105. It is to be further appreciated that both the drive control box 108 and drive unit 104 are adapted for use in both outdoors and indoors conditions.

Figures 3a to 3c according illustrate different views (i.e. front, top plan and side perspective views respectively) of the trolleys system 102. It is to be appreciated that in this embodiment, a total of five target trolleys 1022, 1024 are configured for use on the rail support 105 that supports a ten-lane shooting range, in which the respective shooting lanes are depicted by associated reference numerals, in increasing sequential order from left to right, as shown in Figure 3b. Particularly, target trolleys 1022, 1024 are respectively positioned at odd numbered lanes of the shooting range (i.e. at lanes one, three, five, seven and nine), with the master target trolley 1024 occupying a central position. It is further to be appreciated that preceding any deployment of the target trolleys 1022, 1024 for a firing practice, the target trolleys 1022, 1024 are initially parked in a storage area, to which the rail support 105 is extended accordingly.

Furthermore, it is also to be highlighted that the master and slave target trolleys 1024, 1022 generally share a same basic equipment configuration but with an exception that the master target trolley 1024 is additionally equipped with a switchbox (not shown) and the necessary drive mechanisms for coupling to the second toothbelt 202. In this embodiment, each target trolley 1022, 1024 weighs approximately 28 kg. Ethernet connections for communication are established (through corresponding cables) from the master target trolley 1024 to the

respective slave target trolleys 1022 via the switchbox of the master target trolley 1024. Power cables are similarly run from the master target trolley 1024 to the respective slave target trolleys 1022. It is to be appreciated that the corresponding power and Ethernet cables drawn from the master target trolley
5 1024 to the respective slave target trolleys 1022 are neatly housed in electrical conduits which are mounted on the respective connecting linkage rods 1026. A similar Ethernet connection is also established between the switchbox of the master target trolley 1024 and the switchbox of the main control box 106, as seen from Figure 1. Power and Ethernet cables drawn from the main control box
10 106 to the master target trolley 1024 are housed in a conventional dragchain. The line of Ethernet connections formed between the trolleys system 102, main control box 106, and RCC 110 then effectively enables any operational instructions to be relayed by the system administrator through the RCC 110 for remotely operating the trolleys system 102 in a manner as desired.

15 Figures 4a to 4d show different views (i.e. respectively front, top plan, cross-sectional and side perspective views) of a single target trolley 1022, 1024, which is adapted for use in the trolleys system 102 of target system 100. For ease of understanding, the subsequent description are equally applicable to both the
20 master target trolley 1024, as well as the slave target trolleys 1022 since they share the same basic equipment configuration, as aforementioned. In addition, for sake of brevity, reference is also made simultaneously to Figures 5a to 5d which are magnified views of the respective views depicted in Figures 4a to 4d in the same order.

25 The target trolley 1022, 1024 comprises the following components: an interface and power supply box 402, a slicing target holder 404 on which a target board 406 is detachably mounted on top in an upright position, and a projectile location system (PLS) 408. In addition, the target trolley 1022, 1024 is configured with a
30 plurality of roller wheels 410 to enable the target trolley 1022, 1024 to easily move and slide along the rail support 105. More specifically, the roller wheels 410 serve as guides for the translational movement of the target trolley 1022, 1024 along the rail support 105.

The interface and power supply box 402, as the name suggests, is configured to receive electrical power (through power cables) for powering the associated target trolley 1022, 1024, as well as to receive any transmitted control signals. Specifically, in the case of the master target trolley 1024, the control signals are
5 received from the main control box 106, whereas for the slave target trolleys 1022, the control signals are those received by the master target trolley 1024 but further forwarded to the respective slave target trolleys 1022 via the Ethernet connections established through the switchbox of the master target trolley 1024, as aforementioned.

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The slicing target holder 404 is fitted with an adapter (not shown) on which the target board 406 is detachably mounted, and also configured with built-in target illumination means to simulate moon-light, hit-on-target, or retaliatory fire around/from the target board 406. The target board 406 is to be used as a
15 simulated firing target. More specifically, the adapter is arranged to hold onto the target board 406 using a pair of target clamps which are tighten/loosen by means of hand-operable fastening screws as provided on the clamps. It is to be appreciated that the target clamps are arranged to mount target board 406 that are made of plastic or plywood of thickness of up to 5 mm. Furthermore, the
20 adapter is also configured to be pivotably movable, relative to the slicing target holder 404, in a plane of the mounted target board 406 such that the target board 406 is movable from an original upright position (i.e. target-up) to a horizontal position (i.e. target-down) which consequently positions the length of the target board 406 to be substantially parallel to the rail support 105 (i.e. also
25 see Figure 4a).

In other words, the target board 406 moves through a 90° sweeping clockwise movement in its own plane, drawing a quarter arc during the process, as it is moved by the adapter from the target-up position to the target-down position. In
30 effect, the target board 406 generates a slicing motion through the arcing movement. In addition, the adapter is also arranged to be rotationally movable, relative to the horizontal plane of the slicing target holder 404, such that a mounted target board 406 can be rotated in any desired angle, through 360°, to be displayed to a firer. It is to be appreciated that the adapter only moves the
35 target board 406 to the target-down position when the PLS 408 detects shots

fired at the target board 406 have indeed landed (i.e. successful hits). This is to simulate successful shots being registered, which are then translated into visible movement of the target board 406 easily detected by a candidate (i.e. a firer), who is practising in the shooting range, so that he instantly knows the accuracies of the shots made. In this embodiment, the target board 406 is controllable by the RCC 110 to move between the target-up and target-down positions in within less than 1 second. Additionally, if the target board 406 is not hit by a shot after being moved by the associated target trolley 1022, 1024 for a predetermined distance along the rail support 105, the target board 406 is then moved to the target-down position to simulate disappearance of the firing target to the firer. In this instance, it will be apparent that the time taken for the target board 406 to move from the target-up to target-down positions is the time it requires for the target trolley 1022, 1024 (based on a configured moving speed for the trolleys system 102) to move from a starting point on the rail support 105 to a designated ending point thereon.

Additionally, the trolleys system 102 is also configurable for varying an exposure time of the target boards 406 in terms of being visible to the firers before the target boards 406 are moved to a target-down position, if the respective target boards 406 has not been hit, as afore described. The exposure time is thus otherwise termed as target visible time. More specifically, the target system 100 supports adjustment of target visible time in increments of between 1 second to 20 seconds; in other words, the speed of the trolleys system 102 is configured with corresponding speeds to support the respective target visible time, as desired by the system administrator.

The PLS 408 (also known as "T-Bar" due to the configured shape) is detachably mounted on the slicing target holder 404, and further arranged to be positioned in front of the adapter which holds the target board 406. This specific arrangement is to allow the PLS 408 to be able to detect incoming shots made by the firer when they successfully land on or miss the target board 406. In particular, detection by the PLS 408 of shots made using different calibres is adjustable via software control, and the PLS 408 is configured to detect shots of calibres between 5.56 mm to 12.7 mm. The PLS 408 generates shot data corresponding to registration of the shots landing on the target board 406, and

then transmits the data to the main target trolley 1024 (as an example, assuming the shots in this case lands on the target board 406 of the slave target trolley 1022), then main control box 106, and finally to the RCC 110 for storage and subsequent analysis by the system administrator and candidate.

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Figure 6 shows a magnified top view of a section 502 of the target trolley 1022, 1024 of Figure 5b. In particular, the section 502 depicts the PLS 408 arranged in front of the slicing target holder 404, which is electrically coupled to an Interface Power Supply (IFPS) box 5022 that is also electrically connected to the PLS 408. Additionally, the slicing target holder 404 is also electrically connected to an external contact-hit sensor 5028, which is arranged to be positioned near to the target board 406. The external contact-hit sensor 5028 enables detection and record of a hit on the target board 406, in the event that the hit was somehow not detected by the PLS 408. The IFPS box 5022 is configured with power and Ethernet cables 5024, 5026. In the case of the slave target trolley 1022, the Ethernet cables 5026 of the IFPS box 5022 connect to the switchbox of the master target trolley 1024, while for the master target trolley 1024, the corresponding Ethernet cables 5026 connect to the main control box 106. In addition, the magnified view shows a pair of linkage rods 1026 each arranged on opposite ends of the base of the target trolley 1022, 1024 for coupling to neighbouring target trolleys 1022, 1024.

Figure 7 accordingly illustrates a schematic diagram of the IFPS box 5022, which includes the following onboard components: a CAN PCB 702 and a PCB user interface 704, both of which are mounted on an expansion PCB 706. The IFPS box 5022 also includes a LAN PCB 708 and an analogue/timing PCB 710, both of which are mounted on a basic processor PCB 712. The basic processor PCB 712 is arranged to be independent of the expansion PCB 706. The onboard components of the IFPS box 5022 generally serve to regulate power and communications for the associated target trolley 1022, 1024.

During operation, the system administrator of the target system 100 initially uses the RCC 110 to configure the necessary parameters for deploying the master and slave target trolleys 1024, 1022, based on the specific requirements of a particular firing practice session to be conducted. The parameters include the

number of target trolleys to be deployed, the inter-distance desired between the target trolleys 1022, 1024, related movement/speed of the target trolleys 1022, 1024 during firing (which is directly correlated to the target visible time of the target boards 406), required response of the target boards 406 upon registering
5 a successful hit by a shot, and the like. The parameters are then downloaded to the master target trolley 1024, and slave target trolleys 1022 via the master target trolley 1024 (through the intermediate main control box 106).

Thereafter, based on determined configuration, the target trolleys 1022, 1024
10 are subsequently rolled out and deployed along the rail support 105, which spans the width of the shooting range. It is also apparent that the shooting lanes accordingly span the length of the shooting range. On command, firers commence the firing practice on the deployed target boards 406, and the target trolleys 1022, 1024 respond accordingly based on the programmed
15 configuration. If a hit is registered on an associated target board 406 being fired at, the target board 406 is lowered to a target-down position to visually indicate to the firer that an intended shot has successfully hit the target. Depending on the determined configuration, the target board 406 is thereafter maintained in the target-down position or restored to the target-up position to allow the firer to
20 continue with subsequent practices. During the firing process, associated shot data corresponding to hits/misses are generated and transmitted back to the RCC 110 to be collated for subsequent analysis between the firers and their instructors. When the firing practice has ended, the system administrator then issues a command to instruct the drive control box 108 to drive the entire trolley
25 system 102 back to the storage area for parking and maintenance.

It is to be appreciated that the target system 100 is installed in a manner in a shooting range such that, during operation of the target system 100, only the target boards 406 of the target trolleys 1022, 1024 are visible to firers; in other
30 words, other than the target boards 406, all the other components of the target system 100 are safely arranged and concealed below the ground level, and hence not in direct line of fire. It is also to be further appreciated that those components may be reinforced with additional ballistic protection if necessary.

The process of adjusting the inter-distance between a numbers of target trolleys 1022, 1024 deployed in the shooting range for different firing practice sessions is described hereinafter, with reference to Figures 8a and 8b. As an example, Figure 8a shows five target trolleys 1022, 1024 (which includes four slave target trolleys 1022 and the master target trolley 1024) being initially deployed in the ten-lane shooting range. For the only purpose of illustrating this example, it is assumed that the width of the ten-lane shooting range corresponds to the length of the single rail support 105. In Figure 8a, the pre-configured distance between each target trolley 1022, 1024 is "X" metric units (e.g. metres) for a first firing practice session. More specifically, each linkage rod 1026 is telescopically adjusted (via control signals issued by the system administrator of the target system 100) to have a length of "X" metric units. In other words, only five lanes (out of the ten available lanes) are used for the first firing practice session since only five target trolleys 1022, 1024 are deployed. When the first firing practice session has ended, and a second firing practice session is to be conducted thereafter, the number of target trolleys 1022, 1024 to be subsequently deployed is determined based on the requirements of the second firing practice session.

In this example, three target trolleys 1022, 1024 are to be deployed for the second firing practice session, as shown in Figure 8b. In other words, only three lanes (out of the ten available lanes) are used for the second firing practice session since only three target trolleys 1022, 1024 will be deployed. Specifically, the five already deployed target trolleys 1022, 1024 are first controlled by the system administrator through the RCC 110 to be driven back to the storage area, so that two of the slave target trolleys 1022 may first be disconnected from the trolleys system 102. Disconnecting the slave target trolleys 1022 from the trolleys system 102 involves first decoupling the related slave target trolleys 1022 from the corresponding linkage rods 1026, and thereafter hoisting the decoupled slave target trolleys 1022 and associated linkage rods 1026 off the rail support 105. It is to be appreciated that regardless of any number of target trolleys 1022, 1024 to be deployed for a firing practice session, the master target trolley 1024 needs to be included in the deployed target trolleys 1022, 1024, since the entire trolleys system 102 is driven by virtue of coupling the master target trolley 1024 to the drive unit 104, as afore described with reference to Figure 1. Thereafter, the three configured target

trolleys 1022, 1024 (which now includes two slave target trolleys 1022 and the master target trolley 1024) are then rolled out and deployed along the rail support 105 of the shooting range, so that the second firing practice session can be commenced. The configured distance between each target trolley 1022, 1024 is now "Y" metric units (e.g. metres), and accordingly, it is apparent that "Y" is numerically greater than "X". More specifically, each linkage rod 1026 is re-telescopically adjusted again (via new control signals issued by the system administrator of the target system 100) to have a length of "Y" metric units. It will be apparent that telescopic adjustment of the length of the linkage rods 1026 can be performed either when the target trolleys 1022, 1024 are in the storage area or after being deployed along the rail support 105 in the shooting range.

According to an example for purpose of illustration, the width of the ten-lane shooting range is approximately 30 metres long, and the width of each corresponding shooting lane is thus approximately 3 metres long; in other words, a total of ten target trolleys 1022, 1024 are to be deployed in this instance. When the ten-lane shooting range is subsequently to be reconfigured into seven-lanes, (by only deploying a total of seven target trolleys 1022, 1024), the software intelligence in the functionalities provided through the RCC 110 accordingly recalculates the new width of each corresponding shooting lane to be now approximately 4 metres long.

Advantages of the target system 100 include providing support for a wide range of target commands in relation to movement/type of the target board 406, including configurability for both 2D and 3D targets, moving left/right, moving slower/faster, stopping at a specified position, flipping up of the target boards 406 (to indicate a missed shot), flipping down of the target boards 406 (to indicate a landed shot), and the like. In addition, the target system 100 also supports hit counts of up to, and including, 1200 rounds/hits per minute.

Furthermore, the target system 100 allows action events including acceleration and exposure of the target boards 406 to be individually programmable via the RCC 110, and also to accommodate simultaneous execution of movement, acceleration, and target exposure. In particular, the target system 100 support an "action when hit" mode and an "alternative programming sequence" mode. In

the "action when hit" mode, the target system 100 is configurable to support hit-fall, hit-bob, hit-home, hit-end, and the like. These are to provide support to satisfy the requirement for the target board 406 to automatically lower/fall when being hit by a shot, while the associated target trolley 1022, 1024 continues to
5 move to a stopping position in preparation for the next exposure run.

On the other hand, in the "alternative programming sequence" mode, control software for the target system 100 allows time-out loops to easily be programmed for operating the trolleys system 102. Specifically, the target
10 system 100 may locally be programmed with one of several hit conditions, in which while executing a loop comprising, for example, a sequence of expose, move, and lower commands, individual target trolleys 1022, 1024 may then be configured to fall and return to a pre-programmed position when being hit, or alternatively allow the time-out loop to be completed eventually (i.e. allowing the
15 target trolleys 1022, 1024 to run through a pre-programmed sequence of return, expose, or the like). Further, the target system 100 enables flexibility of adjusting the number of firing lanes since the position of the target trolleys 1022 (and also the position of the master trolley 1024) may be adjusted accordingly. Even further, with the use of the single rail support, this makes the target system
20 100 much easier to deploy on site.

Further, the proposed target system 100 is also advantageous in that since only a single drive unit 104 is required to drive the entire trolleys system 102, the target system 100 may easily be deployed in shooting ranges where space is
25 scarce. There is also an added benefit in respect of lowering the overall cost (i.e. cost optimisation) for deploying the target system 100. Moreover, the target system 100 allows the system administrator to easily adjust the distance between each target trolley 1022, 1024 for flexibility of reconfiguring the number of shooting lanes in a shooting range, in which the target system 100 is installed.
30 Yet further, different types of target boards 406 may easily be used together with the target system 100, and also the visible exposure time (which is related to a configured travelling speed of the trolleys system 102) of the mounted target boards 406 may easily be varied as well, in order to effectively present and simulate different kinds of shooting scenarios for the firers.

The described embodiment(s) should not be construed as limitative. For example, while the described embodiment uses five target trolleys 1022, 1024 for a ten-lane shooting range, it is apparent that any number of target trolleys 1024, 1022 may be deployed based on the specific requirements of the shooting range, which may also be more or less than ten-lanes. Moreover, not all of the slave target trolleys 1022 configured for use in a shooting range need to be deployed every time; in other words, a subset of target trolleys 10, which is less than the total number of slave target trolleys 1022 available for use, may flexibly be deployed as necessary. In addition, more than one master target trolley 1024 may also be used, for example two sets of trolley systems 102 may be deployed on the single rail support 105, each trolley system 102 having a master target trolley 1024 that is independently driven by its own drive unit 104, and is coupled to its own set of multiple slave target trolleys 1022.

It is also apparent that each linkage rod 1026 may be configured to have a non-adjustable length (i.e. fixed length), instead of having a telescopic configuration. Alternatively, each linkage rod 1026 that connects a pair of target trolleys 1022, 1024 may be configured to have a different unique length, such that the spacing between any one pair of target trolleys 1022, 1024 is dissimilar. It is also envisaged that the linkage rods 1026 may not be telescopic and other forms of adjusting the inter-distance between adjacent target trolleys are possible. The target trolleys may be moved collectively or independently. Yet additionally, the master target trolley 1024 may wirelessly relay (using known wireless technologies, for example WiFi) the control signals to the respective slave target trolleys 1022, rather than using the wired Ethernet connections (i.e. cables). Moreover, each target trolleys 1022, 1024 may be powered using battery packs (e.g. lithium-ion batteries), rather than tapping power using power cables through the main control box 106. Further, the rail support 105 may have a non-linear arrangement (i.e. curvy/twisting configuration in relation to lengthwise), as opposed to the linear arrangement afore described. This may then enable the target boards 406 to be displayed to the firers at various varying oblique angles as the target trolleys 1022, 1024 move along curved sections of the non-linearly arranged rail support 105. Yet further, the rail support 105 may also extendably be connected to a plurality of secondary rail supports (not shown), in which each secondary rail support may either be linearly or non-linearly configured,

depending on the specific needs of an application. In this variation, the moving target trolleys 1022, 1024, in operation, may then in approaching the end of the rail support 105 be configured to further move along any one of the secondary rail support, as configured by the system administrator of the target system 100.

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Yet alternatively, with reference to the afore discussed example of changing the deployment from five target trolleys 1022, 1024 (for the first firing practice session) to three target trolleys 1022, 1024 (for the second firing practice session), disconnecting the not required slave target trolleys 1022 from the trolleys system 102 may instead involve adjusting distance between the two unused slave target trolleys 1022 to a minimum, and thereafter moving the associated target boards 406 to the target-down position. Subsequently, the decoupled slave target trolleys 1022 may then be driven to an unused end section of the rail support 105 and the distance between the remaining three target trolleys 1022, 1024 are adjusted so that these remaining target trolleys 1022, 1024 are deployed and aligned to the firing lanes for the second firing practice session. In this way, the system has the flexibility of varying the number of firing targets and thus, firing lanes.

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While the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary, and not restrictive; the invention is not limited to the disclosed embodiments. Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practising the claimed invention.

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Claims

1. A target system for a shooting range, the system comprising:
a plurality of target trolleys for carrying respective target objects, each
5 target trolley being spaced from and connected to each other via linkage rods at
a predetermined distance;
a trolley support to which the plurality of target trolleys is mounted; and
a controller for moving the plurality of target trolleys on the trolley support
to enable the respective target objects to be used as firing targets.
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2. The target system of claim 1, wherein the predetermined distance is fixed.
3. The target system of claim 1, wherein the predetermined distance is
adjustable.
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4. The target system of claim 3, wherein each linkage rod is telescopic.
5. The target system of any preceding claim, wherein the trolley support has
a linear arrangement.
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6. The target system of any of claims 1 to 4, wherein the trolley support has
a non-linear arrangement.
7. The target system of claim 6, wherein the non-linear arrangement
25 includes a curved lengthwise arrangement.
8. The target system of any preceding claim, wherein the trolley support has
a generally I-shaped cross-section.
- 30 9. The target system of any preceding claim, further comprising a plurality of
secondary trolley supports coupled to the trolley support.
10. The target system of claim 9, wherein each secondary trolley support has
a linear arrangement or a non-linear arrangement.
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11. The target system of any preceding claim, wherein each target trolley further comprises an adapter configured to support a target object and to move the target object between a target-up position for firing upon, and a target-down position which is not for firing upon.
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12. The target system of claim 11, wherein the target objects are movable between the target-up and target-down positions during the collective movement of the plurality of target trolleys.
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13. The target system of any preceding claim, further comprising a second plurality of target trolleys and a second trolley support, wherein the second plurality of target trolleys are configured to be collectively driven on the second trolley support.
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14. The target system of any preceding claims, wherein the controller is configured to move the plurality of target trolleys collectively.
15. A method of operating a target system of any preceding claim, the method comprises:
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- moving the plurality of target trolleys collectively on the trolley support.
16. The method of claim 15, further comprises moving the target objects between target-up positions for firing upon, and target-down positions which are not for firing upon during the collective movement of the plurality of target
- 25
- trolleys.
17. The method of claim 15 or 16, further comprises adjusting the respective distances between each of the plurality of target trolleys.